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ABSTRACT

This 13th annual ED-MEDIA conference serves as a multidisciplinary forum for the discussion of the latest research, developments, and applications of multimedia, hypermedia, and telecommunications for all levels of education. This document contains papers from attendees representing more than 60 countries, with keynote speakers representing both academia and industry. Approximately 450 long and brief papers were selected for presentation at the conference. In the papers, there are several common threads along a number of dimensions: discussion of technological tools varying from presentation of a new tool through the application of a commercially available system; new applications of technology varying from neural networks through assistive devices; using technology to support different educational methods from collaborative knowledge building through developing individual thinking skills; and applications of technology in various disciplines. There are 7 panel sessions, 11 tutorials and workshops, and 180 poster sessions. (AEF)

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ED-Media 2001 World Conference on Educational Multimedia, Hypermedia & Telecommunications. Proceedings
(13th, Tampere, Finland, June 25-30, 2001)

ED-MEDIA 2001

World Conference on Educational Multimedia, Hypermedia & Telecommunications

Edited by
Craig Montgomerie
Jarmo Viteli

Proceedings of ED-MEDIA 2001

WORLD CONFERENCE ON EDUCATIONAL MULTIMEDIA, HYPERMEDIA & TELECOMMUNICATIONS

Tampere, Finland; June 25-30, 2001

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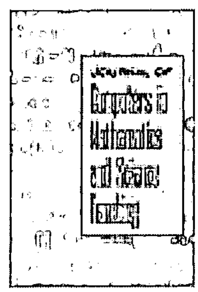

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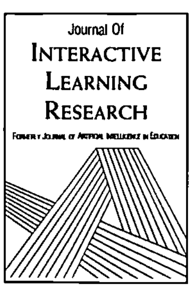

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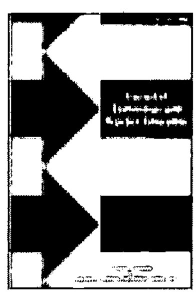

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International Journal of Educational Telecommunications

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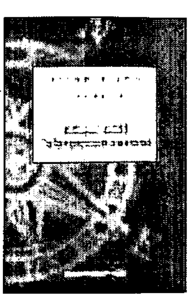

IJET serves as a forum to facilitate the international exchange of information on the current theory, research, development, and practice of telecommunications in education and training. This journal is designed for researchers, developers and practitioners in schools, colleges, and universities, administrators, policy decision-makers, professional trainers, adult educators, and other specialists in education, industry, and government.

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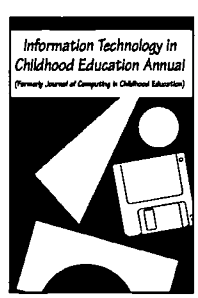

A primary information source and forum to report the research and applications for using information technology in the education of children—early childhood, preschool, and elementary. The annual is a valuable resource for all educators who use computers with children.

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WebNet - World Conference on the WWW & Internet

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Preface

Tervetuloa Tampereelle, Suomeen ja ED-MEDIA 2001!

Welcome to Tampere, Finland and ED-MEDIA 2001!

This is the thirteenth annual ED-MEDIA conference. While 13 is supposed to be an unlucky number in some societies, we believe that we don't need luck to promise you the best ED-MEDIA conference ever. We have been successful in attracting outstanding keynote speakers who represent both Academia and Industry. The papers are of widely varied interest AND all are of excellent quality. The industry tours will show you what the future holds, and the social program is exciting and novel – especially for those of us who are attending from outside of Finland. We hope that by the end of the conference you'll agree that you don't have to be lucky to be outstanding.

ED-MEDIA is routinely held in a different country with Finland being the 5th country to host the conference. This emphasis on being an international organization, the quality of the presentations, and, most importantly, the quality and diversity of the attendees has led to ED-MEDIA being considered the best of many such conferences in the world with attendees coming from more than 60 countries this year.

We are very proud of the program that we have put together this year. This, of course, has nothing to do with us, but is a product of the many excellent papers, panels, workshops, tutorials and poster sessions that were proposed. Each of these went through a rigorous review based upon: relevance to the conference, originality, clarity/quality of English, references, length of the paper, and the potential value/impact of the research or the development presented. We selected approximately 450 long and brief papers as being of high enough quality for presentation at this conference.

As you review the papers, you'll see a several common threads along a number of dimensions:

- discussion of technological tools varying from presentation of a new tool through the application of a commercially available system;
- new applications of technology varying from neural networks through assistive devices;
- using technology to support different educational methods from collaborative knowledge building through developing individual thinking skills and; of course,
- applications of technology in almost every discipline one can imagine.

Similarly, there are 7 panel sessions, 11 tutorials and workshops, and 180 poster sessions. In each of these areas, there is a wide range of topics covered, but the quality of the presentations is uniformly high. Finally, due to the international reputation of ED-

MEDIA, we have been able to attract Keynote and Invited speakers who really are representative of the best our various disciplines have to offer.

This year we are awarding Best Papers in both student and "open" classes. Selection of these best papers was extremely difficult. In the "open" class, we considered only those papers that received an average mark of 4.67 (out of 5) or greater by review teams of (usually) three members of our international Program Committee. Twenty-six papers met these criteria. We (the Program Chairs) then undertook a blind review of these papers and rated them independently. When we compared our evaluations, we had achieved a virtual match on the best papers. A similar process was followed to evaluate the student papers. If you have any fears about the quality of the students in our field today, we challenge you to perform a blind review of the best papers in both classes, then attempt to divide them into student and "open" class.

ED-MEDIA is organized by the internationally respected Association for the Advancement of Computing in Education (AACE). The work of the Program Committee, the reviewers and the Program Chairs is greatly eased by the tremendous work that the AACE staff performs. This year, we received over 1100 presentation proposals from 60 countries. The submission, review and evaluation process is handled by AACE's technically advanced Web-based system. This year saw the introduction of the next generation of this system, which was designed to make the submission, review, and notification process even easier. As professionals working in this field, you are well aware that no new process works perfectly when it is first implemented. We were very pleased that the new system worked extremely well, but if you were one of the few people who did encounter a problem, we know you understand, but we still offer an apology. Be assured that any problems are being corrected and additional useful features are being incorporated. Also, while this conference was being organized, AACE moved their headquarters office. Again, it was amazing that this move occurred with almost no visible effect on the organization of this conference. We would also like to thank the technical and administrative crew who work behind the scenes (and sometimes in front of a restless, yet appreciative, audience) for their tireless efforts in coordinating and managing the huge number of administrative functions and technical requirements that a conference like this necessarily involves. On behalf of the Conference committees and you, the conference participants, we wish to thank Gary Marks and the AACE staff including Marianne Williams, Jennifer Gwaltney, and Jerry Price for their support in this massive endeavor.

As Conference Program Co-chairs, we have been aided considerably by a number of volunteers and helpers who have given tirelessly of their time. In particular, we must thank the Conference Steering Committee of Erik Duval (Chair), Betty Collis, Shelly Heller, Gary Marks, Ron Oliver, and Ivan Tomek who led and coordinated the conference this year. We would like to thank the Chairs of the various Program Sub-Committees: Ron Oliver, Panels Chair; and Sam Rebelsky, Tutorials/Workshops Chair. Finally, we would like to thank the 71 members of the international Program Committee who provided timely and insightful reviews without complaint and little credit.

The University of Tampere and its Hypermedia lab are more than proud to host this year's ED-MEDIA. We thank all of you for being here and, of course our partners and colleagues for making this all possible. Ms. Carolina Pajula and her planning team in Tampere have done a great job to make ED-MEDIA 2001 an enjoyable event for all of us. As you will notice during the conference, a good number of e-Learning experts from Finland are working with us. They are more than happy to share ideas and experiences with you. As you now are visiting "Nokialand," we hope that you also have time to look around this lovely city and country. The city of Tampere has announced that it will be a leading city of information society development in the world (www.etampere.fi) together with its partners the University of Tampere, Technological University of Tampere, City of Tampere, and others. Challenge us, cooperate with us, and especially enjoy your time as our honored guests.

We look forward to meeting with you during the conference. Remember to spend time talking to colleagues from previous ED-MEDIA conferences and make some new friends – the informal program sometimes can have greater rewards than the formal program.

Perhaps you will develop a new collaboration that you can report on at **ED-MEDIA 2002 in Denver, Colorado, June 24-29, 2002** or, if you wish to plan further in advance, at **ED-MEDIA 2003 in Honolulu, Hawaii, June 23-28, 2003.**

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Dialogic Knowledge Construction as the Crucial Issue in Network-Based Learning in Vocational Education

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Abstract: The VETO-project is part of the National Strategy's goals in order to provide good learning opportunities through the use of networks in vocational education in Finland. The methodological strategy is action research. This paper presents some essential results of the ongoing project. The main idea in this project have been to construct a dynamic dialogic model for learning and knowledge construction on the net. In this paper, the basic grounds of the model are described and a tentative model is introduced. The results already available of this project show that it is necessary to develop further pedagogy for dialogic knowledge construction on the net in vocational education. Vocational teachers and learners need cognitive tools in order to be competent on the net. The new learning platforms on the Internet are technically fairly good and versatile, but teachers and learners do not know yet, how to use them pedagogically adequate.

Introduction

The VETO-project is part of the National Strategy's goals set out by the Ministry of Education to develop an Information Society Program in Finnish schools. The goals of the national strategy are to provide basic skills to everybody and life long learning opportunities through the use of networks in studying and teaching. Vocational education has an important role in Finland, and the high level of the technological infrastructure in Finland is utilized effectively in vocational education. Learning environments are extended outside the classrooms, and this demands new pedagogical models of teacher action. Learners will engage in and become inspired by learning activities if they think it makes sense (Enqvist 1999).

Many researches show that teachers should be trained both in information-communication technological (ICT) competence and in how to use the network-based environment in a pedagogically skilful way (Hakkarainen, Ilomäki, Lipponen & Lehtinen 1998). The traditional methods of teachers are so deeply ingrained in their minds that it is difficult for them to learn to construct active and workable situations and processes for learning. Network-based learning environments provide a forum for authentic learning and interpersonal interaction with members of the learning community (see e.g. Lave & Wenger 1991; Harasim , Hiltz, Teles & Turoff 1995; Wenger 1998;), peers, and experts. What must a teacher do and how does she or he achieve the competence to allow the worlds of teaching and learning to meet one another? According to many researchers (Harasim et al. 1995; Warschauer, Turbee & Roberts 1996; Anderson & Kanuka 1997), making good use of the possibilities of interaction and learning on the net produces positive learning experiences.

Producing and Sustaining Authentic Learning in Learning Communities

How can we arouse a real desire of learning and joy of working in the students? The process of passion for learning can proceed, according to Enqvist (1999, 275-277), from an interesting, authentic assignment involved with problem solving and inquiring learning. In vocational education, it is really not difficult to find authentic assignments connected and involved with vocational training.

The significance of social interaction and dialogue in learning, emphasized by Vygotsky (1962; 1978), is crucial in this research. The social interaction is essential to construct knowledge and mastery as well as to get comprehensive and in-depth processed learning outcomes in ICT learning environments (Scardamalia, Bereiter & Lamon 1994; Brown & Campione 1996; Salomon & Perkins 1996). Especially when studying and training vocation and profession, it is important to take into consideration a number of implications derived from Vygotsky's pedagogical thinking by Wells (2000, 60-61). These are:1) The classroom is seen as a collaborative community; 2) Purposeful activities involve whole persons; 3) Activities are situated and unique; 4) Curriculum is a means, not an end; 5) Outcomes are both aimed for and emergent; 6) Activities must allow diversity and originality. Wells (2000) emphasises the importance of the values of inquiry, dialogue, and community.

The notion of a zone of proximal development (ZPD) presented by Vygotsky (1978) is crucial in learning and through that the support of learning can be made adjustable. On the net, this means that it is possible to make learners' thinking transparent so that the teacher can see what kind of tutoring students require in problem-solving situations just at a certain time. The scaffolding metaphor arises from the notion of ZPD (Dillenbourg 1996). A teacher has a big challenge in scaffolding: she or he has to search an optimal model of action, by means of which she or he can promote the learning processes. The opportunity exists, but in order to succeed, in learning collaboration much interpersonal interaction is required (e.g. Bullen 1998; Harasim et al. 1995). Teachers need a model in order to manage learning / teaching situations on the net.

The participators in the learning collaboration can be thought of as cognitive apprentices (Brown, Collins & Duguid 1989), who may increase their knowledge and competence with the assistance of the teacher, peers, and the experts at their disposal. Cognitive apprenticeship supports the learning of professionalism by developing students' "conceptual understanding through social interaction and collaboration in the culture of the domain, not of the school" (Brown et al. 1989, 40). It is especially interesting when the learner can be justified to participate in the activities of some community of experts on the net. Then, one can talk about "legitimate peripheral participation" (Lave & Wenger 1991).

Dialogue in Network-Based Learning

An accepted fact is that in network-based learning, teacher, other experts, and learners form a community where, hopefully, conversation is purposeful, relevant, and fruitful. Dialogue is a type of conversation to achieve these aims (Aarnio 1999). Dialogue as a concept is very complicated and the lay opinion of dialogue is not enough to develop conversation in a network-based environment. According to Bohm (1996, 6), dialogue means "the flow of meaning between or among us". Isaacs (1996; 1999) emphasizes that dialogue does not mean just talking. It is important to distinguish dialogue from the general types of conversations.

Jenlink & Carr (1996) speak of four types of conversations common in educational settings, viz. dialectic, discussion, dialogue, and design. Discussion conversation is the forum in which many of us advocate our own individual position. Dialogue conversation is a conversation where meaning is constructed through sharing. Dialectic conversation focuses on framing a logical argument for distilling the truth. Design conversation focuses on creating something new. Lave and Wenger (1991) believe that an experience can be pedagogically valuable only on one condition: the experience does not consist of individually stored memories, but is primarily comprised of complex interactions and dialogue in the community. A network-based environment is good for this kind of work, where the participants are able to share their knowledge and at the same time contribute to each other's construction of knowledge and competence (Comstock & Fox 1995; Stacey 1999). According to Bohm (1996), it is worth remembering that the word "pa
meanings: "to partake of" and "to partake in". Receiving is as important as contributing.

Responsiveness is very important in the construction of dialogic knowledge and the construction of the meaning happens collaboratively in the act of speaking following one each other (Wells 2000). Bereiter (1994) proposes the word "progressive discourse" in describing the process in which sharing, inquiring, and checking of opinions will shape new understanding.

According to Bohm, Factor & Carret (1991), dialogue is a powerful tool to understand what, actually, is thinking as a process. Factually, all of this knowledge that we have in mind, is transparent in a thought and this knowledge mediates in a thought. We need a tool that will make the process of thinking a little bit slower with the aim of being able to perceive the thinking process at the same time. The skill to find out how somebody is thinking and how she or he explains her or his action (Aarnio 1999, 20-22) could be one method to slow down the process of the thinking. If one has this skill, one can help somebody make her or his thinking process transparent, and at the same time, one is able, as a listener and speaker, to look at one's own process of thinking, namely, what it is like and how it proceeds. In a network-based learning community, one has good chances to develop one's thinking skills through dialogue.

If teachers have the competence to help the learner to open conversation, to inquire and to open so called 'hot words' and utterances, and to express the thinking process on her or his own, which is at that moment incomplete and just getting form, then they will find continuously new paths to promote dialogue. Aarnio (1999) noticed that the student teachers had plenty of difficulties in dialogue, especially in inquiring, in a network-based environment. The facilitators of the dialogue are needed in a network-based environment and participants are assisted at creating dialogue and knowledge construction collaboratively by facilitators. A skilful e-moderator (Berge 1995; Paulsen 1995; Berge &

Collins 2000; Salmon 2000) is able to take the participants into dialogue according to the situation and is also able to continue the dialogue appropriately. Senge (1994) points out that when one can perceive and experience the meanings flowing in a situation and one is able to find out just that thing, which has to put into words, it is an indication of the excellent competence of dialogue. That's why the e-moderator in network based learning should be very sensitive to activate and stimulate the dialogue.

Purpose

The National Board of Education, University of Tampere and Häme Polytechnic, Vocational Teacher Education College and several vocational pilot institutes located at different regions in Finland are involved with the VETO-project. The VETO-project was started 1.5.2000 and will continue until December 2001. The main goal of this VETO-project is to create the dynamic dialogic model for network-based learning to benefit the needs of vocational education and learning on the job. In this article we like to consider two important questions, which are part of our research problems of VETO-project: 1) What are the elements of the dynamic dialogic model for network-based learning in vocational education?; 2) What kind of competence teachers and teacher students have in inquiring as a part of dialogic knowledge construction? We describe some important results and implications we have found out.

Design and Methods

The background of the themes of the VETO-project is based on the results of our earlier researches (Aarnio 1999; Enqvist 1999). We have noticed as teachers in vocational teacher education how difficult it is for teacher students, as well as in-service teachers, to construct learning situations that support problem solving, inquiring, and intensive dialogue in traditional learning and teaching, to say nothing of learning and teaching on the net (Aarnio 1999; Enqvist 1999). The starting point of the VETO-project was the course called "Network-based learning environment as a field of dialogue and learning", and it was organized for 30 vocational teachers from different domain during 5.5.2000 - 9.9.2000. The whole research project was divided into three stages: 1) The orienting and planning stage for the summer and autumn 2000; 2) The applying and constructing stage for the spring 2001; 3) The applying and evaluating stage for the autumn 2001. One of the outcomes of the first stage was a tentative model of network-based learning for vocational education. In the second stage the model has been restructured and improved on grounds of the empirical data that have been collected during research process. The observations in this stage indicate that there is a need to investigate teachers' and teacher students' competence of inquiring as a part of dialogic knowledge construction. Just now the process is in the middle of the stage 2, and that's why the results are tentative.

The strategy of this research project is action research by nature. This research is involved with practical issues, the kind of issues and problems, concerns and needs, that arise as a routine part of activity 'in the real world'. Specifically, practical orientation has remained a defining characteristic of action research. This research has the central features of action research (see Kemmis 1995). It is characteristic of action research that the data is collected by many various mixed methods during the process: e.g. questionnaires, interviews, observation, and documents.

Results

Main result 1

The course "Network-based learning environment as a field of dialogue and learning" was organized for 30 vocational teachers during 5.5.2000 - 9.9.2000. The open question for the course participants (n=30, full time teachers) after the course was: *How has this course improved my understanding concerning of the dialogic knowledge construction?*

The answers of the participants to the open question reflect widely the improved comprehension of this subject area. The participants reflected the importance of the competence of dialogue. Many of them told that they have not been able to think that dialogue is very demanding and learning of dialogue requires a lot of conscious training and great effort. One of the participants answered: *"My understanding of the meaning and the practice of dialogue has been opened so that I am able to evaluate conversations in practical situations in a new way."* His peer caught the point in another way: *"This has shown to me how long the process to change myself as the teacher is with dialogue into e-moderator of the dialogic learning."*

From the participants point of view it was very useful to learn to pick up so called 'hot words' or utterances as a critical skill of dialogue. One participant said that *"it was very insightful to make inquiring questions and to open the 'hot* *words'* and the other one emphasized *"the inquiring method with 'hot words' is a very crucial help in conversation on the net..."*

The contribution of dialogue makes the learning process different on the net. One participant formulated this idea: *"Learning and teaching on the net is entirely new to me. I advanced when I noticed the advantages, which follow after the thinking process has been made transparent and public...On the net it is really possible to get authentic thinking together instead of the change thoughts."* The peer participant described the same thing in this way: *"Collaboration is possible on the net, the students are able to work out things together and to create new common understanding."* Dialogue also helps students on the net in general: *"When the dialogue is going, it is easier to find out the difficulties of the student and the results of learning are better."* One participant had very interesting comment: *"I earnestly believe that the net is a possibility and an answer for many situations as a field of dialogic learning ...To my great surprise I think the net as a human and warm friend, which helps me to mediate my thoughts, hopes, experiences etc. to my peers."*

It is professionally very demanding on the teacher to engage students in dialogic knowledge construction on the net and to facilitate students in their learning processes. The participants reflected these aspects critically and here are some examples of their reflections:
"In the learning processes on the net it is important to set realistic aims and to structure the course very clearly..."
"It is necessary to study to use dialogue with the students and to understand the nature of dialogue before a teacher can assume that the process can start and is progressing well on the net....
"The meaning of the dialogue is really crucial on the net. How does the conversation start, how does it go on, how is it directed, and how can you influence the dialogue as a conversationalist and as a tutor."
"The teacher's role in sustaining learning process in the group is essential... By means of dialogue on the net you can catch up with the students very easily or loose them as well - you have to be attentive..."
"The course has facilitated me to get clearer idea how to use dialogue in order to solve problems together."

The students brought up also that learning on the net must not be a digital version of a correspondence course, and the function of the net is not merely to give out material and many kind of tasks or assignments.

Conclusions 1

The answers of the participants indicate that dialogue has become a useful tool to carry out learning on the net. The participants comprehended the nature of a text or other symbolic language; it is a source to joint comprehension and knowledge construction. A text can be like a 'treasury', full of unfamiliar knowledge that leads you to new combinations of issues or to new insights. So called 'hot words' help to open that 'treasury'. The val
words' can be seen by means of inquiring the meanings which are hidden back of the words. The participants understood that dialogic knowledge construction brings along something that nobody knows before.

The participants were satisfied with the things they learned on the course. Their realized that the mastery of dialogue, the construction of meaningful learning process and structuring the process on the net as explicit as possible, are skills, which cannot be compensated with any other skills. The professional skill of a teacher as a facilitator of dialogue and as a "scaffolder" on the net, demands efforts in order to evolve. The traditional working model of teachers and the monological style of conversational culture, cannot be relied. An attitude of inquiring and explorative talk that will promote learning, was difficult to them.

To sum up, it was demanding for participants to act purposefully in WebCT-learning platform; they have to struggle hard to catch the collaborative idea of dialogue; and they need a lot of help and tutoring in order to become good facilitators of dialogue, "scaffolders", and constructors of meaningful and enthusiastic dialogic and inquiring learning processes.

Main result 2

Because, as we have seen above, the inquiring dialogue is a difficult way to work for teachers, it was important to find out what kind of inquiring questions the vocational teacher students (n=298) could bring up fairly spontaneously on the net in order to help a case example, student (A), to continue her online learning. All these teacher students were studying in Häme Polytechnic, Vocational Teacher Education College and the mail lists and WebCT learning platforms were set up for them. Before sending the proper open question, one preliminary information message was sent to them via e-mail, four days before the proper message. So the students knew to wait some important task message and they knew that when they opened the proper message, they would have only 15 minutes time to perform the task and then send their answers back to the researchers. So the situation was spontaneous enough. 80 reply-message answers were received via e-mail on time.

The teacher students were asked to imagine themselves as an online teacher of the student (A). In the task, there was given an example message written by the student (A): *"The very first day in the world of Internet and e-mail. I feel myself chaotic. It seems that it is difficult for me to face things I don't understand at all. I am distressed, I feel like crying and I feel depressed.... My student fellows have sent an e-mail message to me, but I cannot find it in my computer. I don't know, where I find it. Otherwise, even the simplest operations in the Word- text processing program seem not to be coming to my mind at the moment. Just now, I would like to leave off that job. This feeling of mine has come out also in other awkward and difficult situations. I have to work with this feeling by myself. How is that?"*

Now the teacher students were asked to make 5-8 questions to the student (A), so that the teacher students would find out the train of thought of the student (A) and in order to help the student (A) to make progress. It is very important to notice that the teacher students were asked to make only questions, interrogative sentences, not any piece of advice or something like that. The findings were interesting.

In the answers of the respondents (n=80), there were given 565 reactions and only 135 of them (= 23%) were pure, open questions, without any preassumptions or proposals for the arrangement of the matter. All the other reactions (77 %) were either narration of teacher students' own range of thought and world of experience, emotional support or closed questions. The closed questions lead us into 'either-or' –type of answer giving, or they contain either a proposal of the questioner in order to work out the situation or an interpretation of the student's condition or an interpretation of his/her way of doing things. Then, because the questions are not open, the student's train of thought and starting points will not be found out but they will be stayed unknown. The answers contained a lot of instructions, own ideas or experiences in related situation and interpretations, in other words illusions about the condition of the student (A), although they were asked only to make questions to the student (A), who needed help. Only 2 respondents of 80 understood the idea that scaffolding will succeed when a teacher has patience to start from student's train of thoughts.

Conclusions 2

The teacher students use either closed questions or questions which emerged from the expectations and assumptions of their own. They have also tendency to guide and tutor the student, who needs help, based on the teacher student's own thoughts, experiences and illusions. However, the open problem solving requires the skill of collaborative thinking and thus it should be able to keep the situation appropriately open for the new collaborative thinking. The open and pure questions that familiarize with the train of thoughts of the other, would take in that collaborative direction.

Dynamic Dialogic Model for Learning and Knowledge Construction on the Net

Finally we will present our dynamic dialogic model for learning and knowledge construction on the net in vocational education. Our model is some kind of synthesis of long lasting action research processes since 1996, when we started our earlier action researches (e.g. Aarnio 1999; Enqvist 1999), and ending to the ongoing VETO-project. The model is formed as a result of 1) these earlier action researches; 2) interviews and discussions with teacher trainers in Häme Polytechnic, vocational teachers and students in the pilot institutes; 3) the course "Network-based learning environment as a field of dialogue and learning" for vocational teachers (main result 1); 4) e-mail open question for teacher students (main result 2); and 5) the theory of dialogue and dialogic knowledge construction. VETO-project will continue to the end of the year 2001, and the implementing and testing of the tentative model has been started up and will continue in vocational education.

This model includes the essential elements of the learning and dialogic knowledge construction on the net. The model is dynamic and the progress is cyclic. It helps teachers and learners to identify the critical points or stages in the learning process on the net. (In this paper, there is no room for more details and explanations.)

Teacher activities on the net: 1. Starting up learning process; 2. Assisting in finding and focusing learning problems; 3. Coaching learners; 4. Structuring learning process; 5. Assisting in searching for and finding information on the Internet; 6. Scaffolding learner groups in the learning platforms; 7. Inquiring about learners' train of thought and semantic contents of learners'; 8. Nurturing and caring for community of learners; 9. Participating the process of evaluation.

Learner activities on the net: 1. Becoming acquainted with the world of Internet and the learning platform; 2. Searching for and designing vocational inquiring (study) problems; 3. Exploiting sources of information; 4. Problem solving and knowledge construction; 5. Specifying objectives of vocational skill and knowledge; 6. Knowledge construction according to dialogic inquiring learning; 7. Use of inquiring way of action; 8. Wondering and finding new tracks to continue dialogue; 9. Nurturing and caring for community of learners; 10. Developing vocational practices; 11. Evaluating improvement of vocational practices.

The results already available in this project show that it is necessary to develop further network-based learning and pedagogy in vocational education. The new learning platforms on the Internet are technologically fairly good and versatile learning environments, but teachers do not yet know how to use them in a pedagogically adequate manner. Our aim is that this dynamic dialogic model promotes learning and knowledge construction on the net.

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A tool to practice formal proofs

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Abstract: This paper presents a Logic Tutor, a tool to support computer science students in their learning of logic, more specifically in their learning of formal proofs. The current tool is equipped with a deduction system for propositional logic. However its modular conception makes it easy to change to another logic. Preliminary evaluation shows that this tool has a high educational value, thanks, among others features, to its simple, attractive interface and its specific error messages. The Logic Tutor will be integrated in our Logic teaching course in 2001.

Introduction

For a few decades now, computers have played an increasing role in education. They provide a more or less personalised environment where the learners can practice at their own pace, have access to tutorial lessons, be given explanations and feedback on their performance and so on. Intelligent Tutoring Systems, which make use of Artificial Intelligence and Cognitive Sciences, are a popular target but also require a lot more effort to build. On the other hand, non-intelligent but well-designed systems can also be educationally excellent [1,2]. This paper presents the Logic Tutor, a well-designed program with an attractive interface. It has intelligent features such as the expertise to apply rules of inference and laws of equivalence, as well as a certain level of adaptability to the user.

Students learning formal logic have to understand how conclusions can be derived from a set of premisses using logical rules [4]. The increasing numbers of students in computer science make it difficult to provide enough human tutors to assist students in this part of their learning. Existing tools for practicing Logic have not matched our expectations, mainly because their GUI had high barriers to initial use and did not provide enough feedback to the learner. This led us to design our own tool. The Logic Tutor presents exercises of formal proofs in propositional logic, checks students' answers and provides step-by-step feedback.

Educational value in the Logic Tutor is achieved by five means. First the Logic Tutor provides step by step feedback. Each time a student enters a line of the proof, the line is checked for correctness. In case of mistake, extensive explanation is provided by the use of a 'cascading mistakes' principle. Second, several levels of help are provided, ranging from a quick start button, to a handy reference to rules of inference, and a tutorial on proof strategies. Third, the history storage provides students not only with the exercises they have done or attempted, but also with statistics on their mistakes. Fourthly, files of exercises may be easily created with a possibility of comments, hints, and partial or even complete solutions. Last but not least, the Logic Tutor has a simple and attractive graphical interface. Simplicity means that the barrier of learning how to use the program is almost non existent. Attractiveness, enhanced by a possibility of changing the look and feel, means that students have pleasure in using the program.

Description of the tool

The Logic Tutor is written in java, which makes it a portable tool. The main modules are the user interface module, the student module and the logical system module. The interface module makes use of the java swing library. The student module stores information specific to the student's use of the tool. It records all the attempted exercises along with mistakes. The logical system module is divided into two sub-modules, the verification module and the mistake module. The verification module has the logic expertise and checks the correctness of a student's deductions. The mistake module is articulated to a database of mistake patterns, which is used to produce proper feedback when a student error occurs. This modular design makes it easy to change the logic, as only a few classes are affected. The plug-in of another logic has been successfully tested.

Handling of mistakes

Each logical system, presently the propositional logic system, stores a database of mistake patterns. Whenever the student uses a rule incorrectly, the mistake database is interrogated to find the type of mistake made. The code that checks for mistakes when deductions are entered is thus independent of the logical system the student is currently operating.

This was an invalid application of Modus Tollens *Look into using line references (0,2) instead.*

Fig 1- Invalid lines error message appearing in the mistake viewer.

When students make mistakes, they have quite often made more than one error. This lead to the principle of cascading mistakes. First it is checked that all the fields in the answer are filled with the right type of data. Then the formula is checked for its syntax. Then the real cascade in the derivation begins. The lower level represents general mistakes like incorrect line number and invalid application of the rule. This level is illustrated by Fig 1: the expert module detects that Modus Tollens can be applied, using lines other than those provided by the user. The higher level of mistakes deals with more specific mistakes, like the use of Simplification without Commutation to deduce the right hand side of a conjunct.

All mistakes are context sensitive, which means that explanations are adjusted to the current exercise. Fig 2 shows the explanation provided when the student uses Simplification before Commutation. The student concludes R from ((P->Q) & R) giving Simplification as justification. However Simplification, in the present logic system, has the form 'from (A&B) deduce A'. Thus commutation is needed before R can be deduced. The mistake module uses the original formula to construct an explanation detailing how only the left-hand side can be deduced by simplification.

This was an invalid application of Simplification *You need to apply And Commutation to ((P->Q) & R) before you apply Simplification- since Simplification only lets you deduce the left-hand side: (P->Q).* We can apply Simplification only a different way. The correct application produces (P->Q).

Fig 2- Explanation provided when Simplification is used on the right side of the formula.

A careful analysis of mistakes made by students leads to the organisation of the database mistakes according to patterns. Currently the database has 50 patterns. Two patterns are given as example below.

Incorrect Justification Pattern: this mistake looks at the deduction and can determine that the user meant to use, say, Commutation, but confused the name with Association.

Incorrect Line of Reference Pattern: this mistake picks up typing errors when the user enters the line number references. It will inform them of the correct line numbers by printing ``Try using (1, 3) instead", for example.

Conclusion

Summing up, the Logic Tutor is a tool to support students in their learning of formal logic, and more specifically formal proofs. It cannot yet be classified as an intelligent tutor. However, it has intelligent characteristics. It can adapt to the user by the possibility of changing the look and feel of the interface. It possesses an expert module that enables it to apply rules of inference and laws of equivalence of propositional logic. Moreover its feedback takes into account the inputs of the user, and the explanations provided, in many cases, are as enlightening as the ones provided by a good human tutor. Preliminary qualitative evaluation, which was conducted with students who took the Logic course in 2000, provided a very encouraging feedback.

Immediate future work includes the extension of the database mistakes and the addition of a dynamic exercise generator. This will improve even more the educational value of the tool, both for the student and for the lecturer. The Logic Tutor already provides the learner with the possibility of consulting her/his history using the system. Building on that, a proper learner model, i.e. with insight in the knowledge level and difficulties of the student, is planned to be added the Logic Tutor. This learner model will make use of MOST, a skill acquisition model [5] and maintain the present "scrutability" as it can help the learner to learn better [3].

Finally, our present logic course is being redesigned to include this tool at the teaching level, the training level and the assessment level. Extensive qualitative and quantitative evaluation will be conducted then and meaningful results should be obtained as nearly 500 students enroll in this course.

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Integrating a Course Delivery Platform with Information, Student Management and Administrative Systems.

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Abstract: This paper describes the development of an interactive online teaching and learning system model. Built first as a scoping and costing instrument, it has been transformed through use into a tool for systems integration.

At JCU an initial project set out to answer the questions: Do we need a system to delivery learning materials? If so, what / what else do we want that system to do? Should we build or buy a system?

A system model designed to model user paths assisted in the decisions about architecture, and further, the decision to buy rather than build.

Following a recommendation in March 2000 to purchase the Blackboard system, the system model has been re-purposed as a tool for the next stage of the project, which is integrating the selected course delivery platform with information systems, student management and administrative systems.

This paper will be of interest to institutions engaged in or investigating integration of a course delivery system.

The search for an online system at JCU

In 1999 James Cook University's Teaching and Learning Development Program conducted an evaluation of online teaching and learning systems with a view to selecting one to enhance course delivery at the university.

A comprehensive website describing that Research and Evaluation of Online Systems can be found at http://www.tsd.jcu.edu.au/develop/survey_re/. Throughout 2000 the website provided information about the search for a system, compiling in one place:

- a full overview of the project (context, review of the literature, project plan, resources)
- a survey tool for staff input
- a trial online course developed in a range of systems as a means of comparison of systems and
- a web database of gathered information about system features, sites, capacities.

In March 2000 a report and recommendations for the adoption of online delivery went to senior management. Beginning with the recommendation of specific software (Blackboard 5 Level II) it progressed to strategies for full implementation. The report and its recommendations can be found at the above URL. Through 2000 the website grew, updating the JCU community on the progress of the project. Although its use has passed, it remains a useful resource possibly of interest to other institutions engaged in a similar research and evaluation exercise.

Development of the interactive system model

One aspect of the project which has transformed over that period is the development of an interactive system model. Built first as a series of HTML pages, it was useful first as a starting point, for scoping and costing a home grown system. It has since been re-purposed as a tool for the next stage of the project, which is integrating the selected course delivery platform with information systems, student management and administrative systems.

Build or Buy? The model from scoping and costing tool

We found that systems, like any commodity, can be either home-built, built to specification by an agent, or bought off the shelf. At the research and evaluation stage of this project it was felt important to investigate costs of building a system using university resources. This was because although there are strong reasons for purchase of an off-the-shelf system for online course delivery, there are many successful instances where universities develop a system themselves. It was evident that home-grown systems are often more tailored to a university's specific needs.

It was seen as necessary therefore to scope construction of a system at JCU. Although the exercise excited interest in the IT Resources department, it was difficult when speaking to others including programmers to convey an idea of desired system ingredients without a graphic representation. To this end a system model was designed as an interactive diagram reflecting each part of the system, in prototype. This system model includes basic componentry, specifically what JCU would want in a system. It is a use-case that takes the user - portals users in fact - through a range of pathways to fit their needs. It can be found at http://www.tld.jcu.edu.au/general/survey_re/My_JCU/siteols.html It is a useful tool for estimating costs as it allows more accurate scoping of construction and therefore costing of components and the whole.

We decided not to proceed to build a system ourselves but to purchase Blackboard 5 Level II.

Transformation of the model to integration tool

The next level of purchase, Blackboard 5 Level III provides at additional cost the required APIs and consultancy for institutional tailoring: that is, integration with JCU systems of information, student administration and course delivery. We are now looking at the costs of that integration, whether to purchase the consultancy or to do the integration in–house. The system model is now a low-key but practical aid to assessing the scope of integration. At time of writing it describes generally - possibly inaccurately - some relationships between JCU systems.

Benefits of the system model

As an interactive use-case it expresses what each part would actually do. A number of different users with different needs can walk through the system and test the parts. Its interactivity is its validation as a system and will be a useful means of eliciting from all stakeholders an accurate view of what they want in their part of the system.

It will provide a context when working with reference groups from the main system areas, in fleshing out what we want in that integration. It will elicit feedback by inviting ideas about what the system should do at each point. It will provide a useful vehicle for technical and non-technical administrative personnel to describe the transactions that occur in universities, such as student enrolment flows. It highlights the need for focus groups to work in certain areas as sub-projects.

It is not entirely a descriptive model as it looks forward to what could be, rather than describe what exists. Information and student administration systems at JCU will be replaced and upgraded in the years ahead, and an accurate system model could never be static as it needs to reflect continual operational change and expansion. It already highlights existing work-flows and arrangements that will need to change and become more efficient.

It is a useful exercise for any institution. Each institution will come up with an entirely different system model, one which reflects its specific needs. Other stakeholders could be added as discovered to the dummy 'portal' - e.g. the business selling its product to the university, with its specific pathway and requirements.

Conclusion

As an innovative example of organisational design method and a useful means of testing user pathways through a system, with possible benefits to costing and project management, the system model may interest other universities engaged in the process of development and integration of a course delivery system that meets the needs of all - learners, academic staff and administration.

PRELIMINERY RESULTS OF A PILOT PROJECT INTERNET BASED SUBJECT REGISTRATION SYSTEM

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Abstract: This paper presents the preliminary results of a pilot project on Internet based Subject Registration System. The system allows the students to register for their relevant subjects through Intranet or Internet via any web browser. The system was developed using web programming languages such as html, VB script and ASP (Active server page). The system has been tested successfully on Degree Students of Faculty of Electrical Engineering, Universiti Technology MARA (UiTM) for three phases. The first phase involves only semester two Degree students while the second and third phases involve all degree students. The Internet-based Subject Registration System has managed to ease out congestion and found to be very efficient as it reduces faculty's manpower and resources.

1. Introduction

Rapid advancement in Internet based applications and the wide usage of World Wide Web (WWW) has led to many challenges in information technology (IT) globally. The dawn of the new millennium has seen the births of numerous internet based applications as people are more geared toward borderless environment and communication anywhere anytime.

The trend is of no exception to Malaysia. The IT growth is made more rapid by the government's immense interest in promoting its advancement through the famous Multimedia Super Corridoor (MSC) programme [1]. MSC becomes the nation's catalyst to the multimedia industry so as to provide an efficient information service in business organisation as well as the general public. Organisations have invested millions of ringgit in upgrading the infrastructures and resources to be at par with their counterparts locally and internationally.

Educational organisations are also affected by this technological evolution. New IT techniques are incorporated in their learning methodology such as web based learning (WBL) where traditional classrooms are replaced with multimedia applications[2]. Besides the revolution in learning methodology, various on-line information systems are developed using internet based technology such as student information system, financial system and administration system [3].

Thus, the Faculty of Electrical Engineering of the Universiti Teknologi MARA (UiTM) has taken a bold step in embarking a pilot project in Internet based Subject Registration system for its Degree students.

This paper presents the preliminary results of a pilot project on Internet based Subject Registration System which has been run for three semesters. The system facilitates the students, lecturers and administration with user friendly interfaces and end-user requirement.

2. Internet based Subject Registration System Design

The system is a Web application, running on a Personal Web Server. It is developed using Hypertext Markup Language (HTML), Microsoft® Active Server Pages(ASP), VBScript, Microsoft Access 97 and Open Database Connectivity (ODBC) . The database design was created based on four (4) main contents namely, subjects, student list, lecturers list and class schedule. All the databases were developed using Microsoft Access 97. The detailed contents of the design are shown in Figure 1.

The software is designed to offer a complete feature of registration package to the students and is accessible as follows;

i) Check students' identification numbers (SID) and semester through Student Login
ii) Register Subject, where it displays list of subjects offered and corresponding groups
iii) View schedule after registration which allows the student to see their current semester time table
iv) Change password allows the students to change their password for security reason

The lecturers are able to get access to the student list for the respective subject and able to print the list upon registration. The administration is able to modify timetables, lecturer's and students' identification number and add

3. Interfaces

Figure 2 shows the student interface which is generated as the student selects the subject to be taken for a particular semester and previews his selection. The interface consists of the student's new schedule indicating subjects being registered and subsequently highlight time clashes if there are any. Here, the student can check his selection and hence, proceeds or reenters his selection.

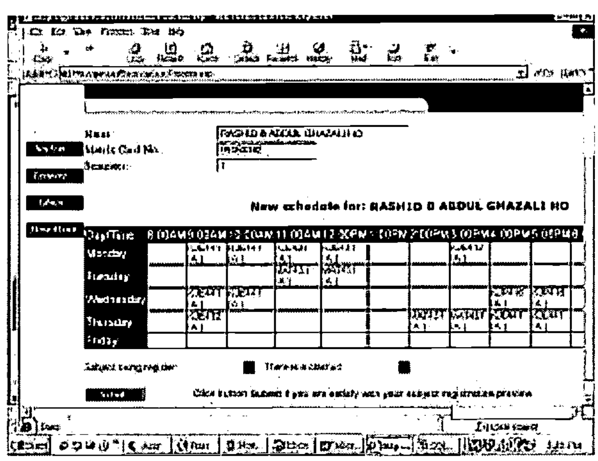

Figure 2 Example of student interface

The administration interface is illustrated in Figure 3. This interface allows an administration to add or delete lecturers' particulars that includes his/her identification number, subject code, number of students per class. Apart from this, the administration is also allowed to view and modify the lecturers' particulars directly from database.

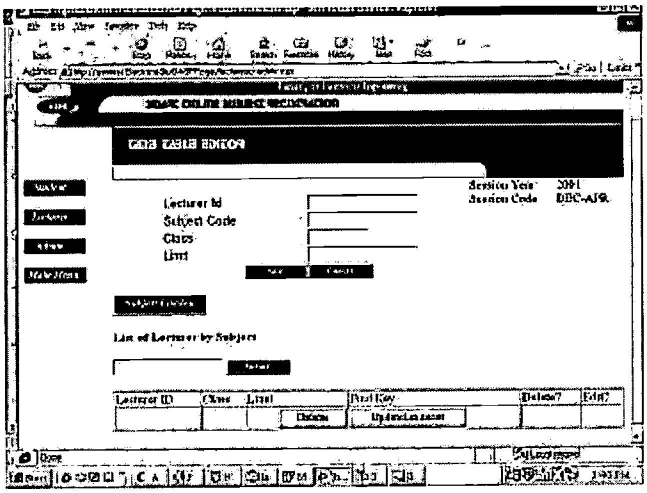

Figure 3 Example of administration interface

Figure 4 shows the lecturer's display window that would allow a lecturer to view or print the students' list. Here, the lecturer is allowed to enter or modify the students' results which will be stored in the system for future reference.

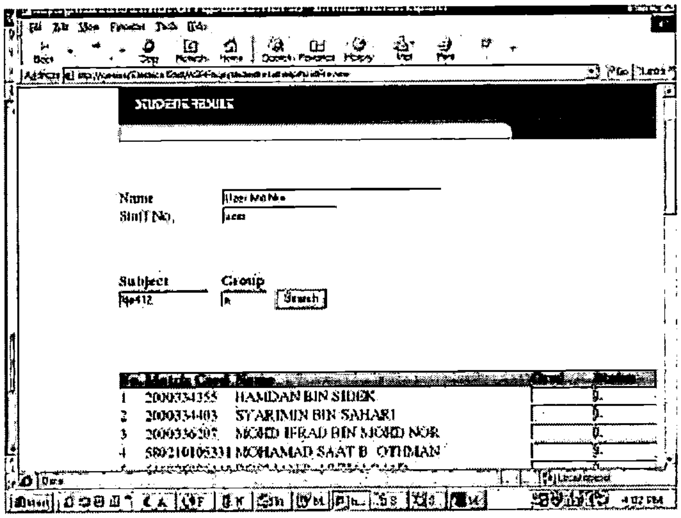

Figure 4 Example of lecturer interface

4. Results and Discussion

This system has been tested successfully on Degree Students for three phases. The first phase involves only semester two Degree students while the second and third phase involves all degree students. The first pilot run was conducted during June-November 1999 session and the second pilot run was conducted during December1999- May

2000. Both testing were carried on workstations and the website can be displayed using Internet Explorer or Netscape. The third run was conducted during June-November 2000 session using personal computers.

Figure 5 shows the number of students registered in each semester and Figure 6 shows the number of successful connections used simultaneously for each semester. The graph illustrated in Figure 6 shows that the system is limited to less than 12 connections when running simultaneously. This is due to the limitation of the database used. Therefore, a research is currently carried out to modify the system database server to accommodate more users and enhance the capability of the system.

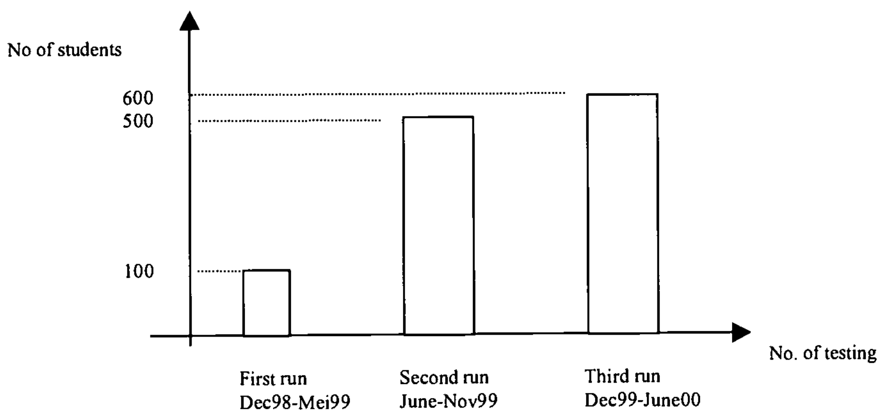

Figure 5 Number of students registered in each run

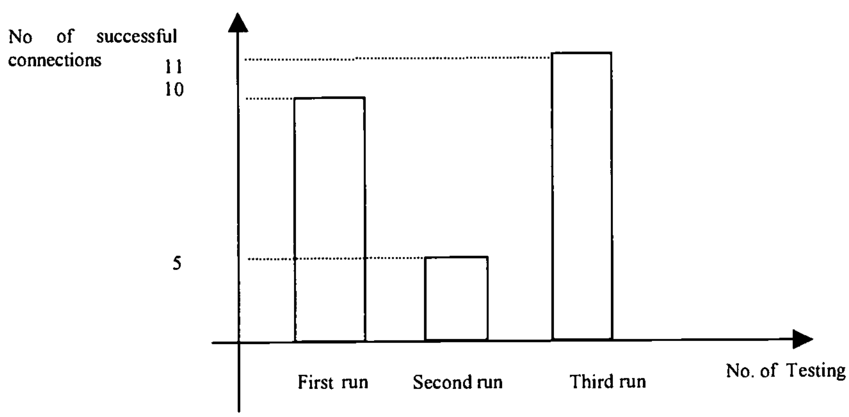

Figure 6 Number of successful connections for each run

5. Conclusion

The Internet-based Subject Registration System has been successfully tested for three semesters with increasing number of students subsequently. The system has managed to ease out congestion as students do not have to move from one room to another to manually register for their subjects. Its user-friendly menu driven web page provide students with information on the study plan, pre-requisites and time table with an added advantage of avoiding time clashes in their time-tables.

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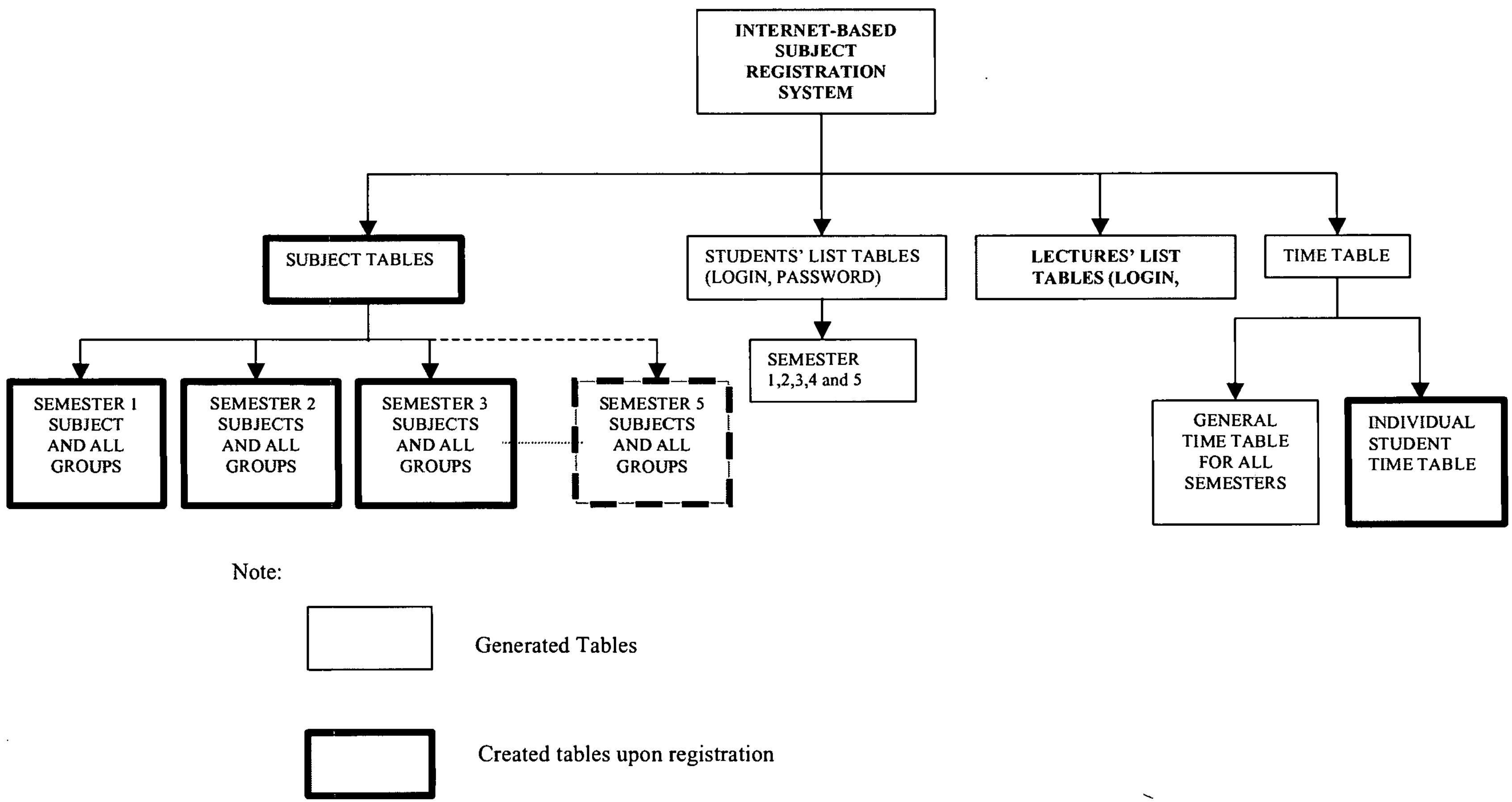

Figure 1: The hierarchy of the data base design for Internet Based Subject Registration

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The Effects of Strategies Instruction via Computer on Student Attitudes toward Mathematics Problem-Solving

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Abstract: This exploratory study, utilizing a general strategy, SPIDER, and two types of computer-based instruction (CBI) programs developed by the researcher, examined the effects of explicit strategies instruction on 105 sixth-grade students' attitudes toward mathematics problem-solving. An attitude survey was administered to investigate their attitude change toward mathematics problem-solving and the CBI program which they received. The findings indicated that students who were exposed to the CBI program either with or without explicit strategies instruction developed more positive attitudes toward mathematics problem-solving. Importantly, some students in the experimental group showed increased self-confidence toward mathematics problem-solving and self-esteem, whereas such comments were not observed from students in the CBI control group.

Rationale and Purpose of Study

In the International Commission on Mathematical Instruction *(ICMI)* study (1986), Howson and his colleagues noted the following teaching conditions which prevent teachers from implementing well organized instruction:

> A teacher who has to teach 5 or 6 classes a day has little time to reflect on his or her teaching, to prepare instructional material, to inspect a variety of alternative approaches, or to work with colleagues in developing and renewing a coherent program. A teacher who lacks a work space, equipment, a budget for purchasing materials or traveling, discretionary time for working with colleagues or students, cannot be expected to develop far as a 'reflective practitioner' (p. 80).

The question that arises then, is how can the teaching of cognitive and metacognitive skills be effectively applied to a classroom setting in the face of all the factors described above? One possible way is to use a computer to teach these skills because the teacher can no longer rely solely on a chalkboard, chalk, paper, pencils, and textbooks (NCTM, 1989). Computers can provide greater degrees of flexibility to activate students' learning processes. For example, computers can provide well-structured, individualized, and user-friendly instructional presentations that can facilitate learning. Silver (1985) suggested, that the "computer can be used as a tool to create environments in which students can be given the opportunity to think mathematically and solve challenging problems,...can be beneficial in the teaching and learning of problem-solving,...can be designed to provide useful feedback or help sequences that focus not simply on the calculation of an answer but also on processes or heuristics generally useful in problem-solving" (p. 263). In addition, motivation will be enhanced since students can learn at their own pace without group competition and evaluation. However, teaching mathematics problem-solving in a computer-based learning environment has not been done in many research studies. Moreover, there is a paucity of literature on the effects of mathematics problem-solving **strategies** instruction via computer on attitudes toward mathematics and mathematics problem-solving. The purpose of this study was to explore the potential effects of general and specific strategies instruction via computer on students' attitudes toward mathematics, mathematics problem-solving, and the CBI programs which they received.

Research Method

This exploratory study, utilizing a general strategy, SPIDER, and two types of computer-based instruction (CBI) programs developed by the researcher, examined the effects of general and specific strategies instruction on 105 sixth-grade students' attitudes toward mathematics problem-solving. Of the 105 students in this study, 68 students in the experimental and CBI control groups completed the entire survey, consisting of 12 Likert-scale items and an open-ended question, whereas 37 students in the traditional control group responded to only the first three items in the survey. Quasi-experimental design was implemented to conduct this study. Students drawn from five public elementary schools were divided into three groups (experimental, CBI control, and traditional control). An attitude survey was administered to investigate their attitude change toward mathematics problem-solving and the CBI program which they received.

Data Analysis

To examine students' attitudes toward mathematics, mathematics problem-solving, and the CBI program (PSS-CBI and Control-CBI programs), data were analyzed using χ^2 tests. An independent variable was three treatment conditions (experimental, CBI control, and traditional control). A dependent variable was the attitude survey.

Results

Attitudes toward mathematics, mathematics problem-solving, and computer use. A comparison was made among the three groups' (experimental, CBI control, and traditional control) responses with respect to their attitudes toward mathematics, mathematics problem-solving, and computer use. Statistical significance levels using the Chi-square tests were found on attitudes toward mathematics (χ^2 (2, $\underline{N}$ = 83) = 16.81, $\underline{p}$ = .000), and mathematics problem-solving (χ^2 (2, $\underline{N}$ = 75) = 12.69, $\underline{p}$ = .000) among the three groups. The findings showed that a significant number of students in the experimental and CBI control groups reported that they favored mathematics (experimental = 74.2% and CBI control = 89.3%) and mathematics problem-solving (experimental = 79.3% and CBI control = 80.0%), whereas only 37.5% of the students in the traditional control group responded that they liked math, and 38.5 % expressed that they favored mathematics problem-solving. These results indicated that students who received the CBI program came to like math and mathematics problem-solving better than students who did not receive the CBI program. Participating in the CBI program appears to have improved students' attitudes toward mathematics and mathematics problem-solving. With respect to their attitudes toward computer use, however, there was no significant difference observed among the three groups (χ^2 (2, $\underline{N}$ = 102) = 3.44, $\underline{p}$ = .179). Regardless of the group, an overwhelming majority of students responded that they were interested in using the computer (experimental = 94.7%, CBI control =100%, and traditional control =100%).

Attitudes toward mathematics problem-solving and the CBI program. To measure the effects of the explicit strategies embedded CBI program on attitudes, students in the experimental and the CBI control groups were given nine Likert-scale questions on attitudes toward mathematics problem-solving, and as well as the CBI program they received. It was observed that there was no significant difference on students' attitudes toward the CBI program between the experimental and CBI control groups.

Comments on the CBI program. As part of the attitude survey, students in the experimental and CBI control groups were also asked for additional comments on the CBI program they received. Students in both groups often mentioned the CBI program as fun and helpful for understanding mathematics problem-solving. They also expressed that the CBI program allowed them to work at their own pace. Interestingly, some students in the experimental group described increased self-confidence in mathematics problem-solving, whereas comments from the CBI control group did not include statements about self-confidence. Generally, students described the CBI program as fun, self-paced, and helpful for understanding mathematics problem-solving.

Recommendation for Future Research

Some students who were exposed to explicit strategies instruction via computer (PSS-CBI program) reported increased self-confidence in mathematics problem-solving and self-esteem; however, such comments were not observed from those who received the Control-CBI program. In order to find a significant effect of explicit strategies instruction via computer on students' self-confidence and self-esteem, future research should include a systematic measure of these affective attributes.

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Capturing Communication and Interaction Needs of the Users – Building Better ICT Based Learning Environments

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Abstract: The design of an ICT based learning environment should combine the communication and interaction needs of different kinds of users in varied situations. The purpose of this study was to explore how the needs of different user groups vary and how their needs could be captured in the design of an ICT based learning environment. The analysis of the user needs was carried out as part of a design process of an interaction and communication environment for community based learning. The results showed that the needs of the user groups vary, which should be taken into consideration while planning new ICT based communication and learning services.

Background

The quality of distance education is highly dependent upon the interaction and participation of the learners (McHenry & Bozik 1995). Holmberg (1989) has stated in his essential principles of distance education that the core of distance education is the interaction between the teaching and learning parties. Each user has multiple communication and learning needs, which affects the choices of media they would like to use. For example Neal's (1997) study showed that the students varied clearly in the preference for, and comfort levels with the different communication tools. The communication tools provided for the users should support both the formal and the informal interaction. Fowler and Mayes (1999) have elaborated Wenger's (1998) ideas on organisational learning in relation to an educational context, and talk about learning relationships as a way of becoming a full member of a society. Learning relationships vary according to the characteristics of the groups involved, the context within which they operate, and the strength of the relationships (Fowler & Mayes 1999). Fowler's and Mayes's study of real world learning relationships implies strongly that also the user needs for ICT based learning environments vary. The goal of this study was to identify the communication and interaction needs of different kind of users.

The Study

The key in user centred design is to use the information gathered in the users' own environments as a basis of design. Typical user-centred methods include observations, listening to the users and talking with them. (Hachos & Redish 1998.) Focus group was selected as the data collection method for this study. During the focus group session the users were presented with a storyboard scenario of an imagined communication and learning service. After the presentation the participants filled in a questionnaire independently and afterwards the group discussed about their needs and concerns related to ICT based learning services. The participants (N=22) were selected to represent different forms of learning relationships defined by Fowler and Mayes (1999) in their study of learning relationships in real life:

a) *Peer relationship:* A relatively small group of people who know each other personally, and have strong relationships (e.g. are good friends). They have relationships outside but although these are usually connected to one member of the group (e.g. a father), they are perceived as a collective asset.
b) *Federal relationship:* The entities do not normally know each other well, and can be very widely distributed. Each entity is viewed as an equal, trading knowledge or skills, to meet their own particular needs, but also recognizing the importance of maintaining the federation for purposes of mutual benefit.

c) *Hierarchical relationship:* A structured and formal set of relationships, where communication patterns are determined mainly by perceived or actual status. The status is however not always explicit but inherent within the community. Movement up the hierarchy is a major motivator. Outside links tend to come in at the pre-defined level reflecting that the hierarchical structure is apparent to external people.

Results of the Study

The study showed that the representatives of the peer group were interested in using an ICT based learning and communication environment for supporting their already existing social and learning relationships while representatives of federal and hierarchical groups felt that a possibility to build new relationships and communities over an ICT based service would be useful for them. The representatives of the peer group didn't mention an ICT based communication and learning service as a possibility to get new contacts or as a possibility to be in contact with experts and teachers. According to Fowler and Mayes (1999) the peer group members have stronger learning and communication relationships, which indicates that their need for new relationships is lower than for federal and hierarchical group members. Fowler and Mayes (1999) have also defined that the members of federal groups are more aware of their own needs and goals and that the group is a mean for them to reach their personal goals. An indication of the need of fulfilling personal goals is that the representatives of the federal group were highly interested in being able to tailor the service to their own needs. The results also showed that the representatives of the hierarchical group were more interested in having contacts with the experts, which slightly indicates their hope for upward movement. Both the representatives of the federal and hierarchical group were interested in having all their communication tools integrated into one learning environment, which was not mentioned by the representatives of the peer group. And they would like to have a possibility to store conversations and other materials for later use especially if they don't have a possibility to be on-line at the same time with their colleagues.

The study showed that the needs and concerns of the different user groups vary and that the distinctions between different groups made by Fowler and Mayes (1999) can be used as a guideline while segmenting the user groups of ICT based learning and communication services. The differences between federal and hierarchical groups should be further explored. Focus group as data collection method combined with independently filled in questionnaire was found suitable for the study. The focus group discussions allowed the participants to share their thoughts, which generated new ideas. The importance of group discussion was evident, especially in the federal and hierarchical groups. The role of the independently filled questionnaire was more important for the representatives of the peer group.

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OrtoWeb - Instructor Networking over Internet for Orthodox Religious Education

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Abstract: This paper is a description about an ongoing development project concerning Greek Orthodox Religious Education in Finland at the information technology based environment. In the project the university co-operates with the local school authorities. A project group has been established of the voluntary Orthodox religion teachers from different school levels. Under the supervision of the university the main tasks of this group are to develop their subject teaching by using digital learning materials during the lessons, to produce new learning materials for the network and to share out the network the new pedagogical knowledge with their geographically widespread colleagues.

Introduction

In Finland Religious Education is a compulsory subject for the pupils both at Elementary and Secondary Schools (Lower and Upper). The Finnish speaking Greek Orthodox Church is a minority religion in Finland. Every school year there are about 6000 Greek orthodox pupils in the country and they are taught by 300 teachers. Because of the historical reasons the members of this Church are spread out all over Finland making up 1% of the total Finnish population of about 5.5 million. The majority of the Orthodox Christians live in the eastern and southern parts of the country. During the decades the Orthodox religion education at schools has faced many problems and among them the main one has been the lack of proper and updated teaching materials.

Since 1996 the Finnish Ministry of Education has launched a program called "Finland as an Information Society". The main targets are to increase the benefits of the new information technology in communication and education, to adopt it in networking between different kinds of institutions, i.e. schools, and to raise the level of education and research by applying information technology.

Network in teaching is based on the idea that a teacher utilises the network services to diversify to multiform teaching. The net is used as teaching aid. At the same time one has to take into consideration the fact that usually a teacher has two roles. He/she can be both the subject and the object of the network working. The network services used in teaching can deal with distributing information or communication. Communication in this environment has many benefits. The information can easily be revised, stored and produced compared to the paper versions. After having material in the network the teaching itself can be planned so that new learning material can be produced from the information located in the net. Students can obtain information independently or they can produce information for the net (i.e. own www-pages). When using the net in this way a teacher always has to remember that the computer-based learning environment itself is not the absolute value. One also has to take into account the functional insecurity when using net in teaching.

Networking over OrtoWeb

With this kind of background described above the local educational authorities and the Department of Applied Education at the University of Joensuu have planned a co-operative project. The focus is to develop networking in Orthodox religious education, and especially its materials and methods, by applying the possibilities of information technology and the internet. The project is one of the 17 projects the Finnish National Board of Education that has started in 1999.

The main target of the project is by using the internet to develop and test a national learning (network) environment for Orthodox religious education, and its teachers to support it at Primary and Secondary Schools (Lower and Upper). During the project there has been for example formulated the technical base (www-site=OrtoWeb), and the teachers have produced visual and auditory learning material of the Orthodox Church for the needs of Religious Education (R.E). Teachers have tested the Religious teaching and learning and communication in general in this environment and given feedback (pedagogical knowledge) from the site. The digital materials made by Orthodox teachers themselves were the answer to a great demand in spite of the product's slight deficiencies in technical level. The material was mainly produced during the workshop days and the teachers got both technical and pedagogical guidance during the working process. In the workshops the contact with the colleagues in small groups supported also their networking. This kind of peer couching or peer tutoring is a good way of learning from colleagues to promote new pedagogical thinking, teaching material and curriculum. During the process they noticed that they had something common to be shared in face to face situation and encouraged by that feeling started to communicate by e-mail, too. In spite of this finding within the project the communication over the network was not very popular in general (discussion group and chat). Only when the teachers had a common topic, which was related to everyone's work, the text based conversation was activated for a while.

Networking among the Orthodox religious teachers has orientated teacher's content and pedagogical knowledge. They have the common substance, but they teach about it without knowing how their colleagues are dealing with the same things under the guidelines of the curriculum. Next step during the networking process has been that this kind of common, but before more or less unshared information can be utilized when making new teaching materials and contents on the net. On the other hand one has to remember that the networking does not just happen by itself. A technical platform has to be chosen, decisions about the server solutions, their administration and programs and so on has to be made. Also the teachers have to be educated in content making and trained to use the network in their communication and teaching. Trough the experiences about sharing one´s diversified teaching knowledge with the colleagues, about making peer consulted digital learning materials and after having tested these in the classroom situations one can say weather the networking is worth it. According to the teachers answers in the questionnaire the answer is: "To get something, just pay it forward".

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Improvement of University Classes Introducing Topics-based Discussion Using the Web Bulletin Board

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Abstract: This paper describes improvement of university classes by introducing topics-based discussions using the Web Bulletin Board (WBB), as a tool for assisting discussion. Students can exchange their ideas or opinions before and after classes by writing and reading on the WBB. The log record, which includes indexes such as access frequency, referred frequency, and student names, and texts written by students on the WBB were analyzed. Results indicate the following research-findings: (1) WBB plays a role to facilitate positive participation to classes, (2) Contrary to the traditional instruction without the WBB access, students were able to deepen their understanding of the theme by accessing the WBB before and after classes, (3) The aforementioned indexes were used as students' evaluation measure.

Introduction

It has been pointed out that Japanese students do not prefer discussion-based classes and lack discussion skills in general. Under the current educational setting, it is very hard to change the traditional lecture-based instruction style to the discussion-based instruction style in universities as well as primary and secondary schools (Akahori,1998; Ertner,1999). The assumption is that integration of the WBB to classes promotes advancement in discussion skills and positive attitudes towards classes. Some papers have addressed advantages of Web-based instruction (Collins,2000; Laffey,et.al.,1998).

Method introducing WBB to class

The author gave lectures on "Educational Technology" for undergraduate students at a university in Tokyo and introduced the WBB to classes in the subject as following.

a) Textbook used: The author's book.
b) Discussion topics: Sixteen topics were selected by the author. For example, "What are the problems on promoting ICT education and making plans to promote teachers' ICT literacy by examining related information."
c) Subjects: Sixty-two undergraduate students were separated into 16 groups.
d) Discussion method: The discussion began by each group choosing one topic and subsequently presenting their opinions and solutions on the topic on the WBB. Other students from the class participated in the discussion by responding to the initial presentation of the opinions and solutions.
e) Privacy protection on the Web Bulletin Board: Students accessed the WBB by entering a password to protect their privacy.
f) Period: Three months from April to June in 2000.

Statistical analysis of the log records from the WBB

The following indexes of the log were analyzed.

(1) Access frequency according to days of the week (Refer to Figure 1)
The classes were conducted from 8:50 to 10:20 on Wednesdays. Access frequency, including both reading and written text on the WBB, showed a peak on Tuesdays. In other words, students accessed the WBB the most on Tuesdays to prepare for the class next day. In figure 2, the gray bars show access frequencies (722 in total) and the black bars show written text only frequencies. Traditionally Japanese students do not study during weekends, however, by using the WBB, results show that students studied even on Saturdays and Sundays. This suggests that students' participation was facilitated.

(2) Access frequency according to hours within a day (Refer to Figure 2)
Figure 3 shows two peaks; one is from 10:00 to 16:00, and another is from 20:00 to 24:00. The two peaks correspond to after class and studying time at home, respectively. This shows that students accessed the WBB frequently outside of class, and therefore, suggests that their interest in the topics presented in class was high.

(3) Log records from the main host server

By examining the log records from the main host server, 339 counts (or 48%) were from the university server, and 373 counts (or 52%) were from commercial servers. This corresponds to the aforementioned two peaks of the access frequency according to hours within a day.

Analysis of text content written on the WBB

The author analyzed features of text content written on the WBB using the following indexes; a) writing frequency by each student, b) text quantity (total byte) written by each student, c) depth of hierarchy tree structure, d) referred frequency (including accessing and quoting) by other students.

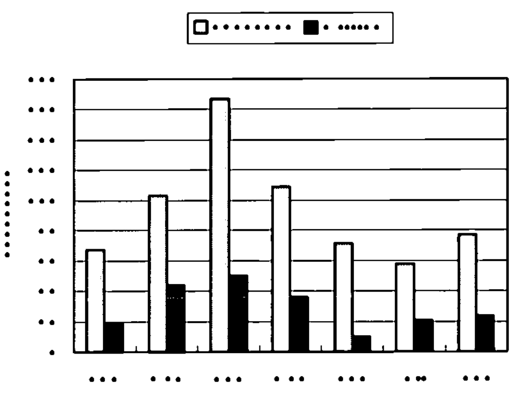
The quality of the written texts were also analyzed and scored (on a 5 point scale) from the following viewpoints; (a) awareness of topics understandings, (b) logical composition of text, (c) originality of ideas, and (d) references of related information including other written texts.

The following results were found by analyzing the text content:

(1) Total frequency of written texts and text quantity written by students depended on the content of the topic. Students were more motivated to discuss about reality based contents such as authentic and realistic problems, planning, and policy making, and contradictory topics for debate.

(2) Referred frequency was not due to the quality of the content of the text. It was due to merely the fact that students accessed the initial text more often than new text because students had to read the initial text to understand the flow of the discussion.

(3) The texts leading to more depth of hierarchy tree structure could not be concluded as high quality content. The author analyzed relationship between text scores of the viewpoints of the contents quality and depth of hierarchy tree structure and couldn't find any clear correlation among them.



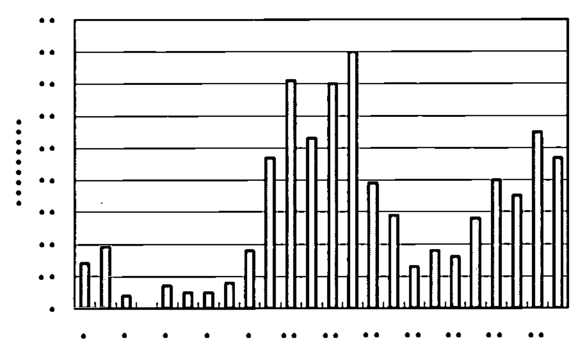


Figure : Access frequency by days of a week   Figure : Access frequency by hours within a day

Implication and future works

The author found effective functions of the WBB, especially to bring students' active participation and positive attitudes to classes. However, since the hierarchy tree may contain too much information, students took excessive amount of time to process the information. For this reason, in the future it is necessary to develop a system where the text content of the hierarchy tree can be summarized in order to grasp the total flow of the discussion with more ease.

The author would like to express a lot of thanks to Mr.Kikuchi and Mr.Shimogohri for their great cooperation.

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Promoting Best Practice in Information and Computer Science Education Through the UK National Subject Centre

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Abstract: The Learning and Teaching Support Network (LTSN) has been established to promote high quality learning and teaching in all subject disciplines in higher education. The Centre for Information and Computer Sciences (ICS) is one of the 24 Subject Centres who supports the sharing of innovation and good practices in learning and teaching in both the information and computer sciences. The Centre will act as a catalyst for change providing both a pro-active and a responsive service to address the evolving requirements of the discipline community.

Introduction
In the UK, the Learning and Teaching Support Network (LTSN) has been established to promote high quality learning and teaching [See http://www.ltsn.ac.uk]. The Centre for Information and Computer Sciences (ICS) is one of 24 Subject Centres who together with a Generic Centre make up the LTSN. The network supports the sharing of innovation and good practice in learning and teaching including the use of communications and information technology (C&IT). The subject discipline focus of the LTSN recognises that for many in HE it is at the subject level where most networking and exchange of best practice and innovation takes place. By working with subject-based communities, the LTSN provides an effective means for dissemination of information and practitioner support. In recent years the services traditionally offered by the library and computer centre have converged in many HE institutions. The establishment of a Centre for ICS mirrors this change and constitutes a major strategic response to the challenges facing academic practitioners within the disciplines of Computer Science and Library & Information Science. By merging existing capabilities within the two disciplines the Centre aims to create a powerful new force for the development of products and services accessible to the entire learning and teaching community.
LTSN-ICS aims to make a rapid and far-reaching contribution to ICS education through:

- identifying and promoting pedagogical innovation and best practice;
- promoting the integration of appropriate C&IT techniques to enhance learning, teaching and assessment;
- building and supporting networks for exchange and dissemination of expertise in relation to developments in learning and teaching;
- opening virtual and regional access points to expertise and resources which will encourage and invigorate local, national and international special interest groups;
- maximising the opportunities for sharing knowledge and evaluating achievements amongst academics;
- creating opportunities for continuous professional development.

Priorities
The Centre is located at the University of Ulster with partners at Loughborough University, University of Warwick, Heriot-Watt University and University of North London. In order that the Centre can respond to the evolving

requirements of the discipline, an early priority was to identify the needs of the subject disciplines. A comprehensive on-line needs analysis survey was issued [http://www.ics.ltsn.ac.uk/needs.html] and the information gathered was used to identify national trends and emerging developments to direct the activities of the Centre. Based on these findings, the authors engaged in informal debate with the community in order to explore:

- requirements for best practice in the teaching and learning of ICS, especially the application of C&IT to support the teaching and learning process;
- the extent to which educators are forging strategic partnerships at local, national and international level to enable and support change in the content and delivery of information and computer science courses.

Results of the survey identified a requirement to promote quality practices in the following areas:

ICT

There is an urgent need to underpin the appropriate use of innovative techniques. Given the particular nature of the ICS community it is recognised that learning technology will play a particularly important role and can act as a driver for the transformation of teaching and learning practice. The Centre fully supports this driving role, while emphasising that such innovations must be deeply pedagogically informed. It provides information and advice on strategic approaches to C&IT based learning support, i.e. the traditional instructionist and the more modern constructivist and dialogic approaches. The Centre will foster and support innovative developments and will widely promote learning technology as a significant and valuable area of research within the ICS discipline.

Collaborative learning

Today's employers have articulated the need for students to improve their communication, project management and team-working skills. Small group project work, in particular inter-institutional work, provides an ideal platform for developing competencies in these areas. New network-based tools that facilitate Computer Supported Collaborative Learning (CSCL) are particularly useful for the flexible interaction required in distance learning. The Centre will provide for the exchange of expertise and appropriate protocols for collaborative learning.

Distance learning

The future demand for ICS education is unlikely to be fully satisfied by conventional courses. Flexible and distance learning is recognised as a vehicle for widening access to programmes of study. Imaginative use of educational technology has the potential to revolutionise the learning environments of our students and provide an opportunity to share resources on an international basis. Experience in areas such as work based learning and the development of a virtual university will be disseminated to the ICS community through the Centre.

Networks of expertise

ICS education is characterised by a rapid rate of change and the short shelf life of curricula and support materials. The Centre actively supports academics by establishing and maintaining practitioner networks providing a forum for innovators to discuss frameworks to guide the integration of innovations into dynamic local academic programmes. A particular requirement for the ICS community is the need to target an increasing number of newly appointed staff, so as to provide immediate opportunities for them to engage with networks facilitated by the Centre.

Dissemination and collaboration

Central to the operation of Centre is a comprehensive web service providing an immediate platform-independent route to current materials suitable for wide scale access and re-use [See http://www.ics.ltsn.ac.uk]. The website provides a 'one-stop-shop' to expertise, resources and world-wide exemplars of good practice. Traditional workshops and seminars are complemented by a programme of web-based video-conferencing events, enabling international participation and interaction. The Centre also supports specialist and emerging areas by facilitating electronic focus groups which are used to provoke debate on the enhancement of learning and teaching. Strategies will be developed to ensure that a valued service is maintained and services will continue to evolve and be amended in the light of ongoing monitoring and evaluation activities.

The Centre actively seeks academic opinion and will undertake a programme of measures to engage effectively with the teaching community. Academic staff from an international audience are positively encouraged to contribute to the activities of the Centre. Through collaborative working the Centre anticipates greater sharing of knowledge, thus enabling effective dissemination of new methods, tools and materials. The ultimate goal of the Centre is enhancement of the quality of learning and an increase in efficiency through the integration of innovative practices into curriculum delivery.

The Evaluation of Multimedia Encyclopedia "Encarta 97"

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1 Introduction

The study presented in this paper attempts to evaluate Encarta 97, a Multimedia Encyclopedia (*English Edition*) in a university setting. Encarta contains the content of a traditional 29 volume print encyclopedia plus thousands of pieces of multimedia (text, sound, graphics, animation, and video) in one CD-ROM. An experiment was carried out in Kuwait University, and 17 students participated in the evaluation. A summative evaluation was carried out to investigate the package by looking at its Usability, Learnability, Enjoyability, and Media Capability. The objectives was to: examine some design aspects of the package; understand how Kuwaiti students perceive a well designed western multimedia package; and apply some alternative evaluation tools.

2 Experimental design

A sample of seventeen students (15 female and 2 males) from the College of Basic Education at Kuwait University participated in the experiment. The students' average age is 22 years and 15 students were final year. They also had little computer experiance and did not use computers in their early education.

The evaluation tools used in this study were a questionnaire, and a direct observation. Summative evaluation was carried out measuring three aspects which have been identified in the Horizon Project (BARKER, 1996). These aspects are: *Usability,* a measure of the effectiveness of the interface, display, and functions; *Learnability,* a measure of the ease with which information, media, and knowledge are accessed and learned; *Enjoyability,* a measure of how interesting and enjoyable the learner thinks the package is. The researcher examined another aspect of evaluation which is: *Media capability,* a measure of the effectiveness of each media element used in the package. The second tool used was direct observation. It involved observing and monitoring students' behaviour and comments while using Encarta. This includes: "walking around in the multimedia lab", observing students' screens to examine "what
"What things they like"; "What problems they face"; and "What comments they make".

An IBM multimedia computer laboratory was prepared for the experiment. Encarta 97 was installed in the PCs which were equipped with CD-ROM drives and speakers. The experiment lasted about 2 hours, the first half hour was used to introduce Encarta to the students, in order to familiarise them with the nature of the electronic encyclopedia and the basic functions of the package. After the introduction, a list of tasks was given to each student in order to ensure that they use most of the package's functions and features.

3 Findings

The students indicated that the visual interface, format, and content of information displayed on the screen were appealing. They felt that they were in control using Encarta, and the package was easy to use.

The interactivity of Encarta seems to provide them not only with access to vast and varied information, but also with control over the way they learn. This control takes three ways: control over the structure, control over the media, and control over the working environment (MCKERLIE & PREECE, 1993).

With regard to the learnability aspect, Encarta provides a good learning environment in which it enhances students' learning experience by the way the content is structured, the various motivational learning activities, and the use of media. Encarta provides exploratory learning and involves various learning activities. This sort of learning which incorporates problem-solving skills as suggested by Quinn, motivates the exploration of the environment (QUINN et al, 1993) and offers increased freedom and motivation to students (OREN, 1990). This view is strengthened also by McAteer and Shaw who stress that learning by performing tasks, making notes, and making conceptual links will provide a full learning experience for students (MCATEER, E. & SHAW, 1995).

Turning to the question of enjoyability, the students indicated that using Encarta is enjoyable. This may reflect the ease of use, content, navigation, access, and control over the package, and indicate that Encarta designers have incorporated appropriate human factors issues which seem to create an enjoyable and motivating learning experience for learners. Thus, the students felt that they wanted to use Encarta more often. This motivation and interest was not only because of the media and the content, but seems to be linked to structure and presentation. Jacques believes that good presentation style makes a good initial impression, and motivates students to continue working on the package (JACQUES et al, 1995).

In respect to the media capability aspect, media is used extensively throughout Encarta. Thousands of photos and illustrations, and hundreds of sound and video clips have been integrated along with text articles. The students indicated that text, graphics, speech, music, animation, and video were extremely well used and presented throughout the package. Research indicate that the effective integration of media in any application with consideration to students' cognitive constraints creates an exciting, creative and supportive system (MCKERLIE & PREECE, 1993). However, there weren't many video clips in Encarta. Vaughan refers the rare use of video in multimedia packages to the big storage space they require and to the absence of efficient compression techniques (VAUGHAN, 1996).

4 Conclusion

Encarta 97 Multimedia Encyclopedia, has been evaluated in this study. Four aspects of evaluation have been considered, Usability, Learnability, Enjoyability, and Media Capability. The finding suggests that Encarta is not only usable and enjoyable, but also provides a good learning environment in which it enhances students' learning experience through the way the content is structured, the various motivational learning activities, and the efficient use of media. Although there is a general positive high response to the package, most of the students suggested the use of an Arabic version of Encarta. This emphasise the need to investigate further to address the effect of culturally designed multimedia interface on students' learning and acceptance. Two evaluation tools were used to collect the data needed. Although the objectives of the use of these tools were clear, most of the data were collected from the questionnaire. It is apparent that the use of direct observation was not effective in this study, and it is suggested that the use of such a tool should be planned properly and used formally for similar studies.

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Intelligent Online-Knowledge-Resources for Intentional Learning

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Abstract: This paper presents the instructional design of online knowledge resources. A project that was designed to meet an instructional need rather than to exploit the capabilities of technology. We will present the instructional needs, a solution that exactly matched the requirements and an evaluation. The project is theory-based rather than technology-driven. The guiding question was: How can the virtual part of a university project enhance classroom teaching and learning? Online resources as well as lectures are organized and visualized as concept maps.

The Project

"ifu - the International Women's University 'Technology and Culture'- is the first and, so far, only gender-specific university project of its kind in Europe. ifu is interdisciplinary in scope and methodology of academic work, and intercultural. Between July and October 2000 the ifu offered 900 female students from all over the world the opportunity to participate in a postgraduate research and study program in six project areas: BODY, CITY, INFORMATION, MIGRATION, WATER, and WORK. In a more long-range perspective, and supported by modern information technologies, the virtual ifu (*vifu*) supported and extended the ifu on the internet." (http://www.vifu.de). The Institute of Computer Engineering - Knowledge Based Systems (KBS), University of Hanover supported the project area WORK. The strength of this work was interdisciplinary collaboration. In order to evaluate the requirements and to face the needs we strongly collaborated with the Institute of Psychology and the Institute of Pedagogy, who made up the curriculum, provided content and organized lectures. They had no specific idea of the use of the internet in learning and on how the virtual part could enhance their teaching. We collaborated in figuring this out. The KBS developed technical infrastructure, support and training and constructed online-knowledge-resources (http://www.work.uni-hannover.de).

The Process

Guiding question: How can the virtual part enhance classroom teaching and learning?
Koshmann et al. argue that computer supported projects should progress through several steps:
"(a) making explicit the instructional requirements that serve as design goals for the project" (Koshmann, 1993/1994, p. 228). First of all our interdisciplinary project group of human scientists (providers of content), computer scientists and media educators (providers of technical infrastructure) made explicit the instructional requirements. We faced the concept of the ifu which comprises five guiding principles: interdependence and interaction of science and society; interdisciplinarity; integration of science and other social practices including the arts, implementation of gender studies as well as an international and intercultural scope.
90 students from all over the world were going to study in the project area WORK: Postgraduated students primarily not from western countries. Most of them researchers, lecturers, assistant professors at universities and NGOs in their home countries. We did not want the students from Africa, America, and Asia to simply "learn from Europe". Even if this was a huge number of students we did not only want to lecture them as they came with a strong cultural, educational, and also working background. But we still wanted to present lectures by experts in the domain of Sociology and Psychology. The humanities are ill-structured domains – there is nothing like a unique ontology. Neither did we want to present given systematics nor taxonomies out of

context. Lectures wanted to afford an opportunity for fluent discussions on theories, methodologies, on interdependence and interrelationships of factors e.g.. Information should be embedded in (cultural) context, by lecturers as well as by students. The students should be enabled to realize interdisciplinary projects, to acquire knowledge presented by experts and practitioners, to share knowledge, to develop communities, to organize their own learning. Presenting knowledge as well as students' project work was supposed to be supported by technical infrastructure, which facilitates networking and integration.

"(b) performing a detailed study of current educational practice with regard to these goals," (ibid.). There was no comparable project of international and intercultural scope to evaluate and to draw experience from.

"(c) developing a specification based on the identified requirements/limitations of the instructional setting and the known capabilities of the technology" (ibid.). The project „Intelligent Online-Knowledge-Resources for Intentional Learning" focussed on three aspects using concept maps to visualize context and topics: (1) The coordinator Margot Poppenhusen and the local dean Regina Becker-Schmidt of the project area WORK used concept maps to specify and structure the curriculum. (2) Online knowledge resources were organized and made in form of concept maps. Access was also provided in form of concept maps. (3) Lecturers visualized their talks in form of concept maps and presented them on the web. These concept maps guided lectures: they were shown during lectures on touch sensitive screens.

"(d) producing an implementation that allows for local adaptation to instructional practice" (ibid.). Two main virtual projects were developed, prepared and provided. Main focus was to visualize context and structure: (1) The term ‚gender' and the concept of gender studies was presented in the context of division of labour and diverse cultural realities. (2) The effect of information technology and its impact on women's work was presented against the background of basic shifts and fundamental transformation of work and work context. Online resources for these projects were organized as concept maps. We helped lecturers as well as students also to organize resources this way. Step by step several projects became available on the web. Students had access to these resources in order to rework lectures and to use resources for their own project work. We offered computer training for the students based on their prior knowledge.

Evaluation

We evaluated the project along the instructional goals. The evaluation is based on qualitative interviews taped on video: The concept maps actually changed the role of teachers and students inside the classroom. Teachers were facilitators, students brought up their own experience. Concept maps supported discussion on structure, terminology, and content. This was seen as relevant in teaching postgraduate students with strong intercultural, educational, and working background. It brought up detailed discussions on interrelationship and interdependence of factors, and on diverse organization of society in different countries and cultures. It made explicit different situational realities and specific problems not experienced in Western countries. Making explicit structure and organization of knowledge enabled students to discuss, define, and mark the differences seen from different perspectives depending on culture and context. It even brought up discussions whether to structure things totally differently: students and lecturers shared different contexts and perspectives. During discussions they restructured subjects collaboratively. In these interviews students pointed out advantage over linear resources.

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Multimedia in Concept Maps: A Design Rationale and Web-Based Application

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Abstract: A concept map is a graphical representation of a person's (student's) knowledge of a domain. Concept maps have been used in educational settings for some time and many computer-based implementations of interactive concept map building tools exist. These concept mapping tools often provide for a solely propositional, primarily textual, knowledge representation scheme and do not fully capitalize on the functionality offered by the computational medium. In this paper, we motivate the enhancement of "traditional" computer-based concept mapping tools with dynamic multimedia—sound, video, and animated images—which offer representational capabilities that are analogous to human knowledge representation mechanisms.

Concept maps

A *concept map*™ is a graphical representation of knowledge of a domain. A concept map consists of nodes representing concepts, objects, or actions, connected by directional links defining the relationships between nodes. A node is represented by a simple geometric object, such as an oval, containing a textual concept name. Inter-node relationship links are represented by textually labeled lines with an arrowhead at one or both ends. Together, nodes and links define *propositions*, assertions about the domain. For example, the nodes and link in Figure 1 represent the proposition "horses can gallop" and might be a portion of a concept map about *horses*.

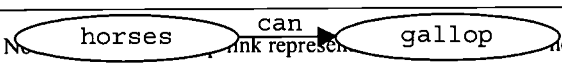


Figure 1. N... nk represen... horses can gallop."

Concept maps have been used in the educational community for decades, in virtually every subject area. In educational settings, concept maps have filled many roles: they allow students to reflect on and demonstrate their knowledge of a domain, may be used for teacher assessment of students' knowledge of a topic covered in class, act as tools to aid study and comprehension of a domain or story, support idea generation and organization in preparation for prose composition, and are used as instructional materials for learning new concepts and their interrelationships.

This paper offers psychological and pedagogical design rationales for the inclusion of multimedia in computer-based concept maps. It also describes a concept mapping application named Webster[1] whose goals include more comprehensively representing students' knowledge of a domain, providing facilities that make concept maps more pedagogically effective for students using them to learn new concepts, and in doing both, capitalizing more fully on the capabilities of the computational medium. There are a number of characteristics of Webster that attempt to achieve these desiderata but in this paper we focus in particular on Webster's use of multimedia to realize these goals.

Why Multimedia Concept Maps?

The purpose of concept maps is to visually represent knowledge of a subject or domain. Indeed, Jonassen (1992) claims that concept maps are accurate reflections of their authors' cognitive structures. But this argument is based on concept maps that portray text-based propositions only. Jonassen goes on to pose the question "What constraints does the software impose on the product?" (p. 20). Older concept map tools are indeed very good at representing text-based propositional statements—wherein concepts are described by verbal means alone—but not necessarily other forms of knowledge. However, if concept maps are to be used to externally represent one's (internal) knowledge, they should allow for nodes to be something other than of a verbal or textual nature. "It is important to note that not all nodes in a semantic memory system have names corresponding to words in natural language" (Rumelhart & Norman, 1985, p. 24). This notion is further supported by numerous researchers who have offered evidence or arguments for the notion that one's knowledge contains more than simply verbal propositional knowledge. Kosslyn (1980), for example, proposes a cognitive model that represents information about objects with both propositional properties and images. Johnson-Laird (1983) similarly asserts that mental models of a domain include both propositions and imagery. Baddeley adds there is "abundant evidence for separate visual and verbal coding" (1985, p. 212). Shephard (1967) has, furthermore, provided evidence that memory for visual imagery is more robust than that for purely textual information. And Paivio (1986) asserts information encoded *both* visually and verbally is more memorable. So, to begin with, we see a need for image-based nodes in concept maps if we wish to more comprehensively represent one's knowledge of a domain or use maps to convey information new to learners.

Intuitively, in addition to static imagery, *temporally dynamic* visual and auditory memories are also part of one's knowledge of an object or domain. Here we're speaking of images in motion and sounds, both of which occur over time. Indeed, this notion has been acknowledged by cognitive science researchers and others. Johnson-Laird (1983) asserts that some mental representations are of temporally dynamic nature. Numerous studies involving music cognition provide strong empirical evidence for long-term auditory memory (see, e.g., Dowling & Harwood, 1986). Even popular culture reflects these notions; for example, as Lennon and McCartney wrote and the Beatles sang, "Penny Lane is in my ears and in my eyes," highlighting the reality that recollections involve long-term auditory and dynamic visual memories. Hence, one's knowledge of horses might include not only what a horse looks like, but what a horse looks like when galloping and when trotting, the image of a jumping horse gliding over an obstacle, the sight and thundering sound of a group of wild horses stampeding across a sandy plain, the moving images of a wild bronco bucking in its attempt to throw a rodeo cowboy off its back, the sound of a horse "neighing." Certainly these are parts of our long-term memories for horses, and we ought to be able to represent these memories in concept maps to demonstrate our own knowledge or to use concept maps as instructional resources.

Imagery in general also offers the important capability of reifying concepts described by text. The ability to represent concrete instances and link them to text-based concepts supports the learning and memorability of those concepts. For example, Moore and Skinner (1985) demonstrated that abstract textual information is better understood and learned when presented along with reifying illustrations. The ability to portray concrete instances of concepts adds significantly to the representational and instructional potential of maps. The ability to use *dynamic* imagery and audio significantly enhances this representational capability. For example, here is a definition of the trotting gait of a horse: "In this most diagonal gait, the diagonal hooves lift off from and hit the ground at the same moment. [Right hind, left front, alternate with left hind, right front.] To see this, focus on a front foot, then include the diagonal hind in your field of vision. You can clearly see them lift off and hit together, in a hard trot. The sound will be a 1-2 beat" (Ziegler, 1988). Compare a concept map that represents these ideas via text-only nodes to another map that accompanies this information with a slow-motion video of a horse actually trotting. Clearly, the latter not only makes the conceptual information concrete but also provides an additional dimension to the map, namely sense-based information the text alone cannot.

The incorporation of temporally dynamic visual and aural elements in a concept map knowledge representation tool enhances its "flexibility of expressiveness" (Heeren & Kommers, 1992). More semantic and aesthetic options are open for the user to decide upon. This may help to accommodate individual differences, that is, to better support students with different expressive or learning preferences or needs when using concept maps to demonstrate their own knowledge or acquire new knowledge. And, clearly, temporally dynamic content in concept maps will better support those using maps for learning new domains and concepts because these users will be presented with: what objects look like when in motion, what they sound like, how things move or sound in particular contexts or situations, instructional visualizations of how to perform procedural tasks, videos showing dynamic interactions between objects or people.

Lastly, the use of multimedia in an interactive concept map builder and viewer may provide for a more engaging user experience. Of course, engaged and motivated learners are a desirable effect of any educational environment or tool (Vroom, 1994).

If we are using the computer to represent students' knowledge, we should more fully benefit from what the computational medium offers over more static media, such as pencil and paper. This includes the ability to incorporate dynamic content in concept maps, thereby more comprehensively representing the knowledge a person possesses. If we are asking students to represent their knowledge, we need to be cognizant of the fact that some aspects of a student's mental model may be expressible only through visual or auditory media. And for students using concept maps to learn about new concepts, the enhancement of those maps with dynamic media has the potential to improve the maps' pedagogical effectiveness. Of course, one's knowledge of a domain may also contain tactile, olfactory, or taste memories. However, standard PCs are not currently capable of representing and "playing back" such sensory information, notwithstanding ongoing research in these areas. But they *are* capable of manipulating video, audio, and animation.

To recap, concept map tools should be able to represent multiple types or forms of knowledge, not merely text-based propositions. Specifically, incorporating multimedia in concept mapping software should (a) provide for greater cognitive fidelity in student-constructed concept maps, allowing students to more comprehensively represent their knowledge in ways similar to their own cognitive representations; (b) offer the illustrative advantages of dynamic visual imagery and audio to students learning new concepts and domains; (c) provide the capability of reifying concepts with concrete instances that can be seen and heard; (d) offer richer expressive power for concept map authors; (e) provide for a more engaging student experience; and (f) better capitalize on functionality available in modern personal computers.

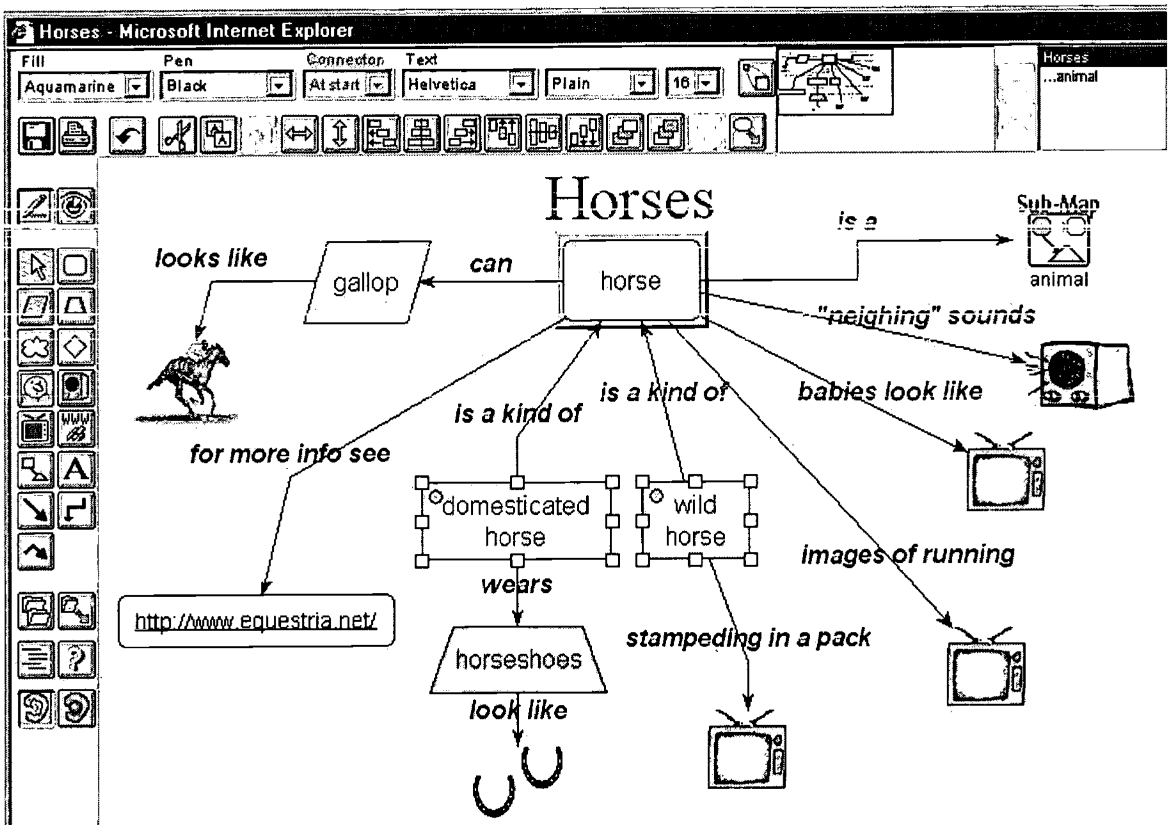


Figure 2. A Webster concept map, in a Web browser window, with a static image (the horseshoes), an animated image node (the galloping horse), an audio element (represented by the radio node), three video nodes (the television nodes), and a hyperlink to an external Web site (equestria.net).

Multimedia in Webster

On the basis of the preceding cognitive and pedagogical design rationale, Webster allows for the representation of dynamic media components as integral constructs of concept maps. That is, Webster provides tools for the facile incorporation of animated images, video, and audio in concept maps. In Webster, multimedia elements are first-class elements of concept maps with the same status and ease-of-use as textual concept nodes.

Figure 2 shows Webster running in a Web browser. Webster is implemented in Java™ and thereby runs as an applet in standard Web navigators, providing student access from anywhere they have access to the Internet. Along the left side of Webster's user interface are tools for creating elements that may reside in a Webster concept map: concept nodes (of various shapes; the user may assign different semantics to different shapes as appropriate for each map), relationship links, image, audio, and video nodes, and other types of map elements. At the top of this toolkit are two mutually exclusive toggle buttons ("iconic radio buttons") that determine whether the user is in *author mode* (the pencil icon) or *viewer mode* (the eye). A user can create or modify maps while in author mode; in viewer mode, the map's knowledge elements may not be edited and it is in this mode that multimedia elements may be viewed. When a teacher reviews a student's concept map, he or she has access to viewer mode only for that map.

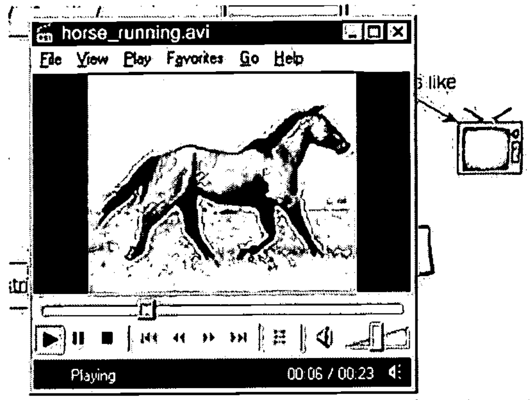


Figure 3. When a user clicks on a television node while in *viewer mode*, Webster directs its Web browser to download and play the node's associated video file. Radio/audio nodes are handled in the same fashion.

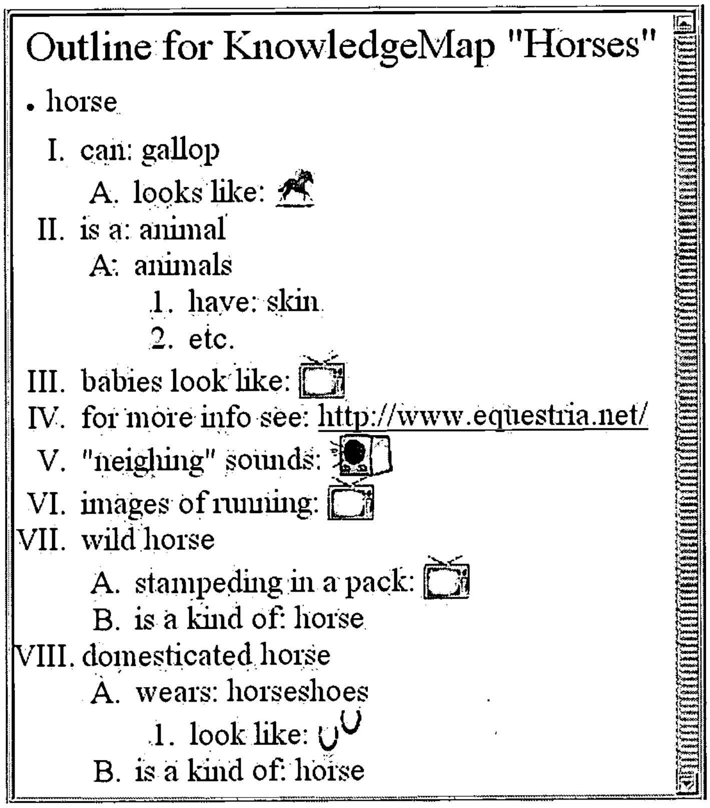
Continuing with our example domain, suppose a student is building a concept map to demonstrate her knowledge of horses. In addition to propositional assertions such as "a horse is an animal," "a horse can gallop," and "domesticated horses wear horseshoes" the student wishes to represent what a typical horse sounds like, what it looks like when galloping, and so on. She therefore requires the ability to incorporate visual imagery and audio in her map. To incorporate sound, she includes an audio node in the map; similarly for video and image data and their respective nodes. To add an audio node to a concept map in Webster, the user clicks on the "radio" tool button in the toolkit on the left and drops a radio (that is, audio) element onto the map. This is the same process used to add textual concept nodes (and other node types) to a map; multimedia nodes are not handled in any sort of special case fashion. Webster responds to the addition of the new audio node by popping up a list of available audio files (only audio files are shown for a radio node), allowing the user to select one to associate with the node. Image and video nodes are handled in the identical manner using the "portrait" tool and "television" tools, respectively. The multimedia file associated with an existing media node may be modified by double-clicking on the particular video, audio, or image node; Webster again displays a list of files of the appropriate media type for the user to select from. This is another example of how multimedia knowledge elements do not involve special case handling; double-clicking to edit a node's content is precisely how textual concept and Web-link nodes are modified.

To listen to an audio, the user (say, a teacher viewing a completed concept map) simply clicks on a radio node in the map (while in *viewer mode*). In response, Webster plays the associated audio file. Video playback is similarly invoked via TV nodes in a map (see Figure 3).

With regard to images, there are other concept map tools that allow the use of static images as nodes in a map (see Related Work). Webster goes a step further in that image-based nodes in a concept map may be animated-GIF images. Thus we may have animations directly within a concept map. For example, the animated horse image in Figure 2 appears to be galloping within the map. Image nodes may be sized (stretched) directly within the map by the map author to show or hide details or otherwise accommodate aesthetic and spatial considerations. If a user wishes to view an image in its originally-created size, she may click on the image node (while in *viewer mode*) and the full-sized image is displayed in the browser frame that exists below the Webster applet (not shown in Figure 2).

Webster also automates the conversion of concept maps to a different representation form, namely outlines. A common activity associated with concept map usage in the classroom is generating and organizing ideas in preparation for writing a report, composition, story, or, a more modern form of "composition," a Web page. Of course, a common representation for idea organization is an outline. Further, alternative representations support developing deeper understanding of a domain. Hence, as in the Inspiration® concept mapping product (more on Inspiration below), Webster can translate a map into an outline containing the map's semantic content.

In Webster, multimedia concept maps become multimedia outlines. The same static and animated images, videos, and audios that are part of a concept map appear in the associated outline representation, as shown in Figure 4. Webster converts maps into outlines as HTML documents that appear in a separate Web browser window. As in the concept map itself, the HTML generated by Webster embeds radio images for audio nodes and a TV for each video. Outlines incorporate the text labels that appear on relationship links in the map, so an outline item (a single line in the outline) might appear with the text "looks like:" followed by a TV image. In the HTML document, the radio and TV images are coded as hyperlinks that reference specific audio or video files. Hence, users simply click on embedded radio and television images to "play" them. With regard to static and animated images, they are handled much as they are in concept maps: images are embedded and visible directly within outline items, so, for example, once again the horse seems to be galloping within the outline. All images are displayed in the outline with the same default thumbnail dimensions. These thumbnail images are also encoded in the HTML as hyperlinks to the full-size image file, so to view the image in its original size, a user simply clicks on the thumbnail in the outline.



Outline for KnowledgeMap "Horses"

- horse
  - I. can: gallop
    - A. looks like:
  - II. is a: animal
    - A: animals
      - 1. have: skin
      - 2. etc.
  - III. babies look like:
  - IV. for more info see: http://www.equestria.net/
  - V. "neighing" sounds:
  - VI. images of running:
  - VII. wild horse
    - A. stampeding in a pack:
    - B. is a kind of: horse
  - VIII. domesticated horse
    - A. wears: horseshoes
      - 1. look like:
    - B. is a kind of: horse

Figure 4. The concept map shown in Figure 2 translated to a multimedia outline displayed as a Web/HTML page. The animated horse appears to be galloping, the radio and TV images are hyperlinks to audio and video files.

Related Work

There are many existing computer-based concept map tools, far too many for exhaustive description here. But, some bear mention. With regard to images, Inspiration and Axon®, two commercial concept mapping products, and SemNet™, a shareware tool (Fisher, 1992), do allow the use of *static* images as nodes in a map. Another mapping tool permits the *association* of static imagery *with* a concept node: Learning Tool™ (Kozma, 1992) has the provision for a "notecard" to be associated with each concept node, and this notecard may contain text and images. These tools certainly offer a step in the right direction beyond text-only representations. But we should be able to incorporate temporally dynamic content in concept maps as well. Further, there are significant differences in the outlines generated by Inspiration and Webster (we'll focus only on the multimedia aspect). Even though Inspiration incorporates only static image and textual nodes in concept maps, the images are absent in its outline translation of a map, whereas Webster's outlines incorporate all the media elements that appear in the corresponding concept map. None of these mapping tools is accessible from a Web browser.

HandLeR is a handheld computer running proprietary software which includes a conceptual mapping tool that incorporates multimedia elements (Sharples, 2000a). In HandLeR's "topic map" tool, topic nodes may reference the same types of media files as supported in Webster (Sharples, 2000b). There are a number of differences between HandLeR's map tool and Webster. Topic nodes in HandLeR are all identical ovals (with embedded text), connected by unlabeled links. Hence, static and animated images are not visible within the map itself. The further implication is that nodes are not "typed"—this is, different node types are not visually distinguished—whereas in Webster concept maps, nodes provide visual cues regarding their content, including the clear indication of the existence of media nodes (video nodes appear as "televisions" and audio nodes as "radios"). We refer to this as *visually typing*, that is, making each node's content type evident by its appearance. Unlike HandLeR, Webster provides an alternative outline representation that incorporates multimedia as well. Lastly, Webster is Web-enabled, providing broader student access to the tool in terms of location and time as well as eliminating the logistical problems of distributing software to individuals, while HandLeR operates on a standalone basis.

In the IHMC CMap toolkit (IHMC, 2000) users may associate *resources* with a concept node. Resources may include images, sounds, or video files. Again, images do not appear directly within the visible concept map per se—users must follow a hyperlink to view an image, and this tool does not incorporate outline translations (multimedia-based or not) of concept maps. There are no labeled relationship links between verbal concepts and media nodes; media resources are, in a sense, part of the concept nodes. We feel that labeled links showing the relationships between media nodes and other nodes represent additional knowledge thereby enhancing the semantics of a map. (Link labels *can* be omitted in Webster if desired; making labels optional and the possible enhanced semantics when links *are* included increase Webster's flexibility of expressiveness for knowledge representation—more options and decisions are left to the user's preferences and representational requirements.) Indeed, based on studies with learning disabled students, Griffin, Simmons, and Kameenui (1992) strongly recommend that concept maps and other graphical organizers explicitly depict (i.e., label) the relationships among conceptual elements to better support the learning and memorability of the represented domain. Further, Webster attempts to make the representation of knowledge elements straightforward and simple, both conceptually and in terms of user interaction, in part by treating different types of knowledge elements in a uniform fashion. Multimedia knowledge is represented as distinct nodes which are manipulated in the same manner as are other nodes in a map. Plus, in our design rationale we stated that there are apparently distinct cognitive systems for the representation of verbal and imaginal elements; if we wish to reflect one's knowledge in a concept map, it seems to follow that knowledge elements of these types be represented by distinct nodes rather than bundled into a single node.

Conclusion

A concept map is a tool for representing knowledge. In asking students to construct concept maps, we are asking them to demonstrate and communicate to others their knowledge of a domain. We ought not limit those students by restricting the types of knowledge they can they can represent. Webster offers greater expressiveness and broader representation capabilities by incorporating multimedia elements in concept maps, thereby attempting to offer a closer match to cognitive knowledge representations. The incorporation of dynamic media also provides concomitant benefits to students using pre-constructed concept maps as tools for new concept learning, because they are exposed to a broader range of knowledge media. Lastly, a concept mapping tool should be able to translate maps into alternative representations, such as outlines which many students find useful or necessary for composing narratives. Webster outlines contain all of a map's content including its multimedia knowledge elements.

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Acknowledgments. Webster's implementation began with *JHotDraw*, a set of Java classes comprising a graphical editor framework. Thanks to Erich Gamma for the JHotDraw source. Thanks to Dick Lam, Lei Kuang, and Cyndi Conway for helping integrate the Webster applet into the *Wired for Learning* community-based educational environment. Thanks to Dick Lam, Peter Fairweather, and Mike Sharples and his students for suggestions regarding Webster. The term *Concept Map* is a pending trademark applied for by Joseph D. Novak. Inspiration® is a registered trademark of Inspiration Software, Inc., www.inspiration.com. Axon®, registered trademark Axon Research, web.singnet.com.sg/~axon2000/index.htm. SemNet™, trademark SemNet Research Group, see www.biologylessons.sdsu.edu/about/aboutsemnet.html. Java™, trademark Sun Microsystems, Inc. "Penny Lane" by John Lennon and Paul McCartney – ©1967 Northern Songs Limited.

Web-Based Notes is an Inadequate Learning Resource

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Abstract: Development of on-line courses requires the use of appropriate educational philosophies that discourage rote learning and passive transfer of information from teacher to learner. This paper reports on the development, use and evaluation of two, second year, Biology on-line software packages used by students in constructivist environments. The courses on carbohydrate and lipid metabolism were developed in conjunction with subject experts but were designed from different perspectives. The carbohydrate metabolism course provided diverse views of a single knowledge domain and included the ability to find information in different ways. The lipid metabolism course was designed as a 'notes-on-the-Web' module. Evaluations were conducted via paper- and electronic-based software evaluation; student interviews; and analyses of student performance (pre- and post-testing; examination results). Results showed that students enjoyed using the software, found the constructivist learning environments challenging, valued the permanent availability of on-line information, found the user interface of the software products easy to use and navigate. Analyses of examination results showed that students performed better than in the previous year (traditional lectures). Results for the carbohydrate course were superior to those of the other course. It appears that interactive components that foster constructivist-based learning skills are more important in on-line learning environments than presentation of information.

Introduction

Attempts in the 1980s to bring technology into the classroom involved the creation of computer literacy classes at secondary school levels (Moersch, 1995) where students learned about computer architecture, operating procedures, basic software applications and introductory programming. Technology carries an expectation that it will transform many aspects of learning including the content and body of knowledge taught, delivery, and the types of facilities required to support delivery (Kook, 1997). Learning environments are becoming more creative and diverse with educational institutions becoming, not only information centres for specific content, but also arenas for technology development and innovation (Kook, 1997). However, technology is not a process, mindset, or a global solution, but is merely a tool. With the onset of the 21st century, it is undeniable that the computer, as a tool, has made by far the biggest impact on human endeavour. "Technology, be it a writing system, a media system, or a computer system, has been proven to be an effective tool to realize the interrelated goals of learning, teaching and cognitive growth" (Chen, 1993). Moersch (1995) stated that computers are used as tools that support and extend student understanding of concepts, processes and themes. In addition to its inherent use as communication tools, technology can also play a direct role in educational activities. Richards *et al.* (1997) argued that the use of technology is two-fold: it accelerates skill and knowledge acquisition and enhances teacher and student abilities. McDonald and Ingvarson (1997) argued that computer applications free students from laborious tasks of rewriting and copying notes. Dorfler (1991), on the other hand, stated that cognitive software tools amplify human ability as "information re-organizational devices" that extend activity and reflection to a higher meta-level.

While the use of computer technology could provide an increasing student population with adequate resources, the focus should still lie with educational issues (Hämäläinen *et al.*, 1996) and user needs (Brown, 1995). Collis (1997) stressed that technology should be used as a tool to make concrete an educational philosophy and Greening (1998) argued that theory should drive the application of technology within educational contexts rather than technology itself. Reeves and Hedberg (1998) defined constructivism as "...the process of how we construct meaning and knowledge in the world..", "..based on our previous experiences and how we organize those experiences into knowledge structures such as schema and mental modes, and the beliefs that we use to interpret the objects and events we encounter in the world". Constructivism is context dependent rather than content dependent (Greening, 1998) and focuses not on the content or its objectives, but on the diverseness and richness of the learning environment and the skills and competencies in learning that may not be directly monitored via behaviouristic assessment methods (Reeves, 1992). Today, most commercial educational software takes little notice of educational models other than instruction. This presents educational developers with two possible options of technology use where either (a) technology is supplemental and rests on existing structures (enrichment) or and (b) it is mandatory and changes the course structure completely (re-engineering) (Collis, 1997).

This project was based on the concept that integration of software into learning environments will only improve learning when courses are re-engineered to support constructivist-learning models and include tools to find, explore and organise information. In other words, the power of technology lies not in the presentation of information, but rather in the ability of learners to navigate information in different ways to enable their own cognitive development.

Materials and Methods

Course Design and Development: Two second-year biochemical courses were converted into resource-based on-line educational material. The original instructivist courses included notes, diagrams and overhead slides developed by the subject experts, based in part on the prescribed textbooks. The re-engineering of these courses included the development of a workbook that posed a number of problems, or exercises, supported by on-line resources. The first course, carbohydrate metabolism, consisted of a number of pathways and reactions, and requires an in depth understanding of compounds involved (their relationships), as well as control and regulation systems of the metabolic pathways. Software developed for this course was based on the idea that multiple representation of a single knowledge domain would enhance the learning process. Analysis of the lecture course identified a number of content building blocks (molecules, reactions, biochemical terminology, processes and actual pathways). These knowledge units were individually constructed using Macromedia Flash 2.0 (figures and charts) and were stored, with relationship information, in a Microsoft Access database. These building blocks, accessed in different ways (using hyperlinks or through a built-in search tool) provided the material for students to construct their own representation of the pathways according to problems presented in the workbooks. In addition a glossary of terms was provided. The interface (constructed in HTML using Microsoft FrontPage and Macromedia Flash 2.0), provided students with a series of notes, which, although static in nature, contained links into the database bound knowledge units. Information was also dynamically accessible via the database, where objects (terms, molecules, pathways) could be immediately viewed in separate browser windows. The second course (describing lipid breakdown) was based on a number of essays broken into separate topics that included molecular data. Notes were pre-prepared by the subject expert and converted into HTML (FrontPage 98) and graphics and diagrams (Macromedia Flash 2.0). These resources were grouped into essays, structures, processes, and transport mechanisms on the introductory page. No search or glossary was provided.

Learning Environment: Students worked in groups of three or four at a single computer (Intel Pentium 233MHz, running Microsoft Windows NT, with Internet Explorer 4.0 browsers and Macromedia Flash plug-in installed) using the supplied on-line material and textbooks to answer questions posed in workbooks. Assistants and the subject expert encouraged group communication and collaboration, provided support and guided learners when asked for help.

Evaluation: A number of different instruments were used to evaluate the courses and included: paper- and electronic-based course evaluation; student interviews and analyses of student performance (pre- and post-testing; examination results). Paper based evaluations were conducted to measure student attitudes with respect to enjoyment of and benefit from the course, types of skills learned, as well as the suitability and feasibility of integrating technology into the classroom. Students were asked specific questions pertaining to: content structure; environment and learning activities; software usage; course structure; and skills and competencies. These evaluations were conducted at the end of the courses and were analysed qualitatively using QSR NUDIST (Qualitative Solutions and Research). Students used the on-line Educational Software Evaluation Tool (ESET) to assess the design of the user interface, pedagogy and interactivity of the software. These results were further analysed using the Wilcoxin Signed Ranks tests (SPSS, SPSS Inc). Thirteen students, who volunteered and represented each group, were informally interviewed to probe more deeply student opinions related to the use of on-line courseware and their use of the learning resources. Students answered questions in the following categories: personal use, perspectives of higher education, the learning environment, and learning outcomes and understanding. Interviews were recorded using a tape recorder, transcribed and analysed using QSR NUDIST.

Anonymous pre- and post-tests were constructed by subject experts and took the form of short questions (one word and short paragraphs) that tested the understanding of the course content. These tests were administered prior to, and after, each of the courses. The Mann Whitney tests (SPSS) were used to evaluate these results. Performance data (examination results) was analysed using Wilcoxin Signed Ranks (SPSS) tests to identify significant differences between computer based and non-computer for the current year. A combination of the Mann Whitney and Wilcoxin tests (SPSS) was use to compare results of the two computer based topics with the previous year's results, as well as comparing each of the computer based course performances to the rest of the course.

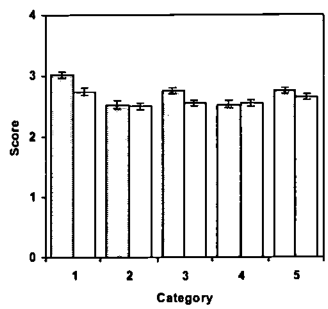

Figure 1. Paper-based student evaluation of the carbohydrate metabolism (n=44) and the lipid metabolism (n=33) courseware. (Bar = SE; Categories: 1. Content structure, 2. Course structure, 3. Software usage, 4. Environment and learning Activities, and 5. Skills and competencies; □ - carbohydrate metabolism, □ - lipid metabolism).

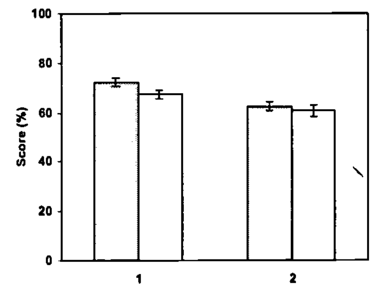

Figure 2. Student evaluation of (1) User Interface and Design and (2) Pedagogy and Interaction using the Education Software Evaluation Tool of the carbohydrate metabolism (□; n=42) and lipid metabolism (□; n=40) courseware (Bar = SE).

Results

Conventional paper based evaluations were conducted to determine student opinion with respect to the learning environment and use of the software. The questionnaire was divided into six categories (content structure; course structure; software usage; environment and learning activities; and skills and competencies) and included statements that students ranked (4-point scale) and short paragraphs answers. Students rated both courses in a similar manner; the content structure higher than any other category; the carbohydrate course content structure higher than that of the lipid metabolism course; and the course structure lower than any other category (Fig. 1). For the carbohydrate course the highest rated statements for each category were: content structure - "It was easy to find relevant information" (3.2); course structure - "I enjoyed working with Internet-based courseware" (3.2); software usage - "I found the glossary very useful" (3.0); environment and learning activities - comfortable working with the material presented" (2.8); and skills and competencies - "I enjoyed using the software" (3.1). Similarly, for the lipid metabolism course the statements ranked highest per category were: content structure – "Development of Internet-based courseware is a good idea" (2.9); course structure printed notes should have been provided" (3.1); software usage "I found the visuals very easy to understand" (2.8); environment and learning activities – "I felt comfortable" (2.8); and skills and competencies – "The course improved my computer skills" (3.1). Statements that scored the lowest included "I would prefer to work on my own" (2.2) for both courses, "I found the relevant information easily" (2.3) for the lipid metabolism course, "I found the time allocated for computer usage adequate" (2.2) both courses and "The course required a lot of problem solving exercises" (2.2) for the lipid metabolism course.

Using ESET students rated the user interface, design, pedagogy and interaction of the carbohydrate metabolism course software higher that the software used in the lipid metabolism course (Fig. 2). For the carbohydrate courseware students rated screen appearance (fonts -78.6%; choice of colours - 82.1%), layout (text flow - 76.2%; consistency - 76.2%), instructions (73.2%); presentation (72%); reading (80.4%); and the search facility (100%) highly. For the lipid metabolism courseware students rated screen fonts (71.9%) and colours (72.5%) high, and screen consistency (66.3%), picture layout (69.4%), intuitive interface (66.3%) and text flow (61.9%) low. Ease of reading was amongst the highest rating components (73.8%) but students found that there were insufficient links (59.4%). A Wilcoxin signed ranks test indicated that the User Interface section and Pedagogy and Interaction for carbohydrate metabolism software was rated significantly better than the lipid metabolism package (asymptote significance < 0.005, z = -3.845a and asymptote significance = 0.006, z = -2.726a respectively).

Students were interviewed to further probe their opinions regarding the two courses. Eight students (62%) said that they have used computers before (between one and two years) and five said that they had not previously used computers. Four of the students reported that they had access to computers at home. Those that had not used computers before stated that they soon became familiar with the software. When asked if they were aware that the computer-based courseware was part of a research project, nine (69.2%) responded positively and four said no (30.8%). Those who responded positively felt that the initiative was new and exciting, with them being the first to tryout this new form of learning. Students also felt that it was an improvement over conventional lecturing since it made learning easier. A few students thought that the approach was experimental and they had no reference to previous years and that the results of such initiatives are unpredictable since the use of technology is new. Students were asked if the change in learning environment was comfortable to work in. Seven students (53.8%) felt that they were comfortable, while three students (23.1%) maintained that they were not comfortable at first, but got used to the course after a while. Two students responded that they were initially lost and attributed this to their lack of computer knowledge as well as the wealth of information presented. However, they reported that they quickly adjusted to the new teaching method. Most of the student comments centred around interactions in the classroom and listed being able to work individually and at their own pace as an advantage. This was further probed by asking questions related to group work. Positive responses included division of labour (two responses), rich social experience (two responses) and ability to discuss problems with peers, tutors and the subject expert. Students did however maintain that group interactions often broke the flow of concentration, decreased the work rate and this caused them to work individually. Other problems identified were a lack of equal contribution, lack of self-discipline and "discussion led by one person". Despite these problems, seven students indicated that their understanding within the group was greatly improved. The key supporting features included: group explanations and discussion of key concepts (five responses); helping one or more students with problems and misunderstandings (four responses) and development of shared understanding amongst participants (two responses). Students were asked to comment on the difficulty of the content. Eleven students (84.6%) regarded the content as simple and easy to understand, even though it may have been difficult to work with the software at first. Although the software was well received, the lipid metabolism software was found more difficult to use. Students were asked to comment on how they felt using technology compared with previous or conventional modes of learning. This question provided the most insightful and varied responses amongst students. Students described different ways in which the technology affected them and made many references to lectures, which they considered as the conventional mode. Working with software was more fun, challenging, much better than lectures, encouraged learning, was interactive, allowed one to find information quickly and easily, made one more responsible, built confidence, improved understanding and made visualization easier. Students were requested to identify the difference between understanding concepts and memorization of content. They clearly understood that there was a difference between understanding and memorization, and that understanding took place before memorization. Students maintained that they did not remember much of what they learned (five responses), but could understand nearly all of what they covered (eight responses). Students also felt that their initial experience with the software mentally prepared them to study for examinations.

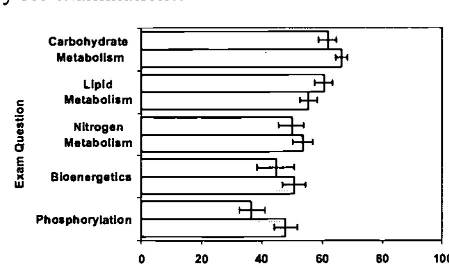

Figure 3. Comparative analysis of average student scores between two consecutive years (□ - 1998, n=39; □ - 1999, n=47; bar = SE).

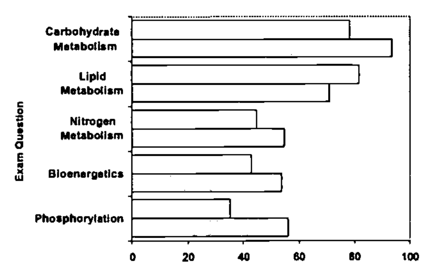

Figure 4. Comparative analysis of student pass rate between two consecutive years (□ - 1998, n=39; □ - 1999, n=47)

Pre- and post-tests were used to determine student understanding of the basic course content before and after using the developed materials. Students received no prior warning before sitting these test and had therefore not prepared themselves for testing. In the carbohydrate metabolism course, students (n=49) scored an average of 15.8 ±1.4% that increased to 34.7±1.4% in the post-test (n=44). Using a 95% confidence level, there was a significant difference between the pre- and post-test (asymptote significance < 0.005, z =-6.841, Mann-Whitney test) indicating that students had gained knowledge during the course. In the lipid metabolism course students (n=39) scored an average of 26.1±1.6% for the pre-test and 34.0±2.2% in the post-test (n=30). The Mann-Whitney test showed a statistical difference between pre- and post test (asymptote significance = 0.009, z=-2.596) indicating that students had gained knowledge during the course.

Examination results from the previous year (all lecture based) were compared (Fig. 3.). There was a 4.8% increase in the current year (66.5%) for the carbohydrate metabolism course and a 5.04% decrease for the lipid metabolism courseware (55.5%). Students appeared to perform similarly in both examinations. However, the pass rate for the carbohydrate metabolism course increased from 78.4% to 93.6% (1999) while that for the other course on lipid decreased from 81.6% to 71.1% (Fig. 4). A comparison (Mann Whitney test) was made between 1998 examination performance and 1999 exam performance using the following sets of scores (1998 carbohydrate and lipid metabolism) - (1998 other courses) versus (1999 carbohydrate and lipid metabolism) - (1998 other courses). Although no significant difference was indicated (asymptote significance = 0.054, z = -19.925), the results can be seen as marginal. The 1999 examination performance results were further analysed using the Wilcoxin Signed Ranks test: the carbohydrate metabolism examination results were significantly better than either the lipid metabolism (asymptote significance = 0.003, z = -2.948) or the traditional lecture-based courses (asymptote significance < 0.005, z = -4.525). No significant difference was found between the lipid metabolism course and the traditional lecture course results (asymptote significance = 0.111, z = -1.594).

Discussion

In order to gain insight into the use of on-line material in constructivist classrooms two second-year biochemical courses were redesigned. The carbohydrate metabolism course on-line resources included multiple views of the knowledge domain, a search tool and glossary. The lipid metabolism course included only text and graphical resources on the Web. Both courses used a constructivist approach where students, working in groups, used the resources to answer problems posed in workbooks. A number of instruments were used to evaluate the courses and included paper and electronic evaluations, interviews and analyses of student performance.

Jarz *et al.* (1997) stated that a user interface has a significant influence on the 'look and feel' of the system and its success and includes "symbols and colours" as basic but important components. Barker (1990) stated that one of the functions of user interfaces is to enable the learner to visualize what is happening within the learning domain with which they are interacting. User interface design should also make full use of technology rather than "transferring paper or previous non-graphic interfaces onto the screen" (Starr, 1997). Results from the paper- and electronic-based evaluations, as well as student interviews, clearly indicated that students found the interfaces easy to use and adapted quickly to the use of the software in the classroom. The carbohydrate courseware was more highly rated than that used in the lipid metabolism course. While the user interface of both on-line resources was rated highly, the lack of search tools, glossary and self-testing components, which could be viewed as cognitive development tools, in the lipid metabolism software resulted in problems in the use of the resources and made it more difficult for students to find relevant information. These results support the arguments that the inclusion of different navigational tools supports different navigation styles (Jonassen and Grabinger, 1990) and learners who are allowed to make choices, answer questions and solve problems, are more motivation and productive (Jih and Reeves, 1992). The inclusion of a wider variety of navigational, visualization and self-assessment tools in the carbohydrate package supports the idea that software that actively engages students in constructive activities biases students towards knowledge transformation activities and away from simple knowledge replication (Ward and Tiessen, 1997).

Gustafson and Branch (1997) argued that the construction of knowledge and skills occur while learners interact with peers, media, content and teachers. Berge (1997) introduced the term "authentic learning activities" that includes inquiry, problem-based activities, case studies, projects, peer critique and support and self-reflection. While some students would have preferred lectures they argued that group work supported the development of understanding and felt that group work encouraged learning.

Reiser and Kegelmann (1994) stated that together with student "attitude data", the pre- and post-test method is a way of improving courseware evaluations. Use of such a method here found that students gained some insight into the concepts of both courses. Evaluation of examination results show that students performed better in the carbohydrate metabolism course compared to the lipid metabolism and traditionally taught courses. While both courses used constructivist principles, performance was only increased in the course that included software that provided learners with a richer set of tools to interrogate information and thereby build knowledge. It is interesting that students would have preferred written notes for the lipid metabolism course as they are familiar and have developed skills in using such media. The carbohydrate metabolism courseware consisted of discrete knowledge units (molecules, terms, pathways) and processes (reactions and control aspects) that fit more easily into a constructivist model. The lipids metabolism courseware was essay-based and textual in nature. The level of interactivity differed significantly between both packages and information was not rigidly structured in the carbohydrate on-line resource. Another important feature that distinguished the packages was the ease of navigation: the carbohydrate metabolism software was much easier to navigate and far more intuitive than the lipid metabolism software. Finally, the carbohydrate metabolism software proved to be more motivating in terms of fun, graphics and student interest. The results presented here clearly show that the use of on-line resources to provide information only provides no benefit to learners while those that are richly textured and include different navigational paths, are built of small interrelated knowledge blocks and include cognitive development tools improve learning. Therefore, computer-learning resources that are just electronic textbooks offer little value in knowledge development.

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The Educational Process in the Emerging Information Society: Conditions for the Reversal of the Linear Model of Education and the Development of an Open Type Hybrid Learning Environment

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Abstract: The introduction of communications and information technologies in the area of education tends to create a totally different environment, which is marked by a change of the teachers' role and a transformation of the basic components that make up the meaning and content of the learning procedure as a whole. We could say that, despite any changes, the training process is subject to a tayloristic linear model of production, which takes the student at childhood and gives him back to society and the dynamics of the market with the hope that he will be able to respond creatively to the constantly increasing demands. As the student moves on the school assembly line, the teachers at the various levels give him the knowledge that has been worked out for each level in a predefined and uniform way. Is the introduction of training technology going to help reverse the closed model of training process, as we have known it up to now, or is it just going to modernize the ways and methods, keeping the main body of the training assembly line unchanged?

1. Introduction

In an era that everything around us is changing at incredibly fast rates, the contemporary human being as well as the social structures that he has built during the ages, are trying to cope with the new demands that are being created. A peculiar technological environment covers the current borders of conventional reality, which seems to retreat scared, yielding more and more vital space to the new information age. Computer systemsare at the peak of technological development, as they constitute the most characteristic advanced party of the new age. From large, hard to use and complicated computing systems, we passed to the era of the personal and easy to use PC which invaded our offices and became an integral part of our daily working life. PCs were equipped with advanced communication capacities and transformed from a medium for facilitating the management function of a business, to a mechanism for interconnecting users with innumerable data and information sources with the help of the Internet. The mass production of PCs at reasonable prices for the average consumer set the basis for the penetration of new technologies into the everyday life of the contemporary human being. Nowadays, the use of a PC not only in the office but also at home is so common, that many people find it hard to distinguish the borders between their business and social life. A lap-top connected to the internet with the help of a mobile telephone can accompany us wherever we go, whatever we do. The basic relationship between the human being and information is reversed (Anastasiades,2000). The information nowadays travels through networks towards people who are looking for it from a fixed geographical point via their personal computer. The same applies to merchandise, to consumer goods, to studies, training, work and even entertainment. Electronic networks will partly replace transport by land, air and sea and will further develop into information highways reaching every household. The Information Society does not lie in the distant future, we already live in and experience it through a many of its applications. The education sector is one of the Information Society's main priority, one of the most important pillars of the new digital age (COM (96), 471 final). The Information Society is based on the informed citizen, on the person who knows the advantages and the challenges of the new era, as well as the ways with which he will seize the opportunities which will be presented to him. The Information Society is based on the aware citizen, on the human being who will be aware of the negative consequences of the advent of the new electronic reality and who will seek ways to avoid or to reduce the possible consequences. The Information Society needs all the citizens without exceptions and exclusions, as it concerns all of us, and affects all sectors of human activity (COM (95), 590 final). The velocity with which new applications are transferred from a company's laboratory to our everyday life is incredible. The downgrading of the basic cognitive competencies of modern human beings, is taking place in a much shorter period of time than in the past, and as a result nowadays entire age groups are threatened by labour extinction if they do not adjust to the new circumstances within the shortest possible period of time. The demand for continuous adjustment to what is "new", is pushing an entire era to its limits, an era that tries with dismay to synchronize itself with the dictates of an entirely different reality. The educational process is presented as the most important tool in the context of transformation towards the Information Society, as its role is to ensure for the citizen all the necessary means in order to manage in a completely different environment, a characteristic feature of which is the continuous effort for creative integration in a rapidly changing world.

2. Characteristics of the conventional – linear model of education

In the existing educational model we can readily locate certain characteristics, which, regardless of the changes and modifications that were occasionally made, remained unchanged and were correctly labeled as the components of the traditional educational system. The first basic characteristic has to do with the role of the teacher, who for years used to be practically the only source of knowledge in the classrooms. The second component has to do with the role of the student, who, within the conventional model, was restricted to a more passive role (lessons attendance, study, taking exams etc.) The training tools (books, notes etc.) that for years formed the two poles of education remained unchanged as to their basic characteristics. One could say that the training process, the way it was established during the years, might be associated with the production line of a commercial product as part of the industrial model of evolution (More Ch., 1997). On the production assembly line we have the subject of the training procedure (the students) going through its pedagogical shaping and knowledge enrichment by the trainers, who play the role of the traditional industrial worker. Utilizing their knowledge and skills in due time and in a predetermined way depending on the production stages, they contribute to the production and development of a learning and pedagogical standard, which has been found to carry the basic characteristics imposed by the market or society demands in different time periods. The introduction of the new technologies of communications and information in the learning areas is a necessary factor for the modernization of the whole system. The question is whether the new training technologies will modify the linear model of education, as we described it above, or just contribute to the modernization of its components, leaving its hard core intact. The development of an open learning environment which will go beyond the linear model of education that was established in the industrial age should not be just a theoretical starting point but also a delimited starting point of efforts carefully planned.

3. The new hybrid type learning environment

3.1 The introduction of information and communication technologies into education sector

The introduction of information and communication technologies into education significantly changes its structure and operation as it has been until now. The basic relationship between educator – learner is reversed as through electronic networks the educational process is transferred to the learner's private space, no matter how many kilometres separate his/her from the educator (DeLoach, 1995). The rapid development of new technological communication and information technology applications (teleconferencing, electronic file transfers, etc.), the electronic interconnection of learning units and the penetration of educational multimedia into the basic body of the learning procedure, establishing is distance learning as the indisputable pioneer of major and radical changes in the wider educational environment (COM (91), 388 final). Through teleconferencing (Retalis, Papaspyrou, Markakis, Skordalakis, 1998) learners can attend organized units of classes and lectures from anywhere they choose and are able to intervene, to ask questions, to exchange notes, reading lists, etc. With a PC and the necessary multimedia applications, a learner can participate in the educational process, acquire knowledge in which he is interested, evaluate his learning ability or even be evaluated from the distance learning centre which will be able to certify his/her knowledge. This living form of the educational process in combination with educational multimedia applications through electronic networks, are literally changing the educational map by offering immeasurable possibilities, which until now were to be found in the realm of desire if not that of fantasy (Rowntree, 1994).

3.2 The meaning and content of the hybrid learning environment

A hybrid learning environment is one in the context of which we try to combine in the best possible way new technological applications – that set the educational process free from its constraints in time and space – and the respective pedagogical references to the basis of the traditional educational procedure school of thought (Anastasiades, 2000).

By the term traditional approach we refer mainly to three points of view.

- The relationship between the educator and the learner is unique and cannot be repeated,
- The educational area is an area for socialization, for promoting collective forms of organisation, an area of competition and noble emulation, an area where human and social bonds develop.
- In the centre of the educational procedure lies the human being and the major universal values.

Aided by the basic information society services, digitised information can be transmitted to the end user via his computer screen thanks to rapid developments in telecommunications and networks.

The integration of all network applications and the basic services in the context of the international Internet makes it the integrated platform for implementing the new educational hybrid environment (Washington DC, 2000).

3.3 The components of the new hybrid environment – The example of a university

The basic characteristics of the new educational environment are the following:

A. Open and distance learning :Conventional educational programmes demanded that learners be present at the place of learning, a fact which used to make it hard for some categories of people to have access to sources of knowledge. The introduction of information and communication technologies in the education sector has significantly changed both the structure of education and the way in which it has worked up to now (Holmberg 1986). Through a networked computer and the necessary hypermedia applications, the learner can participate in the educational process, acquiring the necessary knowledge, evaluating his learning ability while he can also be evaluated from the distance learning centre which will be able to certify his/her knowledge. The application of intelligent teaching systems with the use of advanced tools -Intelligent Agents- (Tecuci, 1998) which recognise some peculiarities and difficulties of the learners and which guide the learner accordingly, create a peculiar personal communication relation between the learner and the teaching system. Through teleconferencing learners around the world can attend a series of classes and lectures at American or European universities without going anywhere and are able to intervene, to ask questions, to exchange notes, reading lists, etc. Distance learning modifies the vital relationship between educator - learner, as it creates a virtual learning environment, in which the educator's role seems to be degraded as he/she does not retain the predominant role that he/she had in the conventional educational context.

B.Electronic interconnection between places of learning and universities: Until now Universities all over the world were independent units of educational and research efforts which communicated among themselves depending on the relationships developed between their members. The electronic interconnection of universities will contribute to the creation of a virtual area of collaboration and of development of the relations between the members of the university community as well as between learners from all parts of the world, encouraging mobility among academics, the joint development of numbers of research tasks, and the widest possible exchange of views and ideas and subjects of common interest. The failure to widely disseminate findings to other institutions inside or outside of the countries of origin makes inter-scientific cooperation more difficult while also contributing to the waste of human resources and intellectual effort expended by Universities. The creation of a network for Universities and research centres allowing access to their research, scientific announcements and in particular their libraries is considered an immediate priority. In this way directly interest parties can gain access to research in the fields of their choice, come into contact with other researchers and scientists exchanging view and promoting their subjects by encouraging collaboration or other forms of cooperation.

C. The meaning of lifelong learning: The rapid introduction of new technologies in the wider working and social environment, downgrades existing knowledge with incredible velocity resulting in the urgent need for the continuous improvement and upgrading of qualifications so that holders of qualifications can respond to new realities. Life long learning is one of the most important priorities of the new approach to education and implies the need for an ongoing dynamic adjustment of learning skills, and of changes occurring in the labour and social environment. This fact gives the learning process a permanent character since it is something which accompanies people throughout their whole professional and social life.

4. Speculation – Requirements for the development of an open learning environment

The introduction of new educational technologies really defines the conditions for the creation of a new learning environment. It would be wrong to say that the use of new technologies would be sufficient in itself to form an open environment of education, thus reversing the linear traditional model.

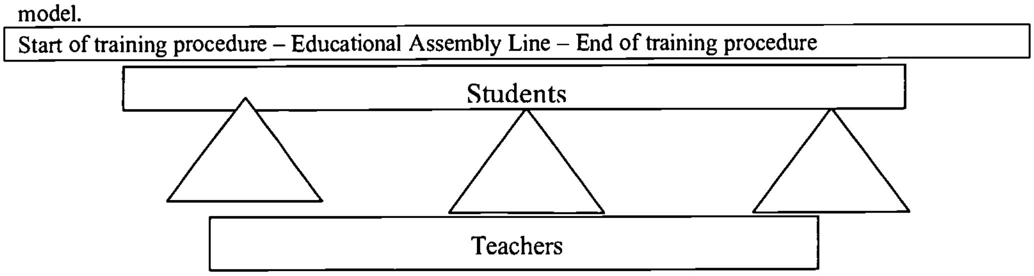

Figure 1: Illustration of the conventional linear model of education.

At this point, it would be useful to describe the most important facts which, combined with the introduction of the training technologies, form the concept of the open learning environment. The first basic characteristic concerns the evolvement of the teacher's role, in the sense that he should now reconcile to the idea that he will lose the uniqueness of his role, since from an absolute authority of knowledge will evolve into a coordinator of many different sources of knowledge and the respective training tools. At the same time, he needs to get familiar with the idea that many times he will leave his traditional place (outside the assembly line) and will move through the new roles that will be developed either inside or outside the conventional imaginary production line of his educational work. The second basic characteristic of the new model will be about the student, since he will now leave the passive position he was in on a permanent basis inside the training assembly line, and will alternatively take the role of an active factor of the training procedure. This can be achieved through the assignment and presentation of projects, the development of learning activities by the students and the connection of the training procedure with the social and production evolution as an integral part of the training procedure in its new form. The third basic characteristic is about increasing the efficiency of the learning tools that are now available for both the trainers and the trainees. The development of internet sites for the courses, the use of modern training material through the utilization of multimedia, the accessibility to countless sources of data, the use of synchronous and asynchronous communication between students and between teachers create in fact a different environment of incredible potential and alternate learning approaches, mainly at the level of the training methods that can now be used. Finally, the introduction of the philosophy of the longlife training in the learning process also releases it from its temporal limitations, since education, in various forms and aspects, will be with us throughout our professional life. We could say that, under the above conditions, the training procedure in the new hybrid environment is changing its structural parts and particularly:

a)The relation between teacher and student, by establishing the principle of changing roles, either in the conventional classroom or the virtual one or its hybrid form. b)The relation of the teachers with teaching itself, since from a unique source of knowledge they evolve into coordinators of numerous sources of information, changing the learning objective from accessing information to the handling and processing of timely and reliable flow of information. c)The relation of the students with the new environment, where the two factors equation of course attendance – examinations is replaced by the three factors equation of active participation in the training procedure, creation of a personal hybrid learning area, multiple and two-way approaches of evaluation. d) The time frame of the training process, which quits the rationale of starting and ending and enters into the lifetime education.

All the above form the concept of the new hybrid type open educational environment, where the learning procedure is released from its traditional limitations in regards to time, space and methodology, allowing the formation of a new consideration, which on one hand will help abolish the linear model of education, and on the other hand will lay the foundation for new types of methodological approaches in the area of education.

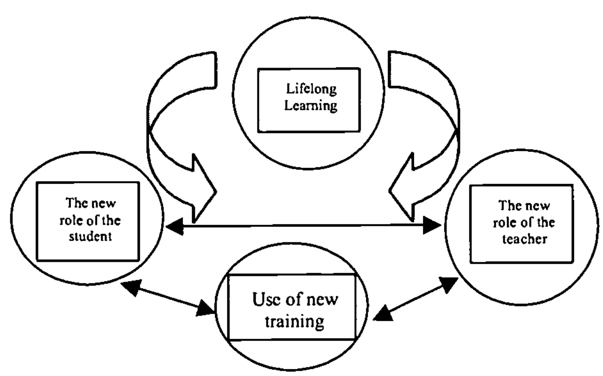

Figure 2: The components of the new hybrid type open learning environment

5. Conclusions

In the context of the emerging Information Society the use of basic teleconferencing, email and electronic file transfer systems in combination with the optimum use of the world wide web are changing the educational landscape as we know it today. The basic characteristics of the new educational environment focus on the process of open, distance learning via electronic connections to universities and on life long learning. The hybrid learning environment is a conceptual and functional integration of traditional educational methods and new modern approaches. Nevertheless, the introduction of new educational technologies and the new hybrid learning environment in particular does not constitute in itself a sufficient and necessary condition to reverse the linear traditional model. The creation of an open learning environment requires the evolvement of the teacher's and the student's roles, as well as the optimum use of the training tools in the direction of changing the learning approaches and training methods, and finally the familiarization of all those involved with the fact that the training procedure will be with us throughout our professional life.

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Secure & Credible E-Learning systems

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Abstract: E-learning is a rapidly growing concept and activity that sprung up due to advances in media technology. We are concerned with the security and credibility of evaluation and assessment in e-learning. The aim is to discuss the essential aspects of assessment, that need to be addressed in a security model and policy for credible e-learning.

The case for and the concerns about E-learning

In 1990, there were 48 million people studying in institutions of higher education, according to a report by Merrill Lynch. By 2025, there will be 160 million people who want to study in universities. (Kelly, 2001). It is inconceivable that traditional systems will be able to meet these needs. Distance education will be required to satisfy this demand. Distance learning in the form of studying by correspondence has been around for a long time. But rapid advances in networked communication and the ease with which "hypertext" media can be created are revolutionizing distance-learning programs, and such programs are becoming a normal part of the education practices of many universities (Schar & Krueger, 2000).

There are still significant problems to be overcome, however. Some are technical. For example, the quality and speed of video transmission over the Internet is still inadequate. More serious are cultural issues related to teaching and learning. The Open University of the United Kingdom (OU) has found that its distance-learning students hunger for face-to-face tutorials (Technology Strategy for Academic Advantage, 1998). The challenge of achieving social involvement among students (virtual and real) and between students and teachers in the distance-education context will be the focus of research for many years to come (Schar and Krueger, 2000).

Perhaps the biggest challenge to the success of distance education is establishing that distance learning is a credible alternative to more traditional, classroom-based approaches. Academics are divided about the merit and reliability of e-learning. Some are enthusiastic and supportive, but many others are sceptical. Keys to this debate are a number of questions, including: How can the confidentiality and fairness of assessments be guaranteed? How can standards of qualifications gained by e-learning be maintained? We aim, through this paper, to discuss some possible answers to these questions and to open the discussion about how to develop a framework for assessment and evaluation in e-learning.

Assessment and Evaluation in e-learning

Assessments and evaluation of students' work are essential components of education. Examinations, essays and research papers are the main tools. Assessment is not only about ranking students and measuring their knowledge and comprehension. It also allows students an opportunity to rehearse skills and gain feedback. Over many years, a variety of assessment standards have developed around the world, and different certificates are compared according to their examination procedures. Developing a model for secure and credible assessment-and-evaluation systems for e-learning must be seen as an evolutionary process. However, an initial framework must address two closely related and complementary issues:

Perception improving measures: The credibility of any educational system in large part depends on public perception of the security and fairness of its evaluation procedures. To reassure the public, and employers, the assessment standards of e-learning programs need to be seen as comparable to those used by the most trusted traditional institutions. Independent advisory groups that oversee distance-education programs and assure transparency and adherence to high academic standards are essential for a trusted public image. Appropriate supervisory and auditing infrastructures should be a pre-requisite to funding for "virtual" institutions.

Methods of assessment: In traditional universities, assessment is based on a weighted combination of coursework and written and oral examinations. Systems that give less weight to examinations are perceived by many academics and employers as less reliable. This view is hotly debated, but it must be taken seriously when thinking of standards for e-learning systems. In such a situation, it pays to be prudent and suggest that examinations account for a very significant part of a student's final mark. Traditionally, examinations are done under controlled conditions, and plagiarism and impersonation are a greater threat in distance-learning settings. Regional examination centers that are manned and monitored are one solution that could instil a good measure of confidence and fairness.

External involvement: Most degree programs in traditional universities, especially postgraduate programs, are regulated according to well established and fairly standard examination systems and procedures that involve trusted independent external examiners from other established universities. There is a need to establish a comparable system that draws on the experience and expertise of the global community, which must be regularly monitored and adhered to with rigour.

Security Model and Policy

The most difficult and crucial step to establish the credibility of e-learning could well be the development of an effective security system. Various models have been developed and refined to deal with the issue of security for different information systems. Examples include models for intelligence services, financial systems and health-information systems (e.g. Anderson, 1993 and Golimimann, 1998). E-learning shares many of its security concerns with other information systems, but it has some unique characteristics as well. Here, we will confine ourselves to the security aspects of assessment and evaluation for e-learning institutions.

A threat model: To construct an effective security system, it is first necessary to accurately outline possible security threats. This would consist of a list of threats that are supported by empirical evidence of actual attacks against similar systems. Here we are at a disadvantage, because there is, as yet, insufficient experience with e-universities and their nascent evaluation systems. Therefore, we must rely on the experiences of traditional universities in the Internet age, as well as the experiences of the OU and its sister institutions. The main threat to the coursework component of the assessment system is plagiarism. Universities are detecting the spread of plagiarism in students' work and the Internet is becoming a plagiarism-enabling tool. For examinations, the main threats are impersonation and cheating. Corrupt staff at regional testing centers could also threaten the examination system. The potential global nature of e-learning means that this threat has serious implications, even if it occurs infrequently or at a small number of sites.

Security policy: The intended policy should have a clear and uncompromising statement on the seriousness of plagiarism. It should also specify detection procedures as well as the consequences of breaches. Prevention of impersonation and cheating must be given a clear priority. It is crucial to have a policy of publicising breaches and the actions taken against their perpetrators.

Enforcement plan: Enforcement mechanisms must be clearly defined and publicized. Detection of plagiarism may require the use of textual profiling software. The use of non-local staff, security cameras and biometrics-based identification systems may all be appropriate ways to prevent fraud. Random inspection of test centers during examinations is a must. It also is essential that independent outside authorities be involved in the design, evaluation and enforcement of security measures.

Conclusions

In this short paper, we discussed the security aspects of e-learning systems. In particular, we outlined the elements of a strategy to protect assessment and evaluation for (virtual) institutions of higher education. This brief discussion is meant to initiate a more substantive work that could aid in the establishment of secure and credible e-learning systems.

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Algorithm Visualization using QuickTime" Movies

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Abstract: The steady evolution in algorithm visualization increasingly favors student interaction with the visualization over the instructorÕs display of the visualization. Consequently, ease of delivery, support for multiple platforms, ease of use, interactivity, and protection of the source are important qualities of an algorithm visualization. Java applets and QuickTime" movies represent two ways of delivering algorithm visualizations to students via the internet which have some or all of these qualities. Visualizations of algorithms from computational geometry will be presented as illustrations of these techniques.

Introduction. The pioneering work in algorithm visualization (Brown, 1988) provided a rich, interactive graphical display to help a student understand the workings and properties of an algorithm. The essential characteristics of this technique (BALSA, etc.) included:

¥ tight coupling of the algorithm with the visualization;
¥ algorithm and visualization available for one platform;
¥ the algorithm visualization delivered on diskette or from a file server;
¥ interactivity included some choices of mode of presentation and size or nature of dataset.

The tight coupling of algorithm to the visualization worked against those institutions which had few fast, full-color monitors or display systems, and made it difficult for a student to work with the algorithm code alone. The decoupling of algorithm and visualization, with systems such as GAIGS (Naps, 1991) allowed a student to code an algorithm herself, and present the results of the algorithm to a visualizer which could run on another machine. This enabled the algorithm to be coded on any machine in any language; visualizers were provided for certain target machines. The communication between the algorithm and the visualizer was by means of a file which contained descriptions of Òimportant eventsÓ in the life of an algorithm (for example, the comparison of two pieces of data; the interchange of two pieces of data).

Heretofore, the student could watch the visualization, but could not interact with it. Several reports suggest that easy access to the animation, textual annotations and questions in the animation, and interaction with the animation is important for student learning (Lawrence, *et al.*, 1994; Byrne, *et al.*, 1996; Kehoe, *et al.*, 1999). It is to these issues that the present work is chiefly aimed. Our goals, therefore, include:

¥ rapid and convenient deployment of an algorithm visualization via the web and onto several platforms;
¥ some choices regarding the nature of the visualization, parameter s of the algorithm, size and characteristics of the dataset;
¥ some interactivity by which textual messages can be presented to the student, including questions which the student should answer before proceeding.

The Java applet meets most of these characteristics: applets can be attached to most web pages, and Java virtual machines are available for many platforms and most web browsers. The applet can be constructed to permit student choice and can provide text which either explains the workings of the algorithm or asks questions of the student. Applets have relatively small download sizes, since most of the functionality is contained within the virtual machine on the studentÕs platform.

But, not all browsers work alike, and therefore differences in applet appearance are beyond the control of the implementer. Although the author has constructed some applets for algorithm visualization, his work has primarily been the construction of QuickTime movies.

The QuickTime movie also meets most of these criteria: movies can be embedded in web pages, or streamed from servers. QuickTime players and browser plug-ins are available for many platforms and browsers. It is difficult to provide choice in data or presentation. Therefore the viewer must choose among several similar movies which span the data space or parameter space. Recent advances in QuickTime technology allow the presentation of text along with the moving picture, and allow for interactive control of the presentation by means of Òsprites.Ó The sprite ÒtrackÓ and text track are the mechanisms for student-instructor interaction.

The disadvantages of the movie are that one forgoes an element of interactivity: the student cannot, for example, choose a dataset; he must choose a movie. This means that the instructor must provide movies which provide a thorough examination of the data space. Another disadvantage is that movies are large, and even though they can be streamed, or fast-started, there can be a considerable waiting time before the student can use the visualization.

The algorithms. I chose to use algorithms from computational geometry to explore the possibilities of using applets and movies in computer science instruction because they are intrinsically graphical, and because existing treatments of these algorithms have rarely used a text accompaniment.

The QuickTime movie technique. Movies are constructed from a program written in C or Java. At each step of the visualization, a picture is drawn to an offscreen canvas; this picture then can be displayed on-screen, and can be conveyed to the codec which controls the movie track. The text track for the movie was developed in the same way: at each step of the algorithm, text was posted to a text track.

Finally, student interaction, in the form of question and answer, was implemented with a sprite track. The sprite track was not developed programmatically, but with the software Livestage Professional¨ from Totally Hip Software, Inc.

Movies were constructed using QuickTime Pro versions 4 and 5. Movies will run with AppleÕs QuickTime player or plug-in (the ÒproÓ version is not required for playback); most should run with QuickTime version 3 as well.

Demonstrations. QuickTime movies are available to illustrate several algorithms from computational geometry: the convex hull problem, the intersection of line segments and the Voronoi diagram. See `http://www.fandm.edu/Departments/ComputerScience/compGraph/CompGraph.html#VizCompGeom`

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Web-based Strategies for Improving Undergraduate Commitment to Learning

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Abstract: Students need a variety of ways to encourage them to learn. Web-based learning can provide a platform for achieving this in a variety of ways, other than the simple provision of "flat" lecture notes. This paper describes a range of strategies used in a module to encourage on-campus, full-time undergraduates to learn and presents feedback on this approach from three cohorts of students. It represents the use of the Web to augment traditional face-to-face teaching rather than to replace it.

Introduction

Web-based learning is ideal for learners studying at a distance but also offers a range of learning opportunities for full-time, on-campus undergraduates (Ryan et al. 2000), many of whom may need help to increase their commitment to learning. A number of factors are driving the use of web-based learning in undergraduate curricula, including:

- the rising expectations of students to use this technology in their learning;
- the benefits that this form of delivery offers in providing an "always on" source of interactive learning that is easy for the tutor to keep current;
- the need to teach larger groups of students;
- the need to offer learning flexibility to the increasing number of full-time students with part-time jobs;
- the need to compete with other providers of higher education that are not necessarily traditional on-campus universities;
- the use of this new technology being implicit in the Dearing Report (Dearing, 1997);
- university strategic plans for learning and teaching where the adoption of this technology is explicit.

This paper describes a number of web-based programs produced by the author which he uses to augment, rather than to replace, traditional face-to-face delivery of a pharmaceutical microbiology module to second year undergraduates on a 4-year MPharm course. It also reports students' feedback and attainment after using these programs.

Microbiology Practical Tutor

Students are required to work through a web-based practical tutor (Fig. 1) before coming to each laboratory class. Each laboratory session has its own set of web pages which explain, using high-quality images, the tasks to be undertaken in the class. Questions are posed about the underlying principles behind the techniques and links are offered to sites on the World Wide Web, such as the UK Public Health Laboratory Service site. In this way, students arrive for the class better prepared, the introductory talk session in reduced and the exercises are completed more efficiently. In addition, the students gain experience of using a range of resources on the Internet and are able to place their learning of practical skills into a practice context. To ensure that this web-based preparatory work has been undertaken, an open-book spot test is given at the beginning of each class, which contributes towards the students' coursework assessment. This web tutor also provides examples of positive and negative results that can be expected in the experiments so that students know beforehand what to look for when they return to the laboratory in a subsequent class to read their results.

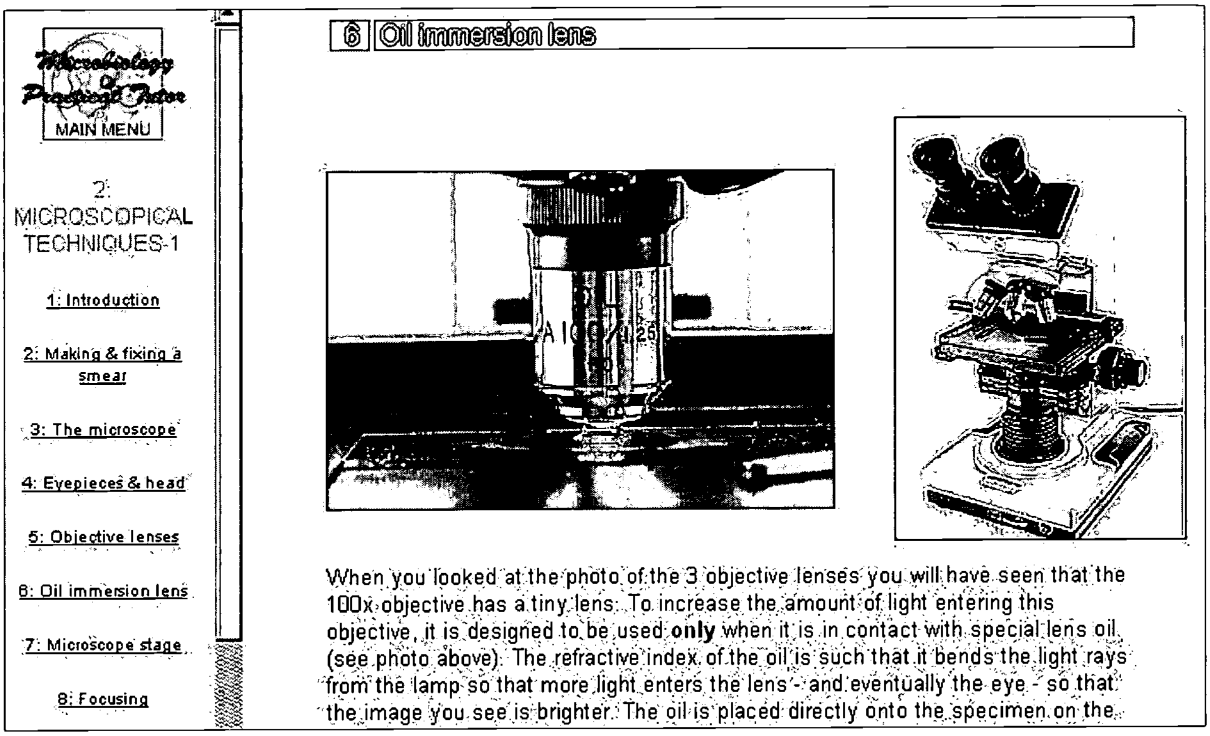

Figure 1: A web page from the *Microbiology Practical Tutor*

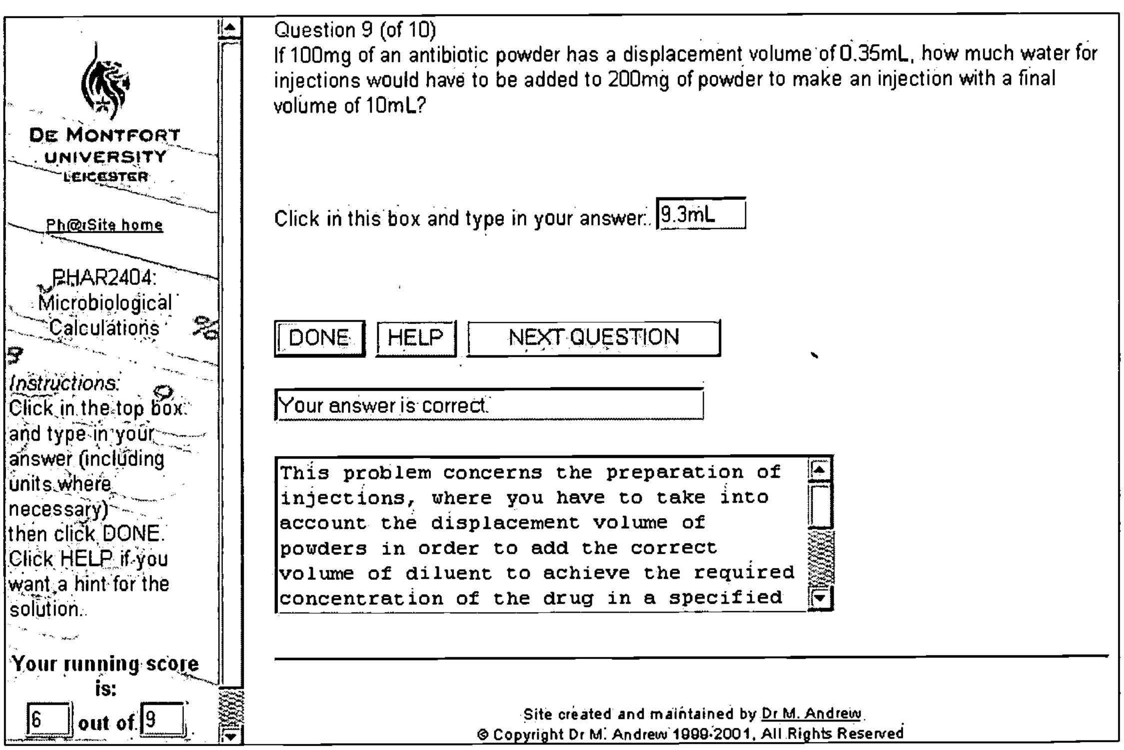

Figure 2: A web page from the *Microbiological Calculations Tutor*

Microbiological Calculations Tutor

The ability to successfully undertake simple calculations is obviously important to prospective pharmacists, who eventually will have to correctly calculate drug doses. Yet, undergraduate students are notoriously bad at calculations. A web-based *Microbiological Calculations Tutor* has been written for them to improve their numeracy (Fig. 2). Students are given three weeks to work through this tutor in their own time and at their own pace before undertaking a time-constrained test without the use of calculators. Each time the test is run, the questions remain the same but the values are changed so students are advised to repeatedly use the package until they become proficient in each type of calculation. A HELP text box is provided for each question, which describes, in simple terms, a method for arriving at the solution. This package has proved popular with students (Tab. 2) and its use has improved their ability to perform the calculations (Fig. 4).

Interactive specimen examination paper

To give practice in answering the end-of-module written examination, an interactive specimen paper is provided, which students work through in their own time. Besides familiarising themselves with the format of the paper, students can attempt to answer the specimen questions provided and receive on-line feedback on their responses (Fig. 3). The second section of the exam paper consists of multiple response questions (MRQs) and a separate web tutor is provided to practise these. The MRQs are fully randomised and provide the opportunity for students to see the impact of the imposed "negative marking" on their performance. Questions are presented 10 at a time and students are encouraged to repeatedly use the tutor until they feel confident to answer the questions correctly. A different bank of questions is used in the real examination paper.

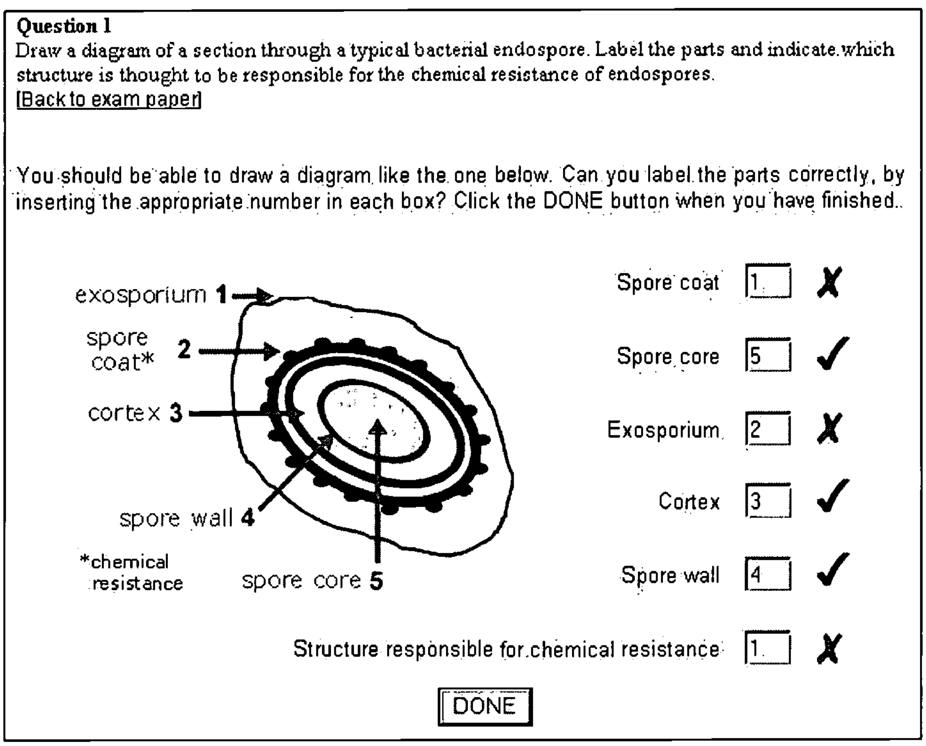

Figure 3: A web page from the interactive specimen examination paper showing the feedback given after the user has completed the question and pressed the DONE button

Feedback on assessment and teaching

Part of good teaching is to provide adequate and timely feedback to students on their assessment. The author uses web pages to do this. Feedback is given in the form of general comments and as histograms of coursework marks and examination performance, so that students can place their own achievement within the context of the whole cohort. The data showing the improvement in performance after using the *Microbiological Calculations Tutor* was published on the module website (Fig. 4) to encourage students to perform as well in similar questions in the end-of-module written examination.

It is equally important to elicit students' views on the delivery of the module, to provide them with an analysis of the results and for the tutor to respond to their comments. This shows students that their comments are valued and also closes the quality loop. The results of all questionnaires completed for the module are published on the website, together with the tutor's responses to the students' comments.

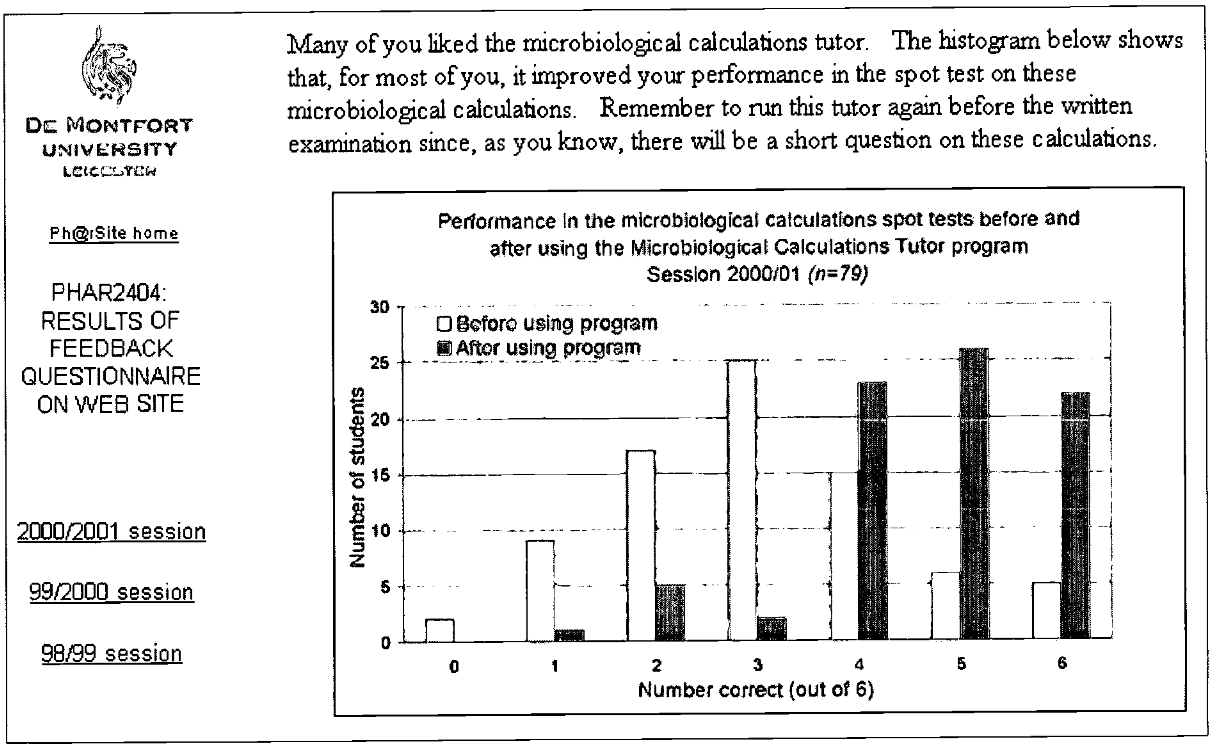

Figure 4: A web page summarising student feedback on use of the module website, showing the tutor's feedback returned to students on their calculations assessment

Putting their studies into context

In vocational courses, like Pharmacy, it is desirable to put the course into the context of the profession wherever possible, so that students can see the relevance of their studies and increase their commitment to the course. Students on our MPharm program are provided with *PharmScape*, which is an interactive website describing the profession of pharmacy (Andrew, 1998). It uses, as a contextual device, the story of the development of a drug from its discovery to its delivery to the patient. As the story unfolds, each of the modules in the MPharm program is introduced to show how they fit into the overall picture. Hyperlinks are provided to show the content of each module. Students are encouraged to refer back to this website regularly during their studies to help them relate learning to practice.

Other web pages for the module

Other learning material that is provided as web pages for the students studying this module includes:

- a list of learning resources, including links to the publishers' websites of the recommended textbooks and to on-line bookshops for possible book purchase;
- lecture outlines and the assessment criteria for the module;
- *Dangerous Microbes*, an interactive tutor for learning the names of microbial pathogens and the diseases they cause;
- The lecture presentations (as HTML versions of the author's *PowerPoint* presentations);
- *Microbes in the News,* links to relevant topical articles from UK newspapers and other media.

Student response to the web-based learning for this module

Student opinions of the web-based learning packages for the module were elicited by means of an anonymous questionnaire. Students responded to the statements using a 5-point Likert scale with the options: strongly agree, agree, neutral, disagree, to strongly disagree. Table 1 summarises the results from questionnaires completed by three cohorts of students.

Statements	Percentage of students agreeing/strongly agreeing		
	1998/99	1999/2000	2000/2001
	n=81	*n=89*	*n=79*
A) It enhanced my learning experience	95	86	96
B) It was clear and easy to use	96	95	97
C) It was of the appropriate intellectual standard	89	90	91
D) I liked learning in this way	56	44	64
E) It increased my interest in microbiology	47	44	44
F) It increased my confidence in using computers	63	44	46

Table 1: Summary of an evaluation of the module website completed by three cohorts of students.

The data show that a high proportion of students felt that the web-based material enhanced their learning experience, that it was clear and easy to use and that it was of the appropriate intellectual standard. Some students were less enthusiastic than others to adopt this technology (see statement D; Tab. 1), but this is not an uncommon finding (French et al. 1999). Face-to-face discussion with the students on their questionnaire responses revealed that the low score for statement F was because many of them felt sufficiently confident in the use of computers before undertaking the module (a tribute to a previous module in which this topic was taught). Generally, there is remarkable consistency between the responses of the different student cohorts.

As part of the questionnaire, the students were invited to add written comments if they wished. Over one third of all respondents chose to do so. All comments were positive; Table 2 shows a representative selection of them.

“I found the website very useful and easy to follow. The microbiology practical tutor and the dangerous microbes programs were very good. Study would be a lot easier if all lecturers had a website like this.”
“"I use the website regularly and find it very helpful. Backs up the lectures and practicals successfully. Increases my confidence for the phar2404 module."
"I think that the website is very good and has been very helpful to me. Also provides extra material to make the practical part of the course feel complete. Very useful."
"Practical tutor helped in practicals a lot."
"The practical tutor was excellent for information about the forthcoming practicals but gaining access to them was sometimes difficult and very time consuming if there was no Internet access at home."
“The website was a different way to aid learning and encouraged more effort to be put in to preparation for the labs.”
"Computer program was very useful, especially the microbiological calculations tutor."
“The calculations tutor was very good as the answers were given and explained in a very understandable manner. This was good as many modules expect you to excel in maths and not all of us do.”
“The website is an excellent way to receive information. The only problem being that the printers in the computer node are rubbish and therefore taking printouts is difficult.”

Table 2: Student comments on the web-based learning material used to deliver the module

Conclusions

Experience of delivering this module over three academic sessions, suggests that using web-based learning to augment traditional face-to-face teaching was successful, both for the tutor and for the students. The website was well used, with some hits even being recorded on Christmas Day on two consecutive years! Student performance in, and commitment to, the module was enhanced, as judged by the feedback questionnaires, attendance at classes and by achievement in assessments. It was clear from the student behaviour that, like many tutors, students find it difficult to shed the “hard copy habit”, feeling the need to printout most of the web pages. This has implications for the support provided for them to do this (see last comment; Tab. 2). Moreover, the amount of web-based learning that is expected of students needs to be carefully judged to avoid “screen fatigue” amongst learners.

It is felt that providing web-based material is an ideal way of augmenting learning in the traditional on-campus setting, although it is arguable whether the “sage on the stage” should be *replaced* by the “guide on the side” for this group of learners. Full-time students have a right to expect access to their tutors and, for this reason, the author has not yet provided a chat-room for this module.

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Development of Technology Based Distance Learning: A Case Study of the Centre for Commerce and Administrative Studies at Athabasca University

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Athabasca University, Canada's largest open, distance-based university, was established in 1971. The University offers both graduate and undergraduate programs. Registrations in the 2000-2001 academic year totalled about 36,000. Though originally designed to serve the needs of Alberta adult learners, more than 50% of University's students now reside outside Alberta. Students outside of Canada accounted for about 5% of 2000-2001 course registrations and this percentage is growing. The Centre for Commerce and Administrative Studies (CCAS) is the undergraduate arm of the University's Open School of Business. Undergraduate business courses account for about 13,000 annual course registrations, or over 1/3 of the University's total undergraduate registrations. At present, there are about 20 faculty members in the Centre.

Over the past several years, CCAS has introduced a fully integrated electronic learning system in addition to providing distance education by traditional paper-based instructional material and telephone support. The process started with the introduction of the Call Centre in 1994, designed to increase student access to administrative and academic support. Instead of the traditional one-on-one tutor-student relationship, students were able to call or e-mail front-line "learning facilitators" who are available approximately 60 hours per week. The Call Centre handles all initial academic, administrative or technical inquiries from students in CCAS print-based and technology-based distance learning (TBDL) courses. As well as improving student service, the introduction of the Call Centre has reduced overall delivery costs. The related financial savings enabled CCAS to develop an integrated Web-based learning environment using Lotus Notes. Group interactivity, audio/video streaming, simulations, electronic assignment submission, on-line exams, and related electronic student support services have gradually been introduced in various courses. Although this system was originally used to convert unpaced, paper-based homestudy courses to TBDL format, it has been modified as of September 1, 2000 to offer paced business courses in "e-class" format. These courses have cohorts of students instructed by an online academic, and commence every September and January for 14-week periods.

The design of this comprehensive electronic system has required the re-conceptualization of all course development and delivery processes within the Centre for Commerce and Administrative Studies. Relatively successful organizational and technological change has permitted the Centre to retain its traditional homestudy student base, work within largely unchanged institutional structures, and develop new online business programs for delivery around the world, while requiring minimal net new financial resources. However, the Centre is now at a crossroads. There are several internal and external factors that will affect the rate and extent of TBDL development within the Centre over the next five years– expectations for growth, prospects for funding and other economic factors, internal strengths and weaknesses, and external opportunities and threats.

Like the rest of the University, the Centre has undergone rapid growth in the last five years. Annual course registrations have increased over 100% in this period. This trend is expected to continue, particularly within business programs. As well, an e-commerce major is now being developed within the Centre's online BComm program. This program commenced in September, 2000. The e-commerce major will require the development of about 20 new courses over the next three years. Finally, there are real prospects for collaboration with Canadian and international educational institutions over the next five years. These factors mean that the number of student registrations will likely continue to grow quite quickly. As a result, additional faculty and technical staff need to be hired and trained, and existing staff need to be retrained.

Fortunately, approximately $675,000 of ongoing funding has been obtained to finance development of the e-commerce major. However, it is becoming clearer that these delivery costs will be higher in the online environment than in the traditional independent study, paper-based courses because online learning increases instructor-student interactions (Annand 1999). CCAS has requested that the delivery allowance be increased from $120 per student to $150 for TBDL courses, though it is unclear how the university will fund this.

The Centre's faculty and staff are generally supportive of new technology applications and online learning initiatives. Most faculty members who resisted the direction of the Center over the last few years have moved on to other centers or institutions. Remaining staff have been able to streamline their work duties as a result of adopting Lotus Notes for a variety of Centre administrative functions, and a core of three technical staff in the Centre provides users with adequate technical assistance. These factors have increased acceptance of change and created overall satisfaction with the new operating environment. Also, research in distance and open education is recognized as a legitimate alternative to discipline-related research for purposes of faculty evaluations and promotion decisions. As a result, there are incentives for faculty to experiment with new TBDL features. A strategic plan for the Centre was adopted several years ago. This continues to inform the direction of the Centre, and provides a point of reference for new initiatives.

There are criticisms of the Centre's evolution to technology based distance learning, however. Some faculty members are raising questions about the andragogy informing online courses. The courses have generally been adapted from the existing paper-based distance learning materials. Although some interactive features have been added, behaviourist learning theory still underlies most of the online courses. Instruction is generally broken down into small units, and detailed learning objectives are used. The courses emphasize the attainment of pre-specified learning outcomes, and the measurement of how well these learning outcomes have been achieved. Though TBDL could support courses informed by constructivist learning theory - where knowledge can be co-constructed by drawing on unique personal experiences and knowledge of the participants, for instance - this has not been the case to date because of limited faculty time and financial constraints. Because traditional homestudy students must still be served, faculty members are reluctant to maintain two versions of essentially the same course. As a result of this and financial costs of increased interaction, collaborative and experiential learning processes, or other forms of online group interaction that can be facilitated by TBDL are used sparingly. This will likely continue.

There are several threats to the TBDL initiatives undertaken by the Centre. Historically and to spur innovation, the University executive has supported development of several TBDL platforms like Lotus Notes, WebCT, and Web Board in different university programs. These platforms are now well-entrenched. The executive now wants to explore the possibility of merging all university programs onto one delivery platform to use resources more effectively. A move away from the Lotus Notes groupware underlying the Centre's learning system would be disruptive to technology and curriculum development plans. The University in general faces criticism about its move to online courses. Even though recent data suggest that over 80% of current students have access to some type of computer equipment, some critics argue that online learning still limits access to students who are economically underprivileged. This contradicts the general mission of the University, which is to remove barriers that traditionally restrict access to university education.

Executive-level negotiations of collaborative arrangements with offshore institutions have resulted in unanticipated demands on CCAS faculty and staff. The decision by the University to join the Global University Alliance (GUA), a consortium of 10 North American universities offering programs by TBDL, has meant that students in the Far East will be able to enroll in the BComm program commencing in September, 2001. These courses need to be converted to Blackboard, the delivery standard for the GUA. Although most of this conversion process will be carried out by a GUA partner, it is unclear what implications this and similar collaborations will have on faculty and staff resources within CCAS. These collaboration projects, which invariably result from the top-down decision making processes within the University, could eventually conflict with the desire for CCAS faculty to set their own research and teaching directions.

Finally, an increase in the number of online courses and programs offered by traditional and private, for-profit business schools means that the Centre may face increased competition in the future. This may curtail or significantly affect present development plans. Competition also increases expectations of students, which implies the need for higher service standards and shorter course revision cycles, for instance. Over the next five years, enrollments in the Centre should continue to grow as students throughout the world exercise their preference for independent study. The increased acceptance of distance education as a viable university-level learning alternative, and the University's commitment and ability to fill expressed learning needs of adult learners should enable the Centre for Commerce and Administrative Studies to flourish during this period. To do this, though, external and internal threats must be managed, the relative costs of delivering various forms of distance education must be recognized, and lower cost alternatives need to be chosen.

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How Faculty Develop and Deliver Online Courses: A Task Analysis

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Abstract: The institution-wide adoption of web-based learning technologies at the Technical University of British Columbia (TechBC) has led to a significant departure from traditional duties for faculty. This paper reports the study results of a task analysis of course development and delivery processes for faculty at TechBC. The study identified critical tasks for academic staff, the tasks most difficult to do, and why these tasks were a problem. Study participants reported a large proportion of course authoring is done off-campus and outside the web development environment. Participants also reported excessive time required for data management tasks associated with team management and assignment grading.

Each course at the Technical University of British Columbia (TechBC) has a substantial online component and is prepared over a 4-month period. Course development consists of 5 stages: planning, specification, design, production, and post-production. Development is carried out by academic staff (faculty and learning support associates) working with instructional designers, media developers, licensing specialists, editors, and technical staff. Throughout delivery and development, academic staff work within the TechBC Course Management System (CMS), an integrated suite of web-based tools built in-house to meet the specific requirements of the institution. Authoring is done in Macromedia® Dreamweaver™, an HTML development tool configured to edit centrally stored files over a local area network. At the time of the study, academic staff needed to be on campus to directly edit course content.

In fall 2000, the Educational Technology and Learning unit of TechBC conducted a study of the work processes of academic staff as they developed and delivered courses. The goal of the study was to provide better tools, support, and professional development for academic staff. The study was designed to identify barriers to academic staff working in TechBC's CMS environment and recommend design improvements.

Methodology

Eleven academic staff participated in one-on-one interviews conducted at their primary workstations. All participants were developing and/or delivering courses. As shown in Table 1, the study comprised 3 stages: identification of high-level tasks, identification of task details, and usability testing of specific problems. The first 2 stages provided a framework for identifying frequent, critical, and difficult tasks, and for identifying problem areas of the CMS. The final stage focused on assignment processing, an area identified in the initial stages as highly problematic.

Stage	Different Participants	Outcome
1. High-level task analysis	3	• Basic task model
2. Detailed task analysis	5	• Detailed task model • Identification of frequent, critical, difficult tasks • Identification of problematic areas of the CMS
3. Usability testing	3	• Usability analysis of online assignment processing • Identification of problems with assignment support in CMS

Table 1: Data-gathering stages of study

Results

Task model

An essential outcome of the study was a hierarchical task model that identified tasks of academic staff, and broke tasks into subtasks and steps. Too large to be presented here, the model is quantitatively summarized in Table 2.

Phases	Tasks	Subtasks	Steps
Development	4	13	70
Delivery	7	19	67
Cleanup & Review	3	undetermined	undetermined
Ongoing	4	0	18
Total	18	32	155

Table 2: Number of tasks, subtasks, and steps in the task model

Participants identified over 18 high-level tasks they needed to do to develop, deliver, and maintain courses to their satisfaction. These 18 tasks were further divided into 32 subtasks and 155 steps.

Difficult tasks

Table 3 shows the subtasks and steps flagged by at least 4 participants as difficult. Number of participants was used to measure the severity of difficulty.

Phase	Task	Subtask	Step > Sub-step	Participants reporting difficulty (total 11)
Develop	Plan	Plan course requirements	Research resources	4
	Develop module	Review/revise module outline	Research resources	6
		Create web presentations for units	Research resources	6
		Create learning objects for units	Research resources	6
		Create f2f and online learning activities for units	Research resources	6
	Produce module	Populate the CMS for each unit	Insert > find	4
			Format	4
			Proof	4
Deliver	Post online assignment listings	Create posting	Create unit listings > duplicate	4
	Assess learners	Mark	Read/evaluate	7
		Collect	Collect in CMS	4
		Give individual feedback	Online > enter comments and marks	4
		Post grades	Format and proof grades for gradebook	4

Table 3: Subtasks or steps flagged as difficult by at least 4 participants

Most participants did a substantial portion of course development from home or other remote locations. They often transferred work to campus using floppy disks or email, then typed or electronically transferred content into Dreamweaver or the CMS text fields. These data management tasks were seen as unnecessarily tedious and difficult.

Recommendations

Based on the study results, these high-priority changes were recommended:

- Provide and support secured remote authoring access to the CMS. Ideally academic staff and other authors should be able to author and edit courses from any location through a browser.
- Provide dynamic content management throughout the CMS to reduce or eliminate the manual entry of the same data in multiple places. For example, when updating the due date for an assignment, the instructor should only have to enter the change once, even though the assignment date may show up in several places.
- Provide online secured spaces and systems for file sharing, collaboration, and storage and retrieval of course resources, including learning objects.

Enhancing student access to the University: The integration of online and course-based material for the visually impaired.

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Abstract: Access to information is a basic right of all students, but this entitlement is not always available to blind or visually impaired students at every Australian university. Our wish to remedy this situation has led to an exploration of alternate uses of technologies such as the Internet, multimedia CDs and assistive software. Through personal experience, and the innovative design of two University subjects, this paper highlights the pressing need for research in this area, and presents possible solutions to this inequitable situation.

There is a paucity of educational research that deals with the problems of sight-impaired students (Williamson, Shnauder & Bow, 2000). In particular, there is a dearth of essential services available to visually impaired students in most areas of Australian educational life. In current times, where course materials are increasingly being placed on the World Wide Web, the technology has the potential to democratise information, not only for sighted students, but also for a whole range of perceptually challenged students. Smith, Waby, Neville and Dalloway (1999) support this finding highlighting the importance of technology for helping the visually impaired.

As educators and researchers, we were inspired to undertake this research, after a profoundly blind student presented her difficulties to us having enrolled in two of our subjects at the University of Western Sydney: Interpersonal Interaction and Electronic Research Methods. Both of these subjects make use of the Web; for example, to display lecture notes, tutorial activities, mock exams questions and real exam questions, displaying announcements and utilising a discussion board. Although we do not rely solely on the Web to educate out students, like other educators, we have found it to be a useful addition to our lectures and tutorials. Moreover, students who find it difficult to attend lectures can access all the information they require on the websites. Despite the versatility of our subjects, our blind student explicated our subjects' limitations.

Each subject presented its unique problems for this student. For example, Interpersonal Interaction required the student to partake in ordinary class work, including reading handouts and the textbooks, and carrying out library research. In contrast, Electronic Research Methods required the student to be able to read the instructional material off the Web, as well as to navigate the web, locate references and complete online exercises. A most unusual event occurred in this subject when this student entered the computer lab with a guide-dog and proceeded to sit down next to a computer with the largest monitor. Given that she was profoundly blind, all she could do was to listen to the instructor explain to the students how to access the online tutorials. She left half-way through the class since she had no way of completing any of the class activities.

As with most other universities, this university has a Special Disabilities service; however, given the range of material the student needed to access and read, they were unable to adequately meet the student's needs. Special Disabilities had alerted us to the existence of this student to which we replied that the subjects were accessible several months before the student needed to enrol. Whilst translation into Braille of all the online material was possible, the student wished to participate in real time. This prompted us to seek funding to carry out our own research into improving education for the visually impaired.

Currently, we are investigating the alternatives to typical classroom activities and online materials. We at first wanted to develop multimedia authored CD's and web pages that can support sound and speech. Our investigations, which are still ongoing include the following:

- Collaborations with the Australian Royal Blind Society in terms of usability and media design for blind and visually impaired persons will provide hands-on R&D of multimedia/Internet navigation;
- Rethinking alternatives to traditional Web site design with traditional peripherals such the mouse and keypad are leading us to other input devices such as touchscreens, 3D mice, and virtual reality devices such as 3D gloves;
- Exploration and testing of the available software which cater for blind and visually impaired people;
- Facilitating maximal interactivity for blind and visually impaired students within our own courses.

Our investigations have revealed that the solution to this problem should be simple and within the reach of most students equipped with ordinary hardware. Special equipment such as special input/output devices are expensive and out of the reach of most students. We also understood that written subject matter could be translated into Braille, but we questioned whether this was entirely necessary.

Screen magnifiers, Braille printers, read-aloud Web connectors, and voice activated wordprocessors all have the potential to assist sight-impaired students. One of the most elegant solution we found was a program called JAWS from Henter-Joyce, a company which specializes in technology assistive products. (www.hj.com).

JAWS is a screen reader which can recite aloud almost everything encountered on a Web screen. The JAWS program 'sits' on top of the Microsoft Windows operating system, and uses an adjustable synthetic voice to give feedback in the form of aural translations of the user's keyboard commands and text/graphics depicted on the Internet. Any text, graphics or links are automatically recited at variable speeds and volumes.

Initially we expected that multimedia CD-ROM's would be an appropriate alternative to the Web. We had planned an elaborate, professionally authored multimedia CD which comprised our lectures and notes. However we discovered that multimedia CD's using software such as Director is a much more problematic solution, since most screen readers have difficulties translating multimedia formats. Multimedia, it seems, is designed mainly for sighted people, with visuals playing a large part of the success of the format.

Using the Web for coursework is also problematic, even implementing the JAWS solution, since much of the online material needs to be located and saved to disk for future reference by blind and sight-impaired students. Thus our solution was to redesign existing Web sites for real-time use by blind students who decided to use the Internet, and to additionally place those Web sites, including all the reading materials on to a HTML encoded CD-ROM. The CD-ROM could also include the screen reading software and would be a perfect facsimile of the real Website. We could additionally include recorded lectures via digitally stored formats such as mpeg or mp3.

The redesign process takes into account the W3C guidelines for accessibility, which include:

- images without alternate text;
- lack of alternate text for imagemap hot-spots;
- misleading use of structural elements on pages;
- uncaptioned audio or undescribed video;
- lack of alternate information for users who cannot access frames or scripts;
- tables that are difficult to decipher when linearised;
- and sites with poor colour contrast. (see http://www.w3c.org)

Our original websites were almost devoid of graphics, the main offending screen elements. We initiated a process of rationalisation whereby we placed the most used links at the beginning of the Web page, so that students would hear this information first, without having to unnecessarily wait. This meant that hypertext links could be chosen quickly. We also broke up long lists of links into logical units and regrouped these under sub-menus for easy navigation and retrieval.

Interactivity and participation are further issues of equity/accessibility affecting both disabled and non-disabled students. As a postscript, we are further exploring the ability of voice recognition software such as Dragon Dictate coupled with JAWS, to enable students to participate in interactive online sessions using chat programs such as ICQ and IRC. If we can generate a system to hold class discussions, without the need for reading and typing, not only would we help blind and visually impaired students, but also remove those inequities produced by distance, and by other perceptual/cognitive loss.

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Measurement and Modelling for Dynamical Human cognition motion process

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Abstruct: The refinement of measurement of a behaviorof a human testee with Eye Mark Recorder on who is playing a computergame or typing keyboard is reported. The new strategy of analyzing the measured huge data isds developed byusing nonlinear feature extraction method. And further, the dynamical process model of humancognition motion process about typing operation using keyboard andplaying the computer game called modified Flipper Game is developed. It gives us the comprehensive understanding of a testee putting on an eye mark recorder and datagloves by analyzing the measured data .

Introduction

Educational Systems on the computer such as CAI,ITS andILE have a long history. Some remarkable progress concerning sucheducational systems was made in 1980's. Student model , subjectmatter and instructional strategy were constructed on the computerexplicitly using knowledge processing technology such as productionsystem to assist a learner in his study effectively.(E.Wenger,1987) In spite of a great deal of effort put into intelligent educationalsystems ,they don't seem be so effective in the actual educationalsituation.Almost all the educational systems require many learner's answer tomany questions given by the system, and they can conjecture thelearner's understanding status using these many answers logically. Consequently , the learner are tired of answering these manyquestions in communicating with these intelligent educational systems.

In the actual education in a classroom , a teacher receives from astudent notonly an answer of question which he gives but also informationsabout nonverbal motion and some behavior of the student. The latter twoinformations are not so logical , but they are important to understandthe student deeply in his learning process.

Educational system which can understand the learner using theseinformationsis necessary to get rid of the above defect of the present intelligenteducational system. It is desirable to give the educational system thecapability to detect cognitive data such as eye movement and finger-armmotion of a learner who interacts with educational system. We introduced eye mark recorders and motion capture system for fingersand arms in our laboratory , and incorporates them with educationalsystem on the computer.(M.Ueno etal 1996),(T.Nisiki etal 1997),(T.Nisiki etal 1998)

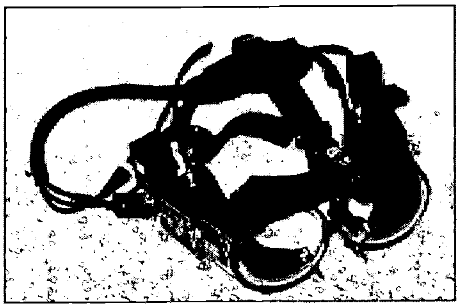

Figure 1: The used Eyemark Recorder: NAC EMR-600 The used Eyemark Recorder: TAKEI T.K.K.2901

The used Eye Markrecorders and measurement of eye movement

The two used Eye Mark Recorders (hereafter we use EMRfor them.) ,NAC EMR-600 and TAKEI T.K.K 2901 are shown in Figure.1.

The eye mark of a testee has been analyzed by a human researcher usingVTR tape usually . The eye movement of a testee in the time range longer than 1/30second can be detected and analyzed in this approach ,but the movementof eye mark in the short time range from 1/30 Sec. to 1 mSec. cannotbe detected by using VTR tape.

So, it is necessary to develop a new measuring system to detect eyemark data in this short time range. A new hardware memory board called CINDY and the software calibration system for EMR which can detect both 600 eye mark data perSec. and another data concerning human behavior at the same time aredeveloped to analyze a human visual cognition and motion.

Using the real time data obtained from this calibration system , thecomputer can respond to human eye movement and vary objects which areseen by a testee on the CRT very quickly.

As a result , some communication environment on the computer which canrespond quickly to eye movement of a testee has been developed in ourresearch. The following two preliminary measurements to have a clear grasp ofthe general features of the eye movement of a learner who traces movingobject is prepared.

1) Tracing a moving point on the CRT(Figure.2) 2) Tracing of vibrating point on the CRT(Figure.3)

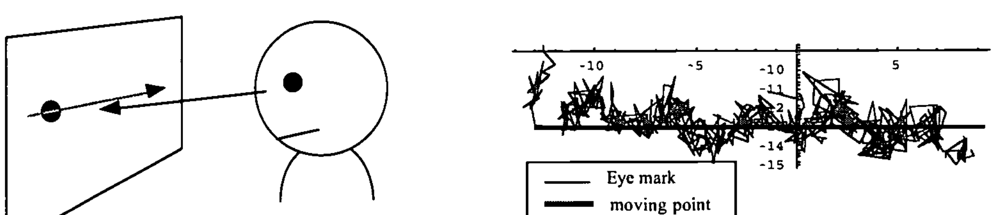

Figure 2: Eye mark for moving point

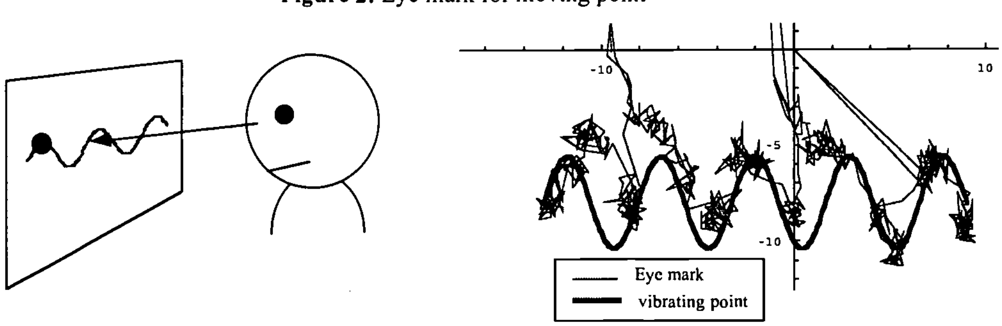

Figure 3: Eye mark for vibrating point

A point moves from the left to the right on the CRT with constantvelocity in measurement 1). A testee is under order to trace thiscircle on the screen.

A point vibrates on the Sin curve on the screen in measurement 2) andthis pointcross the screen about 5 Sec. Also in this case , a testee is underorder to trace this moving point on the screen.

Three different sin curves which have different amplitude are used inour measurement 2).

The gross structure of human eye movement in tracing moving object is grasped from these twodifferent measurements.

The used EMR can trace small variation of human eye movement up tosize 0.7 degree when a testee gazes stopping object. But , testee'seye mark moves in large scale when a testee traces the moving object inmeasurement 1) and 2). It is difficult to identify the absoluteposition of learner's eye mark in this case . In other words , relative variation of eye movement can be detectedeasily , butit is not so easy to detect absolute position of human eye point. So, some correlation mechanism to infer the absolute position oftestee's eye mark from the information about the seen object isnecessary. It is discussed in chap.5 in detail.

Computer game using realtime eye mark data

In almost all the researches about human eye movement, measured data are used for analyzing human behavior only after themeasurements end.But , we want to construct the environment in which the seen object onthe CRT varies according to the real time eye mark of a testee torealize dynamical interaction between a testee and an educationalsystem on the computer by using eye movement.If this environment is developed successfully on the computer, we canhave the chance to analyze behavior of a testee thrown into dynamicalcommunication process with a system using eye movement.It is essential to use real time eye mark data to realize thiscommunication environment on the computer. As CINDY board developed by us made it possible to detect several dataconcerning human visual cognition and motion in high speed simultaneously , we can use it for analyzing this real time communication processbetween a testee and the system. We have developed a computer game called modified Flipper game in whichour testee can play using eye movement. The details of this game areshown in ref. 4 and 5. There is a computer game called Flipper (Figure.4). A player of this gamemoves a mouse to select the squares divided on the screen, and then hecan vary the color of a selected square by clicking a mouse. Six colorsare used in this game.

The color of selected square changes in the cyclic sequence, when theplayer click the mouse. For example ,purple , red ,green , blue and so on.When the colors ofall the squares coincident , then the game is cleared. On the otherhand , the color of each square varies randomly at regular timeintervals on the CRT. So , the player of this game

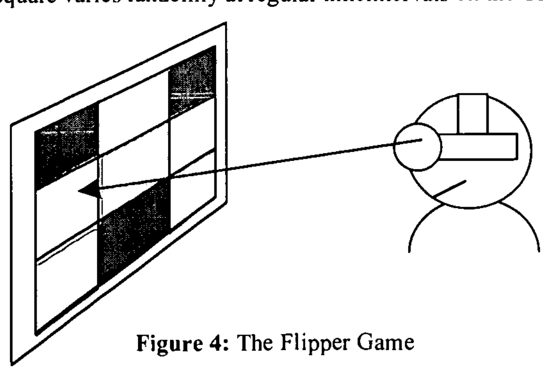

Figure 4: The Flipper Game

must vary the colorof squares as fast as possible. The player can confirm which square is selected by seeing a mousepointer on the CRT controlled by himself in this original Flippergame.

We modified the original Flipper game into the game where a player canselect and change the color of the selected square using eye movement. In this modified Flipper game , a player need not click the mouse tochange the color of the square but he has only to gaze at the squarein a short time interval. If the eye mark of a player stays in asquare for 0.6 Sec. , the system automatically changes the color ofthis square in the cyclic order defined beforehand. The length of thistime interval can be changed easily. Several types of modified Flipper games are developed by us. Thesegames have different division number of sub squares from 2 by 2 to 6by 6 , different number of color assigned to sub square from 2 to 6,and different length of time interval from 0.3 Sec. to 0.6 Sec. The general feature of human dynamical eye movement of a playerconfined in this complicated context of computer game can be measuredand investigated.This measurement is designed to obtain the standardtouchstone for more complicated dynamical human eye movement in playingcomputer game and in operating input devises. The detailed analysis ofthese new data will be shown somewhere.To explain these results in detail , we have to construct the modelwhich canexplain the cognition-motion process in human brain. This will be discussed in chap.6 in detail.

Measurement of human bodymotion and eye movement

It is important to see human body motion such as finger, hand motion to understand the skill level of a testee typing textusing key board.More dynamical information about a testee is obtained by measuring both eye movement and finger motion. The correlation between eye movementand finger motion and the time delay of motion from visual cognitionbring us several cognitive features and parameters which our testeehas.We have measured typing process of our testee who puts on data gloves ,3D motion censor and eye mark recorder. (A.Tsubokura etal 1998)

In this case , 6600 data are obtained from EMR and 6160 data areobtained fromdata gloves per second. The mutual correlation of these data is used to identify types of taskswhich are generated automatically in his manipulation. It gives us thegeneral feature of our testee such as novice or expert, and we can getsome cognitive parameters such as size of memory buffer of our testeefrom these measurement.

Figure 5: Measurement of Human Body Motion and eye movement

It is relatively hard to construct the experimental environment forthis hard dutyhuman measurement. We have succeeded in constructing this environmentandDBMS for human measurement data.Some of our results are shown in ref.5. We are interested in the process of acquiring skill of a learner inhis typing. To explain these combined results concerning visual cognition and bodymotion in detail , we must improve the model which can explain the cognition-motion process in human brain. This will be discussed inchap.6 in detail.

Strategy of data analysis

Eleven data are sent to the analyzing computer from EMRin each detection of an eye mark. The used EMR can detect eye mark 600times per Sec. , so the analyzing computer receives 6600 data persecond from EMR. On the other hand, the used data groves can detect 14 bending anglesfor fingers230 times per second, so 6440 data are sent from data grove persecond. Nonlinear data analyzing system for these complicated data isdeveloped using knowledge information technology. It can extractfeatures of both eye movement and finger motion automatically from theobserved data by using prepared templates and some rules about matchingstrategy. These features are saved in the system as a feature extractedlist.

Many templates are prepared in every sheet of this multi-step featureextraction , the higher features are extracted from the low-levelfeature extracted list .But there is a serious problem in extracting the higher feature from intermediate structures. For example, to identify data with higher feature the system mustuse not only other data which occurred in the past but also otherdata which will occur in the future shown in Figure. 5. As is well known ,human cognition-action behavior depends stronglyupon context of cognition-action history and cognitive situation inwhich a testee is confined , andso it is inevitanable to use this types of matching strategy. So, we cannot avoid designing this type of process dependentnonlinear analysis of visual cognition action behavior of a learner. This type of data analysis is very complicated and time-consuming onthe computer. There are two ways to overcome this difficulty.One is to use a parallel computer to analyze feature extracted listsfor lower levels.The other is to use a model for human behavior to cutoff links among intermediate candidates for visual cognition actionmotion behavior.

Dynamical model for human Cognition-Motion process

The construction of the system to measure eyemovement and finger arm motion of a learner interacting with a computerare reported in the above. These communication processes are verycomplicated and depend on the knowledge which he possess about theobject he sees and the situation a learner is confined to. As thebehavior of eye mark depends on the situation and context strongly,ordinary data analysis is not so effective. The strategy to analyzethese data is designed with the help of both nonlinear data analysisincluding chaotic data analysis and agent-like schema formalization ofhuman processes. Some models for human cognition-motion mechanism are necessary toextract feature of the correlation of eye movement with finger armmotion from these data.

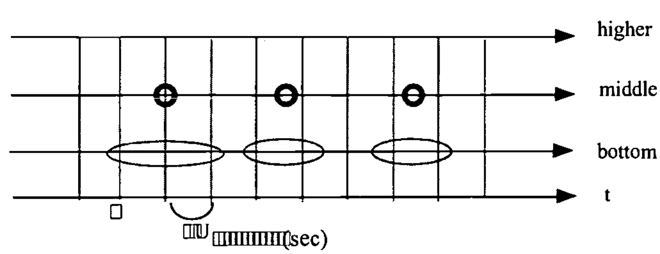

Figure 6: Strategy of nonlinear data Analysis

As is well known , there are several hierarchies of informationprocessing in the human brain concerning visual recognition. The schematheory may be promising as a model of hierarchical visualcognition-motion system. 6) So, we have developed the rule-based modeling ofvisual recognition . This model is quite general , so it may have thecapability to explain different cognition processes reported in thispaper because many local rule corresponding various experimentalsituation can be assembled. Parallel production system called SYMPASI(SYMbolic PArallelSImulator)7) is developed by us to explain the behavior of our testeeplaying Modified FlipperGame. It is possible to set retardation time for each rule to fire inSYMPASI. So , recognition simulation is generated as a result ofsuccessive adaptation of rules. We can tune the system against thespecialized by assembling and modifying various production rules inSYMPASI. Many phenomenological facts concerning visual recognition reported inthis paper can be assembled in SYMPASI , then overall cognition-motionphenomena for a testee is generated by the successive adaptation ofrules in working memory of parallel production system. The structure ofthe rule-based simulator SYMPASI is shown in ref. 7.A part of rules ofSIMPASI tuned for modified Flipper game which is reported in chap.3 indetail are shown in ref.7.

We regards modified Flipper Game as the first milestone for allcognition motion process. The parameters obtained from the analysis ofModified Flipper Game canbe used other cognition motion processes such as text input processusing keyboard.

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Learning Style Theory and Computer Mediated Communication

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Abstract This paper looks at the low participation rates in computer mediated conferences (CMC) and argues that one of the causes of this may be an incompatibility between students' learning styles and the style adopted by CMC. The main learning style theories are viewed through the use of Curry's Onion Model. It is argued that Riding's Cognitive Styles Analysis is the most powerful theory with which to examine educational CMC. A framework for conducting an empirical investigation using this theory is outlined.

1 Introduction

Computer mediated communication (CMC) is becoming a popular tool in tertiary education establishments for both distance and campus-based students. Whilst it offers many advantages, especially to distance students, there are concerns about the low levels of active participation in conferences (Little & Light 1999). Indeed, Mason (1994) proposes the 'thirds theory', which suggests that students fall into three distinct groups: those who actively participate, those who read messages but do not participate and those who take no part. More recently, the experience of many tutors, including the authors, is that participation levels are often much lower even than Mason's estimates (Hewitt and Teplovs 1999).

Reasons for the low participation may relate to the subject matter and the approach of the individual or their learning style. For example, Romiszowski & Ravitz (1997) question whether CMC, which is primarily text-based, is equally suited for various subject matters, whilst Kaye (1989) notes that the pedagogic value of computer-based collaboration depends on *"the educational perspective adopted, the nature of the specific discipline and the characteristics of the learners"*. It is the last of these factors with which the research reported in this paper is concerned.

Each individual responds differently to a learning situation. This response will be influenced by the way the individual thinks, their past experience, the demands of the environment and the current task. This approach is generally recognised as the individual's learning style. A successful learner will be able to adapt his or her approach to meet the needs of any task, but not all learners will have developed this skill. The ability to adapt approaches to learning has led some authors to use the term "learning strategy" rather than "learning style".

CMC is essentially a medium of written discourse. Individuals with an incompatible learning style, who are unable to adapt, may find that CMC perpetuates the inequity of an education system that discriminates against students who talk and listen better than they read and write, disadvantaging the less-verbal students. (Light & Light 1999, Rimmershaw 1999, Mason 1994)

Visual versus Verbal style preferences are one of many learning style theories discussed in the literature. During the last century there have been many investigations into style; these have often been conducted in isolation and have given rise to a large number of different style labels. Curry (1983) proposed the 'Onion' model to group the main types of styles, which she suggested could be grouped into three levels resembling the layers of an onion:

"By this organisation learning behaviour is fundamentally controlled by the central personality dimension, translated through the middle strata information processing dimensions and, given a final twist by interaction with environmental factors encountered in the outer strata."

2 Main Learning Style Theories Viewed Through Curry's Onion Model

Curry's Onion Model provides a well established framework within which to view the main learning style theories (Riding & Rayner 1998). Here we use the model to review these theories and hence to determine the most powerful theory with which to examine educational CMC.

Using CMC requires students to work in a predominantly text-based, somewhat hierarchical environment, which may present them with little or no information, or alternatively proffer vast amounts of information, according to the responses of other users. Although responses are written, the atmosphere is usually fairly informal and often relatively unstructured compared to a classroom. If the conference is asynchronous there may be a long wait for a response. On the other hand, if the discussion is synchronous, everyone may try to 'talk' at the same time leading to confusion. This is the context, then, in which we need to consider the suitability of the various learning style theories.

2.1 Outer Layer – Instructional Preference

The outer layer of Curry's model examines instructional preference. This layer is considered to be most observable, least stable and most easily influenced. Influences include learning environments, learner expectations, teacher expectations and other external features (Curry 1983).

The main theory of instructional preference is proposed by Dunn & Dunn (1978), who believe that learning style reflects the manner in which elements of five basic stimuli affect an individual's ability to perceive, interact with and respond to the learning environment. These are:

- *Environmental*: noise level, light, temperature and class design
- *Emotional*: motivation, persistence, responsibility and structure
- *Sociological*: learning groups, presence of authority figures, learning in varied ways
- *Physiological*: perceptual, intake, time and mobility
- *Psychological*: global v analytic, impulsive v reflective, hemispheric domination

Dunn & Dunn's theory, then, is concerned with stimuli that affect learning. However, although this may provide useful information to individual students in online education some of the stimuli cannot be controlled. Indeed, it has been proposed that the whole concept of a single common learning environment needs to be re-examined in a CMC context, as each individual may be working in a different environment. (Benigno & Trentin 2000) Some of the stimuli will still be relevant, but it is felt that as this level can be easily influenced, advice from the tutor and peers could overcome problems encountered in this area. It is not therefore seen as a fundamentally important theory from the perspective of improving educational CMC.

2.2 Middle Layer – Information Processing Style

The middle layer of Curry's model concerns an individual's intellectual approach to assimilating information (Curry 1983) and encompasses many of the learning style theories currently popular. This layer is considered to be more stable than the outer layer because it does not directly interact with the environment, although it is modifiable by learning strategies. Five main theories fall into this layer.

Kolb (1984) offers an experiential learning cycle, based on the learning models of Lewin, Dewey and Piaget. There are claimed to be four modes of experiential learning based on the cycle, which are presented on a two-axis grid. The horizontal axis runs between active experimentation and reflective observation whilst the vertical axis runs between abstract conceptualisation and concrete experience. The four quadrants are used to identify different types of learners: converger, accommodator, diverger and assimilator. Kolb's model has been used regularly since it was introduced and has led to the development of further models such as Honey & Mumford's LSQ and McCarthy's 4MAT system (discussed below).

The Honey & Mumford model (Honey & Mumford 1992) was developed from Kolb for use in commerce. It is intended to explore the implications of learning style for management and is often used in training situations and to strengthen teamwork. Like Kolb, it is based on a learning cycle and offers four learning styles: activist, theorist, pragmatist and reflector.

McCarthy's 4MAT system (McCarthy 1997) is also based around a four stage learning cycle and offers four learning styles: innovative, analytic, common sense and dynamic. Unlike the other theorists, McCarthy does not provide an assessment tool, instead advocating that every lesson should provide students of all styles with a preferred task for both left and right brain.

Gregorc (1982) proposes that people differ in the way they organise space and time. Individuals are seen as having two significant types of mediation abilities: perception (the way in which information is grasped) and ordering (the way in which the information is arranged, systemised and deposited). Perception has two qualities: abstractness and concreteness. Ordering has two dimensions: sequential and random. As with Kolb, these dimensions combine to provide four learning styles: concrete sequential, concrete random, abstract sequential and abstract random.

Gardener (1993) suggests that each individual has seven distinct areas of intelligence: linguistic, logical-mathematical, musical, bodily kinesthetic, spatial, interpersonal and intrapersonal. Gardener believes that an individual's abilities will differ in each area as will their learning style.

With the exception of the 4MAT system, all learning style theories at the middle layer of Curry's model provide some form of inventory that could be used to study educational CMC. The dialectically opposed modes offered by Kolb (1984), Honey & Mumford (1992) and Gregorc (1982) could all provide interesting insights into contrasting approaches to conferencing. However, we argue that the differences revealed by these modes may be apparent only in extreme cases, and will be difficult to discern in individuals with a more rounded learning style (Atkins 2000). Similarly, although Gardener's multiple intelligences theory (Gardener 1993) may help to provide an insight into the effect of subject matter on the response to computer conferencing, it is not seen as addressing learning style in a way that would aid our current research (Atkins 2000).

In sum, while all the theories in this layer could provide an insight into approaches to CMC, all fail to examine the verbal-visual modality, which is felt to be an important aspect of learning style when looking at a medium that is predominantly text based.

2.3 Inner Layer – Cognitive Personality Style

The inner layer of Curry's model examines cognitive personality style, addressing an individual's approach to adapting and assimilating information. (Curry 1983). This layer is considered to be an underlying and relatively permanent personality dimension. Five main theories fall into this category.

The Felder and Silverman Learning Style Model (Felder 2000) overlaps the middle and inner layers, classifying students on five spectrums: sensing/intuitive, visual/verbal, inductive/deductive, active/reflective, and sequential/global. Although students are classified on five spectrums, the assessment tool only provides a profile over four, omitting inductive/deductive. It is not clear why this is the case. Further, although it may eventually be able to provide a good profile of learners, Felder & Silverman's model is still under development and has no empirical evidence to support it.

Witkin (Witkin & Goodenough 1982) offers the theory of field-dependence and field-independence, based on an individual's ability to extract details from a context. The Rod and Frame Test and the Embedded Figures Test are used to provide a means of assessment for this theory. This approach is currently being used to investigate learning via hypermedia systems (Kim 2000). However, doubts have been expressed about the validity of both the style and the embedded field test. (Riding & Rayner 1998, Sternberg 1997). In particular, the approach has been criticised by Sternberg (1997) on the grounds that the tests have correct and incorrect answers, and that field-independence is seen as preferable to field-dependence, suggesting that the approach is related more to ability than style.

The Myers-Briggs Type Indicator (MBTI) (Association for Psychological Type 2000) is based on Karl Jung's theory of psychological types. Preferences in the four dimensions of: extraversion/ introversion, sensing/ intuition, thinking/feeling, and judging/perceiving, are used to characterise people according to sixteen types. Work is already being in progress using the MBTI to relate personality type to performance in CMC (Ahn & Ahn 2000). Kiersey develops two questionnaires, the Kiersey Temperament Sorter and the Kiersey Character Sorter, aimed at assessing temperament using different methods. (Kiersey 2000) These are broadly similar (approximately .75 correlation) to the Myers-Briggs Type Indicator. As in the MBTI Kiersey uses four temperaments and sixteen variants. However, both the Myers-Briggs Type Indicator and the Kiersey instruments examine personality types rather than learning styles. Although these theories are sometimes linked to particular learning styles, their primary use in not in that area.

Finally, Riding & Rayner (1998) offer the Cognitive Styles Analysis (CSA), developed as a result of their research on style differences in learning and behaviour. Over 30 style labels were reviewed, including some of the theories reviewed above. Riding and Rayner believe that style is divided into two dimensions: wholist-analytic (the way in which an individual would organise information - in parts or as a whole) and verbal-imagery (the way in which an individual would represent knowledge - in mental pictures or words). This verbal-imagery dimension which would appear to be highly relevant to CMC, given the latter's predominantly text-based nature. Further, the model has been developed for electronic use, has been in use for a number of years and has considerable empirical evidence.

In sum, two models, namely those of Felder & Silverman and Riding & Rayner, offer an investigation of an individual's preferences on the verbal-visual dimension that appears the most likely to affect CMC. Felder & Silverman examine four dimensions, which would give a broader picture than the two dimensions examined by Riding & Rayner. However, given the lack of empirical evidence to support Felder & Silverman's model, we argue that the CSA is currently the best model to use to examine the effects of learning style in a CMC environment.

3 A Framework for Empirical Investigation of Learning Style and CMC.

Our argument is, then, that the CSA should be used to empirically investigate the influence of learning styles on the effective use of educational computer conferencing. Much of the current use of, and interest in, CMC involves higher education, not least because of the growing economic pressures in that sector (Skillcorn 1996). Consequently, we propose an investigation of undergraduate study as a useful starting point for such an empirical study, using the following framework.

We begin by giving the target groups basic instruction in the use of text-based computer conferencing. Next we ask them to complete the Cognitive Styles Analysis which will determine their preferred learning style according to the CSA model and an attitudinal survey regarding their prior experience and attitudes to group work and CMC. Half of the sample is then asked to work on a time-constrained collaborative exercise using computer conferencing and given a similar exercise to work on in a face-to-face context at a later date. The other half of the sample participates in the exercises in reverse order i.e. face-to-face followed by CMC. This is an attempt to counteract the learning effect inherent in conducting two similar exercises.

Data is collected in a number of ways. An attitudinal survey at the end of each session obtains the students' reactions to the exercises. The face-to-face sessions are taped. Records of the CMC sessions are obtained from the computer. Statistical and qualitative analysis can then be used to evaluate the contribution of individual students in each situation, and results viewed in conjunction with the attitudinal surveys and learning style profiles.

We are currently putting this framework into practice with computing undergraduates. A later study will carry out a similar exercise with a comparable group of students from a different discipline, to investigate the possible effects of domain of study. A subsequent cross-sectional study will be undertaken to examine the possibility that maturation may alter the results. We also propose to conduct similar investigations with distance learning students.

4 Summary

It has been noted that often less than one third of students actively take part in a computer conference, and we have argued that this disappointingly low level of activity may be due, in part, to a mismatch between the presentation of CMC and the individual's learning style. Using Curry's Onion Model the main learning style theories have been reviewed and discussed. Whilst all of these may have some relevance to CMC, we have argued that Riding & Rayner's Cognitive Styles Analysis (CSA) is the theory that best addresses the issues that are fundamental to the successful use of computer conferencing. Finally, we have specified an approach to the empirical study of learning style theory for CMC.

We believe that the research outlined in this paper will lead to improvements in text-based computer conferencing and more active participation by a much higher percentage of conference members. This in turn should lead to important gains in the acceptability and usefulness of Computer Mediated Conferencing.

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A multimedia gate to Museum of Astronomy

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The Astronomical Observatory of Capodimonte is strongly working in the design and realization of multimedia and hypermedia educational products, in order to spreading the Astronomical Culture over a wider public. At present, there is a popular interest not only towards the astronomical research, but even for the historical events and their protagonists referring to Astronomy. Why the Bourbon, in XVII Century, would an Astronomical Observatory in the chief town of their kingdom? Who were the protagonists, artists - architects - astronomer, of the magnificent projects? What is their inheritance, in the light of the present scientific activity? To satisfy these questions, it is in progress the realization of a CD-ROM about the history of the Observatory and of Astronomy through the Museum of Astronomy, that is the testimony of a long history of astronomical research, presenting a unique collections of scientific and astronomic instruments of the 19th and first decades of the 20th century.

The CD-ROM features a highly interactive user friendly program. The structure is based upon fast and simple links among the various sections. The scientific contents are adapted to a language (word-image-sound) of strong communicative impact, without any spectacular effect that are dominant in many multimedia products. The educational aim is marked.

It is in progress the test phase of the software tools and of the authoring program that will be used for the CD-ROM realization.

Need for Intelligent Web Server with Powerful Authoring Functions: No More Stress on Web Authors

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Abstract: If we consider the rapid development of the Web technology, it will not always be possible for Web authors to keep up with the dramatic change of the authoring environment. In addition, there are several serious internal problems of WWW itself that make the Web authoring task laborious, e.g., the hyperlink management problem. As the number of Web servers will still continue to increase, and as more and more educators will join in the Web authoring activities, the demand for an intelligent Web server like Hyperwave will surely increase greatly in the near future.

Introduction

In the mid-1990s, when WWW first came into being, people were glad and excited because they thought that there would be only one common platform for hypertext authoring. Before that time, there existed a number of authoring tools that were mostly "machine-dependent." Thus, the widespread dissemination of high-quality multimedia materials developed with a specific authoring program was quite difficult. The emergence of WWW at first meant the separation of content authoring and navigation programming, since in HTML, hyperlinks are easily implemented just by writing simple tags. Today, the situation is not so simple. Needless to say, HTTP is the base system that enables communication in hypertext format on the Internet, and in this sense it is just the physical "rail" of the railway system. However, as we can see in some parts of Switzerland or Japan, several railway companies are now sharing the same "rail!" There exist several versions of HTML now, and several different types of programming languages have been developed for Web browsers. Streaming is no longer the monopoly of RealAudio and RealVideo, and the emergence of MP3 has had a great impact on the distribution of multimedia content over the Internet. Such developments may be indeed necessary for industrial evolution, but in order to maintain the presence of a Website in the total world of WWW, we have to create a really cool and sophisticated homepage. This inevitably gives a tremendous stress to Web authors. In addition, most of the Web authors creating educational Websites at educational institutions are not experts in information processing, so it is quite difficult for them to keep up with the current rapid development of Web authoring environments.

Further Problems

When we get accustomed to publishing documents on a Web server, we will soon encounter the difficulty of managing a rapidly increasing number of documents and multimedia objects on the server. Generally speaking, the energy required for the maintenance of a Website increases dramatically in proportion to the number of the Web pages and other objects, and will vary exponentially according to the total number of these objects. If we have too many pages and objects on a Web server, it will become very difficult to modify the contents of the Web pages or the directory structure, since these manipulations will inevitably force us to rewrite all link information involved. This is a very difficult task, and the perfect management of the link structure will be nearly impossible. As a result, large Websites will be never free from missing or broken hyperlinks.

In creating a new Website, we normally try to make an effort to create the best possible site in the beginning. We tend to spend a lot of time and lot of energy to create the "first version" of the new Website. However, as experience often shows, laziness will suddenly overcome us, and we often tend to be quite reluctant to continue the updating jobs to keep the site fully ready and fresh. Some researchers argue that there is a common psychological tendency among Web authors in regard to this problem. However, this author believes that this problem has something to do with the evolution of the HTTP platform itself. Today we are accustomed to the cool design of well-known Websites, and when we visit such cool Websites, we often notice that navigation switches are created in a very sophisticated way. Some employ a bold and novel graphic image and some employ Java, so that a Web page including such navigation switches requires nearly a minute for all the contents included in the page to be downloaded. This produces unbearable frustration for dial-up Internet users. The role of a navigation switch is "only" to lead the user to a certain URL and nothing more. The emergence of WWW seemed to have provided us with freedom from the complicated programming-like task involved in hyperlink implementation, and seemed to have let us concentrate on content when creating hypertext materials. In the course of the evolutionary development of WWW, however, Web authors have begun to totally confuse the navigation tools with content these days.

As we have seen, these problems arose in the course of the recent development of WWW, and the evolution of the total WWW system will go on regardless of the original philosophy of HTTP and WWW. Although Web authoring software will also undergo a dramatic development in the future, earnest teachers who are going to learn the authoring method of Web-based educational materials will inevitably encounter these internal problems of WWW.

Solution to Web Authoring Problems

The author has already argued that as the number of the Web pages stored on the Web server increases, the energy required for link management increases dramatically. It was also pointed out that a large Website would be never free from missing or broken links. One of the solutions to this problem, together with the above-mentioned authoring problems, is to use Hyperwave Information Server (HWIS), originally developed as Hyper-G, at the Institute for Information Processing and Computer Supported New Media (IICM), Graz University of Technology, Austria. HWIS is a next-generation Internet/Intranet server with powerful authoring functions and full-text search capability. The browsing and editing of the documents on HWIS requires no special client software, and Web authors can do almost all of the editing work and publication of objects just by using existing Web browsers. This is quite different from the system of Lotus Notes, where a special Notes client is necessary even just to browse simple documents. In addition, academic use of HWIS is basically free of charge.

On entering documents onto a certain directory of HWIS, hyperlinks with the name of each document will be automatically generated. When we access the same directory after publication, the document titles will automatically appear in the form of hyperlinks, and by clicking a desired title, we can easily open the necessary document. Basic navigation switches together with other switches used for editing works, authentication, preference settings, etc., are offered in the standard header automatically generated by HWIS. This will free us from the complicated task of link management and enable us to concentrate on the authoring of pure content material for of hypertext documents. Needless to say, it is also possible to embed hyperlinks in the contents themselves. The information about each hyperlink is stored separately from the object itself, as part of its "meta-information," in a special form by which the target of a link "knows" which documents or objects point to it on HWIS. Thus, the internal link structure is always kept intact even if some objects are moved to a different directory, or the directory structure is dramatically modified. In this sense, links are "bi-directional" within HWIS. When an object is totally removed from the server, the relevant hyperlinks pointing to it will automatically disappear, and if a link is embedded in the contents of a Web page, it changes into a normal phrase in black letters, and the default blue color and the underline indicating the existence of a link automatically vanish away.

HWIS is also equipped with powerful access rights control. Access rights of every object published on HWIS can be easily controlled just by using ordinary Web browsers. The easy control of access rights is also useful when we establish a BBS, which is internally offered in HWIS under the name of "Discussion Forum," because very often we would like only a limited pool of people to be able to post messages so that "uninvited guests" will not be able to post inappropriate messages. Of course, we can easily establish a BBS if we use one of the Web authoring software products such as Microsoft Front Page, but the control of detailed access rights is quite difficult if we use a WindowsNT/2000 based system.

Conclusion

If we consider the rapid change of the Web authoring environment, there seems to be only two choices for Web authors and publishers. One choice is to manage to keep up with the rapid change of the authoring environment, always learning new techniques of Web authoring and the related technology. The other choice is to rely on a Web server with powerful editing functions like HWIS, and concentrate on the contents of the documents. Considering the rapid development of the whole Internet infrastructure, it will not always be possible to continue to train educators in the most recent media-literacy skills. As the number of Web servers will continue to increase, and as more and more educators will join in Web authoring activities, the demand for an intelligent Web server like HWIS will surely increase greatly in the near future.

Genesis of a CD-based Authorware application: Lessons learned from six years of design and development

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The current paper describes the design, development, and evaluation of self-paced multimedia modules that are used in an advanced General Education course at San Jose State University. The design and development cycle of these modules began in 1994 and encompassed four major revisions. The General Education course, Technology and Civilization (TECH 198), is designed to introduce students to the realm of history and usage of technology in society and to increase their awareness of both the uncertainties as well as the promises of the utilization of technology as a creative human enterprise. The most recent version of the software (version 4.2) is used in lieu of classroom instruction. This presentation will display the evolution and evaluation of these multimedia modules over time. A focus will be on the lessons learned from the years of multimedia development.

Educational Applications of Conversational Agents

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Abstract: Conversational agents have historically been used for entertainment purposes. In this paper, we discuss new work that extends the capabilities of conversational agent

Conversational agents, often referred to as "chatterbots", have a long history dating back to the "Eliza" program written by Joseph Weizenbaum in the 1960's. Eliza attempts to simulate a Rogerian

a simple transformation algorithm to change user input into a follow up question (Weizenbaum 1966). Since that time, many chatterbots have been written and the basic techniques improved upon to include knowledge bases and logical inference mechanisms.

is paper discusses the application of certain techniques from the domains of intelligent tutoring systems and pedagogical agents to chatterbots for the purpose of providing a natural language conversational partner to support on line educational experiences.

Chatterbots do not perform general natural language understanding as of yet, which is a difficult open

user's natural language input. When a pattern or key word is recognized, the chatterbot crafts an

and has not found a match in the user's input, it "punts" and outputs a response not based on the user's

phrases such as "please go on..." More sophisticated chatterbots, including those we are developing, perform a certain amount of user modeling

the conversation (likes and dislikes, etc.). These chatterbots bring this information back up in the form of a question when they encounter a problem recognizing input and are forced to pu

continuity to conversations, these chatterbots do not typically provide significant intelligent direction to the conversation, relying instead on the user for direction. While this behavior is adequate for entertainment

it is often incompatible with educational objectives, and is a main area that we improve in our educational chatterbot. In addition to conversational direction and focusing mechanisms, we can adapt

intelligent tutoring systems to provide more individualized interaction.

To achieve a directed conversation, we must give the chatterbot an idea of a precise conversational

ct in the conversation. The student dialog can include tangents initiated by the user. However, the chatterbot remembers where it is in

conversation to meet its educational goals. This type of conversation lends itself to Socratic dialog in

understand the reasoning given, then it can offer a possible line of reasoning (either correct or faulty) and

provide a reason, or it can choose to back up to prerequisite material in this case. If the student does

test that theory with. Students' subsequent answers can be checked for consistency with their current theory. If an answer is not c

student for a new theory. The most difficult part of creating this type of behavior is the design of the conversational transition network for the chatterbot so that it knows

large knowledge base. This knowledge base can be specific to the instructional domain it is designed to work with (mathematics, for example), or it may also include general knowledge (birds lay eggs, have feathers, can fly, are a type of animal, are thought by some to be the evolutionary descendents of dinosaurs, etc.) Knowledge can be organized according to a variety of conceptual hierarchies. Students may query the agent for information from this knowledge base, such as "Tell me about Pascal's Triangle", or "Is an integer a type of real number?" In addition, the agent may contain self-referential knowledge used to establish aspects of its personality.

In order for an educational chatterbot to tailor its conversation to best suit the knowledge of a particular student, we can employ student modeling techniques which attempt to give the agent an idea of what concepts the student either knows or has misconceptions about. The student modeling technique we employ is based on educational research described by Jim Minstrell and others, and is founded on an idea called a facet (Minstrell 1992). A facet represents a particular conception or misconception of a certain idea, which a student may or may not hold. For each important idea in a curriculum, there exists a cluster of facets, each facet representing a different level of student expertise. A chatterbot can be programmed so that certain things that the student says in the course of a conversation (particularly a directed conversation) can be interpreted as evidence that the student holds a particular concept or "facet". When deciding how to respond to student input, the chatterbot may be designed to take into account relevant facets that it has inferred the student holds and alter its behavior accordingly. This student modeling technique has some similarities to the classic "overlay" techniques used by some intelligent tutoring systems (Carbonell 1970), but does not suffer from the lack of misconception information found in such models. It is currently being used in pedagogical agent development work being performed at the University of Washington (Baer & Tanimoto 2000). Chatterbots are not a replacement for teachers, but compliment teachers' educational objectives. Using student modeling techniques, they can also do limited assessment of student knowledge and can provide assessment evidence and suggestions as an educational resource to the teacher.

Taken together, the techniques described in this paper offer a great deal of opportunity for chatterbots to be applied in educational settings, where their ability to interact using a natural language interface may be of value to students, particularly those who may feel put off or intimidated by other types of human-computer interactions. Even in an educational setting, a conversation with a chatterbot can be entertaining – sometimes they say rather amusing things – and this may contribute to the motivation of students to continue interacting with the system and learning. These agents can be implemented as either stand-alone conversational agents or as conversational pedagogical agents within the context of an interactive learning environment. As stand-alone agents, they can provide an entertaining method of delivering educational content in an interactive and conversational way, without requiring the development of a complete computer-based learning environment and accompanying agent for each topic that one wishes to teach.

We have begun a project to develop chatterbots for educational purposes. We began by initially building a basic framework for an entertaining chatterbot, and are currently in the process of building directed conversations around specific subjects for our chatterbot. The first of these will guide the user through a dialog to discover the relation that describes Pascal's Triangle. We are also building a conversational pedagogical agent to support a language arts and word processing learning environment for 6th graders.

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The Internet Shared Laboratory Project

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Abstract: In this paper we present the project of an Internet shared instrumentation laboratory for measurement on electronic circuits. The main project goal is to perform experiments driving real instrumentation and controlling the real operational conditions, working from any node on the network in a multiuser environment. We realize a virtual presence into the laboratory since it is obtained through software interfaces that remotely allow instrumentation control. The interaction with real devices overcomes the typical limitations connected with simulation and leads to an effective learning by doing educational environment. A measurement testbench prototype has been implemented following the proposed model.

Introduction

Virtual reality has been successfully used to build experimental environments mainly addressed to the reproduction of the aspect and the behaviour of physical systems. Complex models have been developed and a high level of realism has been reached. We believe that virtuality is well suited to the "learning by doing" approach of technical disciplines where the experimental work is an essential support to the learning process of theoretical topics. Practice is often constrained by the availability of proper resources. A virtual approach and computer networks can provide instrumentation access for a wider community. The effectiveness of virtual laboratories as experimental environment depends on the level of realism obtained by the operational conditions and on the simplicity and robustness of its software interfaces (Ferrero, A. 1999, G. Orange, G. 2000).

We are working on the project of an Internet shared instrumentation laboratory for measurement on electronic circuits. The project is addressed to drive real instrumentation and to control the real operational conditions, accessing the laboratory from any node on the network in a multiuser concurrent environment.

We realize a virtual presence into the laboratory since it is obtained through software interfaces that remotely allow instrumentation control. A big effort has been addressed to the implementation of these interfaces in order to lead to a high level of interactivity and reproduce, as far as possible, the laboratory environment. It is worth noting that the interaction with a real environment overcomes the typical constraints due to simulation-canned drills and leads to an effective learning by doing educational approach.

A major problem concerning real instrumentation control comes from the contemporary interaction of multiple users. In presence of instruments simulators, the software itself will provide coherency of the concurrent experiments execution reserving a separate task for each user, by forking or instantiating new processes; on the contrary, when real instrumentation is driven remotely, implementing coherency between actions and results for each user is more complex. We need to manage many contemporary experiments: each experiment has its actions queue, each user has to be sure to perform his/her own actions and observe the related results. The instruments must be reset to their previous state before any new action in order to avoid unpredictable results.

The experiment execution and management can be efficiently implemented through a laboratory server acting as a manager able to separate actions and data belonging to each specific experiment.
Main tasks of this server are:

- identification of different workspaces for each experiment and reservation of resources for its execution;
- scheduling of the execution of different requests addressed to the same instrument;
- communication of action results.

The Project

The client-server paradigm is the basic architectural concept and the system functionality are distributed both on the server and the clients. On the client side, a web-based interface to the laboratory allows to select the experiments. The dialogue with instrumentation is developed by means of Java applets. On the server side the system is based on a web server that introduces users into the laboratory, implements access control, lets them select experiments and distribute instruments interfaces (e.g. applets). A specific application runs as a daemon and takes care of the communication with the clients and of the concurrency of many experiments. This is the core of the environment and can run on the same platform of the web server or on a dedicated one.
Our solution for the implementation of the system is based on the LabVIEW programming environment from National Instruments (see http://www.ni.com) and Java. The hardware requirements can be satisfied by standard PCs interfaced to the laboratory instrumentation. The laboratory core server has been developed using LabVIEW, since it is a standard "de facto" in measurement and virtual control of instrumentation.
The client application is completely platform independent. It has been developed using the AppletVIEW Toolkit (see http://nacimiento.com/AppletVIEW/) that represents an effective solution for the integration of Java and LabVIEW. By this way no specific requirements exists for the client that can work through a Java enabled standard browser. The applets open a dedicated communication channel with the laboratory server using a specific TCP/IP port. All the data are passed through this dedicated channel until the end of the session, when the channel is closed and all the resources released. A measurement testbench has been implemented following the proposed model. In Figure 1 a sketch of the system architecture is shown. A waveform generator and an oscilloscope are the instruments available to conduct measurements on circuits under test. Registration and authentication tasks are carried on the basis of a user database and activity logs are available.

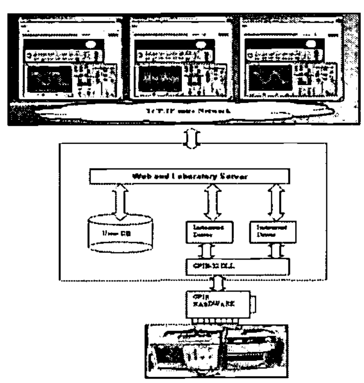

Figure1: The laboratory prototype

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Interactive multimedia authoring tool for web-based testing

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Abstract: The paper presents the architecture of student self-evaluation and on-line assessment system TestTool. The purpose of the system is to improve the web-based self-instructional mode of learning, grounded on the constructivist model of education. The TestTool assessment engine along with traditional types of questions includes a new question type, called as 'graphical construct', which is addressed to assess real problem understanding rather than recalling and looking for correct answer among a few predefined alternatives. TestTool is realized in JAVA and uses Oracle as a repository for various assessment data.

Introduction

With advancements in network-based learning Computer-Assisted Assessment (CAA) is being increasingly used in higher education institutions. CAA is seen as particularly appropriate for knowledge-based subjects with recall and recognition skills predominating. Typical subjects being taught at our technological university belong to category of science and technology where understanding of processes or constructions is needed. Engineering studies are based on knowledge building via real understanding how process or construction works as a whole. This real understanding must be achieved through accumulating subject knowledge base as well as through developing skills. CAA environments currently in use helps mainly to assess level of knowledge, but have limited skills testing possibilities. In this paper we focus on distinctive features of CCA using TestTool system developed at our University under the EU funded project MATEN. We will also discuss on results of extensive usability test from the tutor's point of view.

Graphical construct question

The TestTool is comprised of three software modules – Tutor, Author, Student – to work together using data stored on database server. Technologically it is implemented in Java and due to many practical exploitation reasons is linked with Oracle database.

For authors and users as testing facility the system exposes a new significant feature. The TestTool assessment engine along with traditional types of questions such as various forms of Multiple Choice (MCQ) includes a new possibility addressed to assess real problem understanding rather than recalling and selecting a correct answer among a few predefined alternatives. That new type of question has been called as 'graphical construct' question (GCQ). The concept of the GCQ is in giving a student the task to create or assemble a correct construction from a set of objects displayed in constrained area on the screen, called a 'graphical panel'. Non-movable objects are put in their fixed place, movable objects may be dragged into any place within the panel area. Behind the scene there is a correct construct created by the author, which is used by assessment engine when student submits his answer. Correctness is defined by checking whether movable objects were actually positioned in a proper place relatively to other objects.

To prove the strengths and weaknesses of the approach, self-evaluation exercises and summative assessment questions for the course module "Data Structures" were prepared. Three test sequences have been designed in accordance with content of the module (Tab. 1). Each sequence includes a given number of questions, which are selected randomly from a stock of variants during the testing session. The Test III includes mostly a GCQ type questions.

Test Sequence	No. of questions in a sequence	Stock of variants for exercises			Stock of variants for summative assessment			Average time in min. to take a test
		Total	Includes GCQ		Total	Includes GCQ		
			Simple	Complex		Simple	Complex	
Test I	6	49	-	-	49	-	-	4-8
Test II	5	40	12	-	65	27	-	8-12
Test III	5	28	7	21	55	-	31	12-30

Table 1. Quantity of questions in the tests.

A rather simple example of GCQ is given on the Fig. 1. It is the view, which is seen by author when he sets up a single test question. The display is split into two graphical panels: left hand side is the area where question or task situation has to be created by selecting and drawing objects using graphical editor and menu. Equally on the right side panel author provides a desirable solution of the task, which must be stored as anticipated answer in the database. Definitely, a student taking a test receives only a left hand side view.

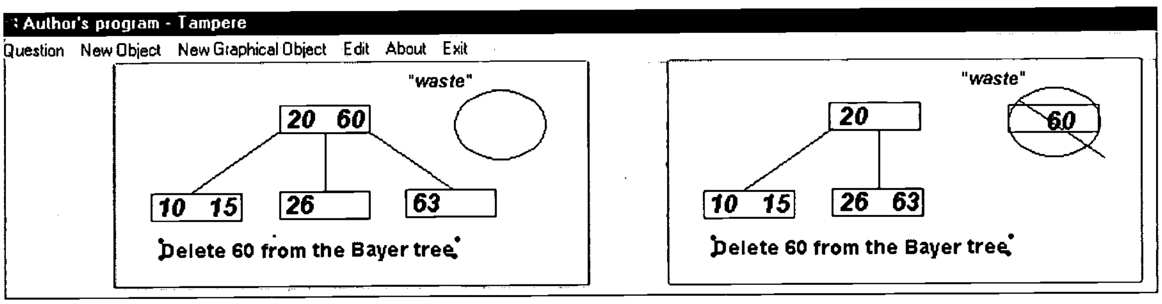

Fig. 1. The example of graphical construct question.

Lets have a look into left-hand side task panel. Bottom line is a task – to delete element 60 from the initial Bayer tree. A student has to make a several displacements and/or substitutions in order to obtain a correct data structure, i.e. Bayer tree. During the usability experiment it has been proved that performing such kind of constructive activities learners comprehend and gain data structures understanding rapidly.

The usability test has been done in real teaching setting when delivering "Data Structures" course module for CS undergraduates. The 266 students were registered. They took tests in training mode first, after that did examination test and were graded. The www discussion board and E-mail facilities were available for students to communicate among themselves or with tutor, also they were asked to express their opinions regarding content and procedure of assessment using TestTool. In general, students' appreciations were positive.

Discussion

In current CAA systems dominate various forms of MCQs and Open Questions(OQ) are also in use. A standard web programming means can be used for MCQs implementation quite simply and cheaply. From didactic point of view, however, multiple choice significantly restricts students' activity and does not support constructivistic mode of learning. On the other hand, OQs allows students to construct their answers and provide them in most suitable and clear for them form. But checking for correctness of such answers still is not computerized and must be performed by tutor. In the case of growing number of students it becomes increasingly less acceptable. The GQC, we think, falls in between of these two extremities. This type of question allows to simulate constructivistic mode of learning. The mechanism to define correctness of answer using location of the objects within constrained area in some extent is a weakness of the concept. It is because a student may drag any movable object into approximately correct location, but it could be 'not enough a bit' to hit a target area for this object. The use of GCQs in practice clearly proved, that new didactic possibilities opened for tutors outweigh this kind of weakness. It should be anticipated, however, that it is quite difficult to create reasonable set of GCQs in a given subject area. Since TestTool technology allows to realize the given GCQ scenario easily, it becomes worthy to do. The usability experiment, in which participated 266 students and three tutors, proved the correctness of the approach, also disclosed some drawbacks suggesting further improvements for developers.

Constructivist Instructional Design and Development of a Networked Learning Skills (NICLS) Module for Continuing Professional Education Distance Learning

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Abstract: This paper proposes an ISD approach for the design and development of a basic Networked Information and Communication Literacy Skills (NICLS) module. The need for such courses as pre-modules for on-line distance education programmes for professional adults is presented and discussed. Furthermore, and as part of the design process the paper discusses and defines information and communication literacy and its main aspects. The curriculum is then designed using an experiential learning approach and the resulting web based educational approach presented and described.

Motivation

Online environments, and the use of the WWW in online courses, have been seen as the most recent educational panacea to try and provide students with such skills as online communication, online discussion and negotiation of meaning (Bowskill, 1998). The emergence of new educational approaches and epistemologies, such as constructivism and problem based learning, have also been identified as possible ways of fostering and promoting the mentioned skills (Nunes et al., 2000; Pincas, 2000).

As a consequence, students feel compelled to undertake new methods of instruction and provision without being properly equipped with the basic skills required explore a networked learning environment. In fact, students are expected to developed high cognitive skills such as negotiation of meaning, long-life learning, reflective analysis and meta-cognition without being properly trained in low-level skills such as the use of computer mediated technology, online etiquette, web navigation, and web searching. These skills were identified by Nunes et al. (2000) as basic *networked information and communication literacy skills (NICLS)* and are required to succeed in the online learning environment to which students are exposed, but also an essential part of all aspects of daily networked activity.

This paper concentrates on the design and development of a NICLS core skills pre-module for the MA Information Technology Management (MA ITM). The course is entirely a distance learning programme and course participants are professionals in the Information Technology (IT) sector. In previous years, it was assumed that, because of their professional and technical background, they would posses this type of skill, and therefore, that no particular training was required. This resulted in under-usage of existing online resources and consequently under-performance and failure to match student and tutor expectations.

Educational Hypermedia Development Methodology

An educational web application can be seen as an instructional system, in the sense put forward by Nervig (1990): as sets of interacting, interrelated, structured experiences that are designed to achieve specific educational objectives, but organised into a unified dynamic whole. Hence, the design of such an hypermedia application should result from the design specifications emerging from the process of analysing curricular problems.

To design and implement these web-based applications, practitioners require instructional systems design (ISD) frameworks. The importance of this overall ISD rests in assuring that the whole environment is implemented using the same learning theory (Nunes, 1999). In fact, if not carefully planned, the web-based environment could result in a mix of eventually conflicting techniques from different theoretical perspectives.

Therefore this paper discusses the design and development of web-based applications for higher education (HE). Academic learning is here seen as an active process in which meaning is developed on the basis of experience, in accordance with the constructivist theoretical frame (Laurillard, 1993). So, to develop web applications in keeping with a constructivist approach, it is important to have an understanding of the kind of specifications that will result from constructivist instructional design (Tam, 2000).

Constructivist Instructional Design

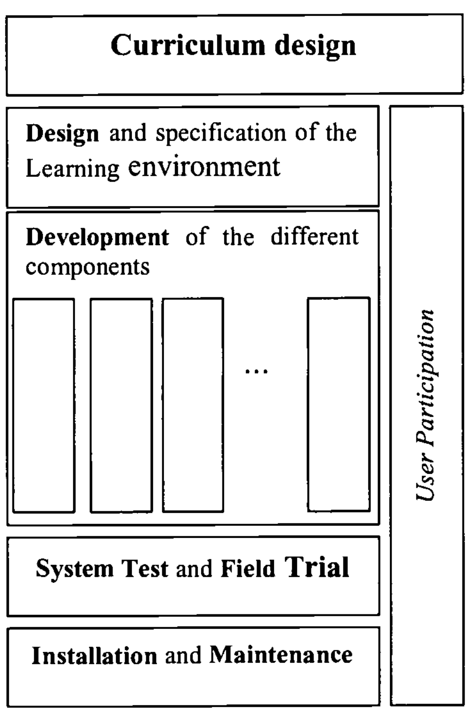

Fig. 1 General ISD framework adapted from Croft (1993) and Nunes (1999).

In the design and development of our web based application the ISD model shown in Fig. 1 was used. Since according to the constructivist philosophy, knowledge domains are not readily separated in the world, information from many sources bears on the analysis of any particular subject matter and it is not possible to isolate units of information. A *central core body of information* must thus be defined in the *curriculum design*, but boundaries of what may be relevant should not be strongly imposed. Instead of dividing the subject matter into logical analysis of dependencies, the constructivist approach turns toward a consideration of what users of that knowledge domain do in real life contexts. The ultimate goal of this approach is to move the learner into thinking in the knowledge domain as if he/she were an expert user of that domain Bednar *et al.* (1992). The designer should then define simplified but still authentic tasks to be experienced by the learner. The goal is to portray authentic learning activities, not to define the structure of learning to achieve the tasks, since it is the process of constructing a perspective or understanding that is important and no meaningful construction is possible if all relevant information is pre-specified (Bednar *et al.,* 1992).

Additionally, curriculum design must ensure that activities are situated in real world contexts, are authentic, and provide multiple perspectives on the subject matter. Some degree of *coaching* or guidance must be provided, by including meaningful examples and the different perspectives of experts and peers. A central strategy for achieving this consists in providing collaborative learning environments including computer mediated communication (CMC) facilities.

CMC allows both peer-to-peer and peer-to-tutor communication. Additionally, access to extra information sources must be enabled in order to allow different learner's needs to be satisfied.

It is in the *design phase* that all the components of the learning environment required by the curriculum design are defined and specified. During the *development phase* the learning environment is implemented according to the specifications coming from the design phase. Since different types of educational technologies may be needed, to implement all the planned activities, examples and communication channels, different development methodologies may then be applied. Finally the hypermedia application must be system tested and field-tested as an embedded component in the overall learning environment.

Web Application Development Methodology

The software development methodology that best supports the production of web-based educational applications is the rapid prototyping approach. A rapid prototype is a simplified and untested equivalent of the actual application, performing all the basic functions specified for the final product (Howell, 1992). As shown in Fig 2, by implementing a prototype first, the hypermedia designers are able to put forward a fully functioning application, presenting all the basic features of the final product such as: user-interface, link structure and coaching facilities. This is not a diagrammatic approximation or representation, which tends to be looked at as an abstract thing, but an actual implementation of the specifications for the application.

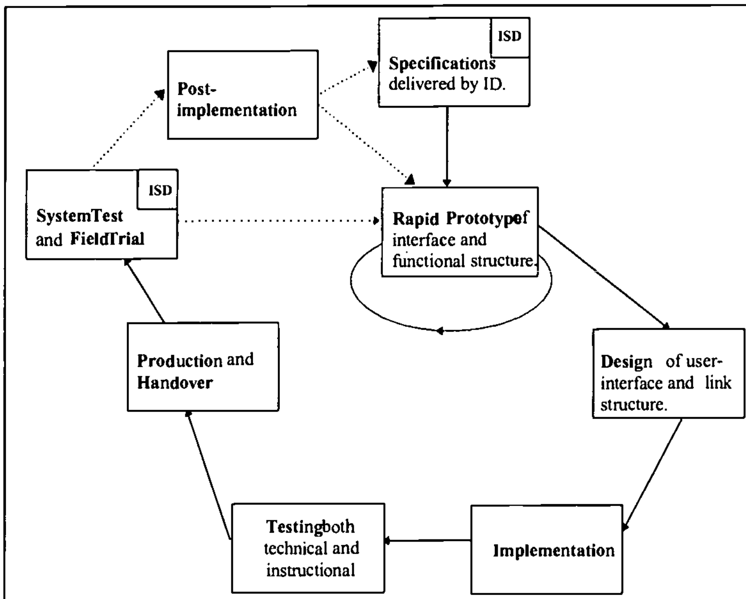

Fig. 2. Rapid Prototyping Hypermedia Development Cycle.

These prototypes can be realistically tested and assessed and rapidly changed in an iterative manner until consensus is reached. Evaluation and testing of these prototypes must be done by instructional designers and ideally include pilot tests using target learners. Furthermore, web-based applications are inherently different from other software applications. The volume of actual code produced in scripts is relatively low and emphasis is put in user-interface design, link structure design and definition of content entry as the different multimedia components. These characteristics, along with widespread availability of authoring tools, make it possible for rapid development and testing of prototypes.

Curriculum Design for the NICLS Module for Online Distance Education

NICLS can be defined, as the skills required to use networked communication and information technologies to support networked learning activities. Goodyear (2000) defines 'networked learning' as:

> "learning in which information and communications technology (ICT) is used to promote connections: between one learner and other learners, between learners and tutors, between a learning community and its learning resources"
>
> (Goodyear, 2000: 9).

Therefore, NICLS can clearly be divided into two main categories: CMC and information skills. CMC skills are related to the interaction of the student with the learning community and have very different features from both written and spoken language as proposed by Yates (1993,1995). Information skills are required due to problems of information anxiety and overload as well as access to the learning resources caused by the erosion of information boundaries (Pincas, 2000).

The curriculum being proposed was based on this theoretical framework as well as a preliminary survey of student requirements. This survey suggests that the latter of the two initial categories identified above, needs to be further subdivided. In fact, students have two main difficulties when using on-line resources: finding and evaluating them. Consequently the syllabus for the NICLS module was designed around the three main topics:

- Online Collaboration and Co-operation;
- Information Searching and Retrieval;
- Evaluation of Networked Information Resources.

The Pedagogical Approach

A *constructivist pedagogical approach* has been considered for the design of this module. The following assumptions are behind the selection of this approach:

- that learning involves an active process of construction on the part of the learners at individual and social levels, rather than the passive reception of data;
- that the role of the tutor is that of a facilitator to support independent engagement in the process of construction, "scaffolding" the learning environment by providing relevant resources;
- that collaboration and peer support relationships are as essential features as those of the educators in order to engage in dialogs and explore multiple perspectives, exchanging experience, ideas and feedback;
- that learning activities must be authentic and situated within a real context if learning and skills are to be transferred easily into another contexts;
- that course design should engages with learners' individual experiences and encourage ownership of, and motivation to learning.

However, and as discussed by Wilson (1993) constructivism is a philosophy not a strategy, that is, constructivism is an epistemology of learning rather then a framework of teaching (Fosnot, 1996). Consequently as argued by Nunes (1999:53-57), educational practitioners require a clearer educational framework to design their courses.
Experiential learning is a framework that can be used as a constructivist tool as described by Nunes and Fowell (1996). This course was designed using this approach. The aim is to encourage participants' awareness of and skills in reflective practice, i.e. learning by doing. Thus, the course has been based in a selection of activities, which aim to encourage learner's engagement with all the phases of the experiential learning cycle.

The course design comprises a blend of activities to set within the same platform in which learners are going to undertake their masters' degree - WebCT. Therefore it promotes a hands-on and authentic learning environment conducive to collaborative learning. The NICLS course was structured according to the course outline presented in Appendix 1.

NICLS Module Design and Development

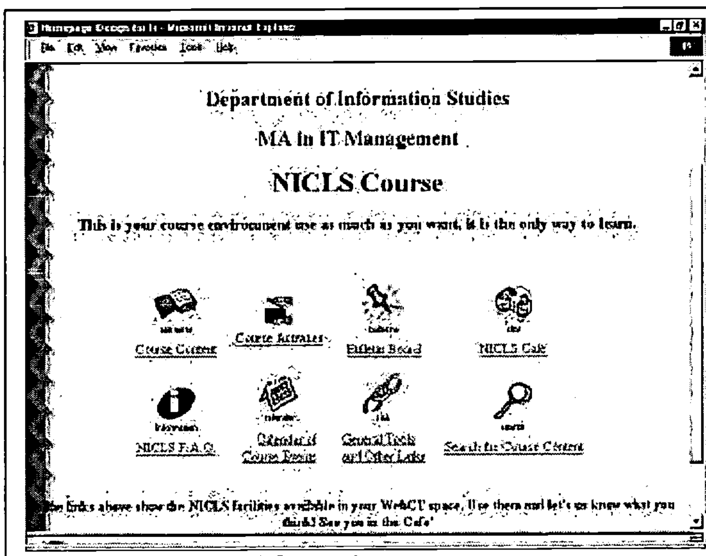

Fig. 3 The NICLS WebCT Environment.

Since the NICLS module is supposed to be a preparation module for on-line learning and in a constructivist environment learning activities have to be situated, it was a natural choice to implement the module using WebCT. Design tasks involved choosing appropriate facilities and WebCT tools. Development consisted in preparing facilities and tools for student use. The resulting environment was prototyped with the participation of both lecturers and current students. An illustration of the current iteration of the course is shown in Fig. 3.

Course Contents provides links to resources such as: course overview, course structure, explicit materials for the five units, and a course map. *Course Activities* provides links to the activities of the week, previous activities and reference materials. The Bulletin Board is used as open posting facility open to all. NICLS Café is an informal social space open to all participants. Specific conferences and chat rooms are created for specific activities. Finally, the NICLS FAQ is a frequent asked questions facility that aims at collecting students questions, comments and anxieties about the course and provide an information repository for reification for future students.

Conclusion and Future Work

Implementing hypermedia educational applications means much more than just designing a few screens and specifying their sequence (Nunes and Fowell, 1996b). Today, such an approach is not sufficient to support effectively support the learning processes envisaged in constructivist, collaborative or experiential learning philosophies. Understanding the web as an educational technology, and its role within educational practice, is the key to the development of successful learning environments. Moreover, the way to prevent a backlash against the use of this educational technology lies in recognising both the technical and pedagogic components of instructional design and integrating them in a methodologically coherent manner. Rapid prototyping is an ideal approach, which facilitates the integration of the different agents in educational software development: the subject matter experts, the instructional designers and the software developers.

However, designing good learning environments is clearly not enough to guarantee the success of the learning process. In fact, learners that are supposed to use these environments, have to be trained and allowed to acquire the skills needed to be successful on-line learners. The design and development process described in this paper is part of an ongoing research on Networked Learning Support. The module presented is currently being tested with new students enrolling the MA ITM course, prior to commencing their studies. The module and the instructional design process used to design and develop it, need to be carefully and thoroughly evaluated. If successful, this module will be used in all other programs in the Department, and eventually proposed as a University wide elective module.
Furthermore, it is thought that, after the evaluation process, both the module and the curriculum will have to be remodelled regularly in order to accommodate the changing characteristics of both learners and networked environment.

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The University of Sheffield
Department of Information Studies
Module Outline 2000-01

Module Title:	Basic Networked Information and Communication Literacy (NICL)
Module Code:	ITM000
Pre-Requisites:	None
Status:	core: MSc ITM approved: MA LIM, MScIM, MSc HIM
Credits:	0 credits
Timetabling:	Induction Period
Lecturers:	Dr. Miguel Baptista Nunes and Ms. Maggie McPherson
Tutors:	Mariano Rico
Version Date:	99.12.15

Aims and Description:
This module aims to provide learners with a core competence of basic communication and information skills, prior to starting the MA in ITM programme. This will allow students to effectively carry out the course learning activities in the selected web based learning environment with. Consequently, the purpose of this pre-module is mainly to deliver a hands-on experience with the tools and methods for networked learning that are to be used by learners in a web based distance education master's degree course. The module also aims to encourage participants to work collaboratively with their peers, in order to become aware of the potentials and constrains of networked learning.

Objectives:
By the end of the course, students be able to:
- Demonstrate proficiency in the use of the technologies used for CMC;
- Show awareness of the social factors affecting CMC;
- Use and comply with the different conventions and etiquette for CMC;
- Effectively communicate and work collaboratively on-line with both peers and tutors;
- Formulate different searching strategies effectively;
- Demonstrate the knowledge of criteria for evaluating online resources;
- Evaluate the validity of search findings.

Methods/Course Delivery:
The module will be presented via a combination of online activities and tutorials. It runs for 5 weeks, prior to the start of the first module of the MA in ITM programme. Students are required to spend about 6 hours per week with different learning activities. Since participation is based to a large extent on on-line discussion and activities, students will need to set aside regular and reasonably frequent times for on-line participation. However, although the level of weekly participation is set at 6 hours, students' weekly timetable for the course can be flexible to fit in with changing needs and work patterns.

Syllabus Content:

Week	Theory	Learning Activities
1	Introduction to the course and to the ethos of the learning experience. Fundamentals of CMC.	1. Email 2. Web Conferencing
2	Synchronous and asynchronous Communication: technical aspects.	1. Using Chat 2. Case Study 1 Discussion
3	Synchronous and asynchronous Communication: social aspects.Introduction to the Coursework Project.	1. Case-Study 2 Discussion
4	Information Search and Retrieval in Networked Environments.	1. Using Search Engines 2. Using the Library Catalogue 3. Formulating Search Strategies 4. Case-Study 3 Discussion
5	Networked Information Evaluation	1. Case-Study 4 Discussion 2. Online production of the coursework report.

Assessment:
No formal assessment is proposed for this module. Students will be assessed on a Pass/Fail basis by means of a group project that involves the production of collaborative work.

Further details of the case study forming the basis of the coursework, along with a list of specific deliverables is presented during the week 3.

CREATING AND SUPPORTING ONLINE LEARNING COMMUNITIES

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Abstract: Educational technology and the ways in which it is used have undergone considerable changes over the last three decades. Various technology-driven 'change agents' have been responsible for the ways in which this subject has evolved from 'chalk and talk' through 'multimedia' to sophisticated virtual reality training environments. Increasingly, educational technology has to be used to support online communities of learners. This paper discusses some of the issues involved and uses a case study to illustrate some of the important techniques that are currently in use..

Introduction

Many new ways are now becoming available for using computer-based communications technology to distribute and store online information. Such developments necessitate that we critically review the approaches that we employ for the realisation of the basic infrastructures that are used for the support of teaching, training and learning activities. This is especially so with respect to lifelong learning, work-based study, and continuing professional development. With this objective in mind, this paper introduces and discusses a model of teaching and learning that can be used as a basis for building new types of educational infrastructure based upon the use of web-based resources, peer group interaction and online tutoring.

Fundamental to this approach to educational delivery is the creation of an online community of learners involving students, academics, practitioners and subject experts. Members of such a community can interact with each other in both a synchronous and an asynchronous fashion by means of appropriately designed computer conferencing facilities, electronic mail and web-based resources. Naturally, the design and implementation strategies that are used to create and support online learning communities must cater for a variety of different study modes - such as individualised learning and situations that involve collaborative group work. Of course, it is also necessary to ensure that the skills students develop are accredited in appropriate ways using online assessment systems.

Some of the issues involved in designing and implementing online courses have been discussed in detail by Barker (1999a), Barker and Giller (2001), Duchastel (1997), Carr-Chelman and Duchastel (2000) and Ryan et al (2000). There is also a growing volume of literature available electronically through the Internet - both in the form of written publications and contributions to discussion groups. The following section of the paper briefly discusses some of the material that is relevant to the work that is described in this paper.

Some Basic Models

Three broad types of model are needed in order to understand, design and implement learning systems for online users. The first of these relates to the communities of online users for whom the systems are designed; the important issues here are concerned with the ways in which online communities are formed and the ways in which they behave (Preece, 2000). The second type of model relates to the role of technology in society and the ways in which its ongoing development influences the nature of what people do, how they react and the ways in which their goals and ambitions are influenced. The third type of model concerns the ways in which technology can be used in order to fabricate new types of educational system and new approaches to teaching and learning. It is this latter type of model which is considered in the remainder of this paper.

The underlying model that we use to design electronic courses for online delivery has been described in detail previously (Barker, 1999b). Essentially, this model depicts the relationships that exist between an online learning community and the four major building blocks used to create an electronic course for such a group of learners. The four essential components that we believe are necessary to build an online course are: (1) the web-based resources that are needed to provide basic course content; (2) an online support infrastructure (tutors and technical help); (3) the communication strategies that underlie course-related online dialogue and student conversations; and (4) the various learning tasks undertaken by students during a given course. The latter may be designed to support skill development activities or assessment procedures. Of course, the tasks that students undertake during their studies will normally involve both individual study activities and group-based working.

In order to support the tasks involved in group-based working it is necessary to have an underlying model that describes the essential features of what is happening. In addition, appropriate tools will also be needed in order to support the basic processes that are involved. The tools that are most often used are described and discussed in the following section; this section therefore concentrates on the underlying model that we use for the support of collaborative learning at a distance.

Some of the important generic models upon which human communication processes depend have been described in detail elsewhere (Barker, 2000). Our model of collaborative online learning, through computer-mediated communication (CMC) techniques, evolves naturally from these. At its centre, the CMC model requires a problem space in which shared objects relating to an online learning activity can be created. The CMC environment must then be able to provide a communication framework that allows two basic functions to be realised. First, learners must be able to communicate with each other with respect to objects existing in the shared problem space; second, they must have available an appropriate repertoire of commands to enable objects in the shared workspace to be manipulated in various ways. Obviously, the power and utility of a CMC environment will depend upon both the nature of the shared workspaces that it supports and the communication/manipulation tools that it provides for its users. This latter issue is discussed in the following section.

Communication Tools

If students are to learn from each other through dialogue and conversation in an online environment then it is imperative that we put into place an appropriate infrastructure to facilitate their communication needs. A variety of different electronic communication tools exist to support the delivery of online courses. Typically, these include electronic mail packages, list servers, bulletin board systems and computer conferencing packages.

Undoubtedly, electronic mail has become one of the most common methods of exchanging messages using computer-based communication networks. Through the use of 'attachments' a wide variety of materials can be exchanged – such as essays, digital photographs, sound clips, video footage and executable programs. Each of these types of medium has a significant educational value in the context of online conversational activity. Although electronic mail is a powerful technique, it has many limitations for use within educational settings, particularly online learning environments. For example, there are no simple mechanisms to allow message threading to reflect the various dialogue strands that might emerge within an online discussion forum. Furthermore, it is not easy to look at message histories in order to identify who has (or has not) read a particular message. There is no control over who submits material and the nature of what is submitted, and so on. For simple online support, electronic mail has many attractions. However, for more sophisticated use it has severe limitations. More powerful CMC tools are therefore needed.

Some of the other important tools that are often used within online learning environments include: a web browser (of course); and programs that facilitate either the transfer of data files between users (such as '*ftp*') or online 'terminal' sessions with remote computers (this is usually accomplished with '*telnet*'). Together, these three basic communication tools form an important 'toolkit' for users of online learning systems. However, as is the case with electronic mail, these tools do not really provide many sophisticated techniques for the support of dialogue processes between groups of students and/or tutors - of course, some browsers such as Internet Explorer (Version 5) do provide a group networking capability.

Computer-conferencing systems represent an example of the type of tool that is now often used to create and support online communities of learners (McConnell, 2000; Harris, 1999). Such tools often provide a wide range of built-in facilities that allow many of the limitations of conventional electronic mail to be overcome. Indeed, used in an appropriate way, alongside a suitably designed teaching web, a CMC system can provide a rich and powerful facility for both student and staff support within an online learning environment. In the case study that is described in the following section, a powerful computer-conferencing facility (SoftArc's *FirstClass* system) is used as a basic building block within the online course that is described.

Both Persico and Manco (2000) and Blanchfield et al (2000) have described some of the ways in which the *FirstClass* system can be used in a teaching and learning environment. These latter authors provide a useful summary of the facilities offered by *FirstClass*. Namely, its ability to allow its users to: send email to and receive email from other users; browse, contribute and subscribe to special mail groups (called 'conferences'); exchange files with other users; and use other features, such as the real-time chat feature. Of course, the system also provides many other 'special' facilities for tutors; these can be used to set up conferences, organise students into tutorial groups and monitor what students are doing.

Naturally, the transition from a conventional teaching and learning environment towards one that is based on online delivery of material (using the types of tool that were described above) has many implications for students, teaching staff and educational organisations. Changes in organisational infrastructure are needed and different types of working practice have to be developed. In addition, the expectations of students are likely to change significantly. Some of the important issues involved in making the transition from a 'chalk and talk' environment to a 'web and email' system have been described and discussed by Duggleby (2000) and Salmon (2000).

Case Study

In this section of the paper the underlying approach that we advocate for the design and creation of online courses will be illustrated by means of a case study involving the delivery of an electronic course that is taught entirely online and which involves no conventional face-to-face contact with students. A description of the basic objectives of the course is given along with a brief outline of how these are realised. The implications of this approach, for future educational systems development, will be briefly discussed. Particular emphasis will be given to the new roles that '*online tutors*' have to play and the nature of the demands that are placed upon them.

The online course that is used in this case study is a UK Open University (OU) foundation level course (*T171*) entitled '*You, Your Computer and the Net*'. The aims of the course are to develop students' understanding of their personal computers (PCs) and the ways in which these can be used as a tool to explore the Internet and facilitate study using the World Wide Web. These aims are realised through the utilisation of: an elegantly designed web structure (*http://t171.open.ac.uk*); a powerful computer-conferencing system (*FirstClass*); a network of online tutors; a collection of skill development tasks; and an automated electronic assessment handling system (*ETMA*). The *T171* course was piloted in 1999 and then made available to students in 2000. The course attracted a record (for the OU) 12,000 students

Essentially, the *T171* course is organised into three main web-based modules. These deal with: [1] the development of both individual online learning skills and group learning in cyberspace (*Module 1: Computing with Confidence*); [2] the history and development of the personal computer (*Module 2: The Story of the PC*); and [3] the Internet and World Wide Web (*Module 3: The Net, Where it Came from and How it Works*). As well as the web-based multimedia materials, there are two set books which students are expected to read. In addition, the course is supported by a set of 15 online '*Study Guides*' that tell students what they should be doing at any particular time. For tutorial support, students are grouped into cohorts of about 20 students; each cohort is then allocated to an online tutor.

During the course there are numerous practical exercises for students to undertake using their computers. Some of these involve individual effort while others require collaborative group working. If students run into difficulty while they are studying or while working on a practical exercise, they can contact their tutor either by electronic mail or by telephone. The skills that students develop as a consequence of studying the *T171* course are assessed using a series of four '*Tutor-Marked Assignments* (TMAs) and an '*End of Course Assessment*' (ECA). There are no formal examinations as such. Students are 'graded' according to their performance in the TMAs and the ECA.

Three of the most important support tools used in the *T171* course (from both a student's and a tutor's perspective) are the *online search engine*, the *FirstClass conferencing package* and the OU's own '*Electronic Tutor-Marked Assignment*' (ETMA) *system*. The search engine allows the whole *T171* web site to be searched (using words and phrases) to locate particular items of interest. The ETMA facility allows students to submit their TMA and ECA materials from their personal computers to a central server at the Open University's main site in Milton Keynes. Subsequently, online tutors can download these materials (from the OU server) to their PCs, mark them and then complete electronic feedback forms. These forms and the marked assignments can then be uploaded from a tutor's PC back to the OU central server for students to collect and inspect.

From a communications perspective, the *FirstClass* (FC) system is undoubtedly the 'mainstay' of the *T171* course. This can be accessed in two basic ways: either using a web browser or by means of software that is installed on its user's PC (this is called *'FC Client'*). Of the two approaches to using *FirstClass*, the latter is by far the most useful since *FC Client* provides far more capabilities - both for students and for tutors - and it can be used in off-line mode. In addition, *FC Client* also supports real-time chat facilities. These can be used to enable groups of students, with or without a tutor, to discuss issues arising from their studies. These discussions take place in 'real-time', that is, while the participants are actually online.

As was mentioned above, the *FirstClass* facility allows various types of conference to be set up - both by the 'course team' and by regional online tutors. The creator of a conference can specify what properties that conference has, who may access it and how it may be accessed (this could involve only reading, reading and writing, and so on). Within any given conference, sub-conferences can be set up so that particular items of importance can be discussed in greater depth. Usually, tutors act as moderators for the conferences that they create - although, sometimes the responsibility for this can be delegated to one or more students within a given 'tutorial group'.

Once a given presentation of the *T171* course is running, tutors involved in that presentation are emailed on a fortnightly basis with instructions about what students should be doing. These regular '*Tutor Guides*' give tutors specific details of the various activities that they have to set up for the students in their tutor group. Throughout the course, each tutor runs a *tutor group conference* to which any student in his/her group can contribute. This main ongoing conference is supported by various other sub-conferences that are set up by tutors in order to provide a forum for discussing and debating issues relating to different parts of the course. As well as tutor group conferences, the *T171* teaching team also sets up a variety of national and regional conferences to which students and staff can contribute.

The *FirstClass* system is also used to provide help and support for the network of online tutors involved in running the course. As an example of this, the '*T171 Teaching Team*' conference contains four sub-conferences entitled '*Tutors Notices*', '*Technical Help*', '*Course Help*' and '*FirstClass Training*'. The '*Tutors*

Notices' conference, in turn, contains two further sub-conferences; these are entitled '*Tutors Resources*' and '*Study Guides*'. These conferences can be used by T171 tutors in order to exchange ideas about the course, swap teaching/tutoring techniques with each other and find solutions to the problems that they encounter. Examples of some of the other online conferences that are available for staff include the '*FirstClass Reference*' and the '*Staff Development*' conferences.

We believe that the case study described in this section of the paper provides a powerful example of the way in which appropriately designed computing resources, Internet facilities and an international team of online tutors can be integrated to produce an effective and scaleable online course. Indeed, we feel that there are many important lessons to be learned from this case study by those others who are involved in designing and producing online courses. These lessons relate both to technical/educational matters and the organisational/logistical issues involved in co-ordinating and synchronising the activities of a large student and staff population in order to create high levels of learning synergy.

Conclusions

The creation of sophisticated electronic courses to support communities of online learners requires the provision and appropriate integration of four basic types of resource. In our opinion the important components that are needed to build a successful online course are as follows. First, an appropriate web structure containing the information that is to be assimilated and/or used as a basis for the course. Second, a range of online communication strategies that allows students to exchange information and converse with each other - and with their online tutors. Third, an appropriate set of problem-based tasks that will facilitate both the development of skills and their accreditation. Fourth, a network of online tutors that can provide help, assistance and motivation for members of the online learning community. Naturally, it is important that these resources are integrated and synchronised in ways that will lead to the derivation of high levels of learning synergy. This paper has introduced a model of web-based teaching and learning which will allow this goal to be achieved. The relevance of the model has been illustrated (using a case study describing a dynamic online course that involves no face-to-face contact with students) and some of the implications of such courses for online tutors have been briefly discussed. This latter issue is discussed and debated in greater depth elsewhere (Barker, 2001).

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Networking Schools: What Services do we Need?

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Abstract: This paper outlines the planning and implementation processes that a Catholic education system has gone through to provide network and Internet services to some 80 schools across Western Sydney. It will outline the system planning process for the project including: the vision and objectives of the project, the personnel required to achieve the desired results, the types of educational services desired and required by schools (primary and secondary) and the skills training and professional development programs required to ensure the successful integration of technology across the school curriculum.

Background

The Catholic Education Office (CEO) of Parramatta, NSW provides systemic Catholic education across approximately 80 schools in the Western Sydney area and includes some 25 secondary schools and 55 primary and special education school facilities.

Decisions were made in 1996 to investigate the feasibility of providing network and Internet services to all school facilities. In effect, this meant providing cabled access to those services from every learning space in every school. A secure and private wide area network (WAN) was designed and progressively enabled over the period 1998-2001.

This paper discusses the importance of having clear project objectives and the right personnel in place to ensure that the proposed educational services are delivered.

Project Vision & Objectives

The CEO was attempting to address the issue of *schools and teachers using the capacity of new technologies to enhance learning and teaching.* As a system the response was to embark on a concurrent multifaceted strategic approach to assist in the process. The focus was not on the types of technologies to purchase, nor what software to run, but rather on researching good learning and teaching strategies and what tools and support can the system provide to enhance the teaching and learning in each school. As such, the focus was placed squarely on supporting the teachers and the students.

To support this vision, there were 4 major objectives from the planning period of the project (1995-1996):

1. *Connect all schools* and provide network and Internet services
2. *Provide school support staff* – this included:
   - at an *organisational level*, the employment of a Learning Technologies Group (LTG) that included a Senior Education Officer (SEO) and 4 Education Officers (EO)
   - at a *school level,* a time release position (called a *Learning Technologies Support Teacher* or LTST) in every school to train and professionally develop staff in the use of technology to enhance teaching and learning. The time release per school population was as follows:
     a. 0.1 FTE[1] for school populations 1-359

    b. 0.2 FTE for school populations 360-599
    c. 0.3 FTE for school populations 600+
3. *Establish an Information Technology Education Centre* (ITEC)
    - In March 1997 ITEC was opened as a purpose built centre to provide professional development and research opportunities for teachers and leaders in the system.
4. *Explore ways to give teachers access to hardware* for their personal use.

The focus of each of these objectives was to enhance teaching and learning with technology.

The Services Delivered

Investigations were undertaken to determine the types and range of services that schools might require in order to cater for the changing learning environment of the 21st century. These investigations informed the design and implementation of the services to be delivered including:

- *Network services* – each school has its own *Novell* server, router and switched fibre/CAT5 LAN which is connected via ISDN links to hub servers. Each school has the ability to drag and drop files across all school servers in the diocese (within their rights) as well as to create a private network within the school. The network services are essentially file, print and email with each school locally administering their LAN NDS[2] configuration.
- *Internet services* – all schools access the Internet via a single entry/exit point at the network firewall where there is a 2Mbps frame relay connection. The network is set up to provide caching at 3 levels prior to http:// requests exiting the firewall. This service is provided at no cost to the schools. There is no filtering of content by the organisation, however individual schools are strongly encouraged to implement acceptable use agreements with staff, students and the school community. There is the ability at the school level to use *Novell BorderManager* to filter sites as defined by local needs.
- *Personnel services* – the LTST role was created in every school and supported by the systemic role of the LTG. The role of the LTG was to:
    - Support schools – each EO supports approximately 22 schools in:
        - Strategic technology planning – how is my school reinventing itself to cater for technological change?
        - Professional development – how do I adapt my teaching to cater for the 'new literacies' wrought by technological change?
        - Training – skill development in the use of the technology? ITEC is used extensively for this purpose.
        - Setting up and configuring hardware/software/network infrastructure – the EO was the liaison interface and 'interpreter' between the school LTST, external value-add services providers and the technical consultants implementing the infrastructure
    - Provide school and system advice regarding the integration of technology into teaching and learning – this is showcased in the monthly publication of a newsletter by the LTG entitled *Bits 'n Bytes*
    - Develop draft system policy documents and tools for school support – the LTG has developed a number of documents and tools to support the work of schools including:
        - *The LTAC Statement* (Learning Technologies Across the Curriculum) – a statement concerning the development of learning tasks that promote critical literacy skills with the use of technology as an integrated component
        - The *SILT* databases – these databases are used by schools to provide snapshots of their planning for, and use of, technology with learning.

Conclusion

This paper has shown how the development of a system-wide network infrastructure to deliver educational services requires clear project objectives and on-going training and professional development for teachers.

Reflections on the Use of an Integrated Computer-based Collaborative Learning Program in a Curriculum Design Course for Science Teachers

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Abstract: This paper discusses the author's reflections on the use of an integrated computer-based collaborative program in a university-level curriculum design course for science teachers. The program, Daedalus, is composed of a series of modules that work together to help the learner during each phase of the writing process.

A relatively "traditional" curriculum writing and development course was re-designed to enhance the spirit of cooperative learning and curriculum development among teachers enrolled in a graduate level course in science education. The Daedalus module, "Interchange", was used in the course. "Interchange" is a real-time conferencing program in which the learner composes messages privately and then sends them to all members of the class. The newly developed collaborative writing course proved valuable in encouraging collaborative writing and development and in assisting each teacher to construct his/her "personalized" framework for a curriculum project. Perceptions of teachers and the instructor, examples of final curriculum projects, an overview and evolution of the writing process, and strengths and weaknesses of Daedalus will be presented.

This paper discusses the author's reflections on the use of an integrated computer-based collaborative program in a university-level curriculum design course for science teachers. The program, Daedalus, is composed of a series of modules that work together to help the learner during each phase of the writing process.

A relatively traditional curriculum writing and development course was re-designed to enhance the spirit of cooperative learning and curriculum development among teachers enrolled in a graduate level course in science education. The focus of the applied course was designed to enhance students' skill and knowledge base in curriculum writing and development in science education. Two drivers formed the philosophical underpinnings for the course: (1). The course must include activities that encourage the types of learning necessary for critical thinking, reading, and writing, and, (2). The course must focus on situations and opportunities for students to interact in a positive, supportive, collaborative learning environment.

The final product was a "curriculum", a meaningful set of research-based materials that illustrate good science teaching and learning. The course format included seminars, lectures, independent and group work, student presentations and cooperative writing via the Daedalus-Integrated Writing Environment. The Daedalus module, "Interchange", was used in the course. "Interchange" is a real-time conferencing program in which the learner composes messages privately and then sends them to all members of the class.

Based on the analyses of student discourse, seven reflective conclusions were generated: (1). The process of collaborative writing appears to be developmental. (2). It takes time for collaborative groups to construct understanding. (3). The role of the instructor is the most important factor to ensure success throughout the collaborative writing process. (4). Students learn how to negotiate and manage conflict productively. (5). The process encourages students to see different components of the writing process- invention, pre-writing, composing, and revising. (6). It integrates students and instructors into a collaborative community of learners. and, (7). The process helps to "see" students " in a different way. The newly developed collaborative writing course proved valuable in encouraging collaborative writing and development and in assisting each teacher to construct his/her "personalized" framework for a curriculum project

Meeting Teacher Technology Competencies
In the Classroom with a Focus on Writing/Communication Skills

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Abstract: This paper is based on a series of workshops offered to kindergarten through eighth grade classroom teachers. The focus of the workshops was to increase student academic expectations and accountability through technology integration. Two built-in objectives of this staff development included the use of highly motivating student-centered technology activities to increase student academic involvement in writing and communication skills. Various teaching methodologies were encouraged throughout this process, including constructivist approaches and cooperative learning. A hands-on approach to the staff development and transfer to student learning was enhanced through innovative ideas and measures, group creativity, and exposure to web-based learning and exploration. Helpful teaching sites and activities are a part of the presentation, along with feedback regarding increased teacher awareness and knowledge on the use of technology in the classroom setting.

Overview of the Staff Development

This staff development included approximately fifty teachers and media-coordinators in two different public school systems. Both systems exist in rural areas in western North Carolina, USA. The participants trained in school computer labs, as they were later expected to duplicate their hands-on experiences with their students. This work was completed in the Fall, 2000 semester and End-of-Grade test results will be reviewed at the end of Spring, 2001. The goal of the staff development was to increase student writing and communication skills test scores, by increasing teacher technology awareness, involvement, and ability. These ideas were based on research that suggests "that the introduction of technology to classrooms does not radically change teaching; instead, technology can serve as a symbol of change, granting teachers a license for experimentation" (Sandholtz, Ringstaff, &Dwyer, 1997, p.171).

The overall approach used in the staff development and the approach to be transferred in the classroom environment were "Piaget's basic concept of constructivism, which is that children construct their understanding of any given object, concept, or idea based on their own explorations; and Vygotsky's idea that social interaction is a critical ingredient in furthering the child's understanding" (Brown, Metz, & Campione, 1996). In order to implement this approach and cognitive theory, extensive student/teacher exploration and hands-on activities were encouraged.

North Carolina Computer/Technology Skills Curriculum

Specific goals exist for all students in the North Carolina Competency-Based Curriculum (1992) and the staff development plans revolved around these goals. Goal 1 states that the learner will understand important issues of a technology-based society and will exhibit ethical behavior in the use of computer and other technologies. Goal 2 states that the learner will demonstrate knowledge and skills in the use of computer and other technologies. Goal 3 states that the learner will use a variety of technologies to access, analyze, interpret, synthesize, apply, and communicate information.

Workshop Outline

Introductory processes involving various servers, common domains, and interest searches set the stage for basic information and Internet research. This section was stressed as a vital part to introducing sites to students, along with the importance of student input and inclusion in class activities.

Teachers were then introduced to the idea of on-line journals and student publishing sites as a means for developing writing skills. Sites were reviewed that allow student input and on-line publishing opportunities. Branching away from simple journal and/or story writing experiences, poetry was also introduced as a method for writing and publishing. For example, "a structured option is to have students read a specific poem on-line, then have an activity that relates to that poem. It can be as simple as creating some type of collage of art to represent the poem, or writing a short story that ties into the poem. You also can study the poem's structure—dissecting the parts of speech used, rhyme scheme, etc." (Goodson, 2001, p.13). Other publishing ideas included the creation of books, school newsletters, the creation of posters, pen pals, and graphic organizers.

The next topic centered around student organization and structure required of writing. Different web or outline activities were introduced. Many students require a more visual organization effect when organizing their thoughts on paper. Again, various forms and software packages were introduced to the teachers.

Teachers were introduced to the many uses of on-line newspapers and current event topics to be used for writing prompts. Time was also allotted for exploration on various news sites and methods of integrating these into all subject areas. The ability to critique current events in classroom debates and discussions through the use of reading on-line editorials and writings was discussed as a vital method to enhance cognitive learning and individual critical thinking skills.

Power Point presentations and displays were introduced as a means for student involvement and assessment variation in the classroom grading system. In addition to student power point presentations, on-line presentations were reviewed for more interesting and motivating teaching lessons.

Last, time was allotted for exploration on the many available teaching sites with ready-made lesson plans and ideas. These sites ranged from simple phonics, yearbook publications, grammar lessons, word processing, to writing with the Thesaurus.

Conclusions

Based on the general observations, surveys, and group discussion, the workshop proved to be helpful and easy to adapt to various classrooms. Writing and communication skills test results will be viewed and assessed when available.

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The New Digital Civilization: The Best of Times, the Worst of Times

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Abstract The purpose of the new digital civilization research was twofold. First, the study compared the learning style preferences of undergraduate students enrolled in an on-line version of an education course (Technology in Education) to students enrolled in the traditional, face-to-face version of the same course. Second, the primary investigators restructured both versions of the course to effectively address identified learning styles by providing new strategies and developing multimedia products, which appeal to visual, auditory, and/or kinesthetic learners.

Narrative

The year 2001 offers educators the best of times for making use of technology in the teaching and learning environment. Access and availability of digital tools increases as the global society evolves into an inner-connected digital civilization (Dockerman 99). Technology of the new digital civilization presents innovative opportunities for increased student learning, assessment and communication. Through the use of technology, individual learning styles of students is readily addressed with the use of contemporary digital tools (Becker 99). The tools include presentation graphic software, Internet resources and interactive multimedia applications in a variety of content areas. Authentic assessment of students takes place as students use digital technology to create products reflective of their understanding of educational content. Communication with educators and peers takes place at the point of instruction, in either a synchronous or asynchronous learning environment (Gates 96). 2001 truly presents the best of times for learning.

However, these same pioneering digital tools present instructors at all levels of education with a worst of times challenge. Technology has changed expectations of students in their educational experiences. Digital tools change and expand at a rapid pace. Comprehensive training is required to keep pace with these changes if students are to be taught in an effective and contemporary manner. Members of the new digital civilization disengage with instructors who are not able to participate in the civilization's digital velocity (James 96).

The purpose of this study is to examine emerging roles of the primary investigators and undergraduate students in the on-line environment as compared to the face-to-face traditional classroom. Learning styles of the students will be compared and contrasted in both environments. The Environmental Preference Survey (created by Dunn, Dunn, and Price) was used for the evaluation.

Procedure

Students in each group (on-line and face-to-face) were randomly selected for voluntary participation in the study. The total number of participating students was 37. The students completed the Environmental Preference Survey (EPS) during the fall 2001 semester. Comparison of the two groups' scores on the EPS was determined significant at the .05 level.

Undergraduate students enrolled in EDUC4823, Technology in Education, were asked to voluntarily participate in a comparative study to evaluate learning style preferences and computer anxiety reduction in an online learning environment and a face-to-face (FTF) learning environment. Students were randomly selected for participation from each version of EDUC4823 class. (12 on-line participating students and 25 FTF participating students). The data for this study was gathered as a pilot study during the fall 2000 semester. During the semester, the students completed an Environmental Preference Survey (EPS) to determine individual learning styles preferences. The EPS instrument was developed by Dunn, Dunn, and Price (1985) and is used currently by the campus-supported institution OIL, Oklahoma Institute for Learning Styles, to analyze and summarize results of an individual's environmental preference while performing learning tasks.

Random number codes were assigned and individual student scores entered and compared. All individual identifying information was eliminated within each type of Technology in Education course, insuring complete anonymity. The individual learning style preferences were investigated using a t test by preferences within each group. Statistical significance was determined at the .05 level.

Results

Using a two-tailed t test, there was no significant difference in the learning styles preference between the two groups of students. These results will make the second purpose of the study straightforward: restructuring of the course and production of multimedia products for both courses. Using a one-sample t test, the learning style preference of structure was a significant factor for both groups of students. The instructors will field test the restructured course format and multimedia products in the fall 2001 semester. For example, specific guidelines for all course projects will be provided to both classes. In addition, a timeline for course content will also be provided in an interactive, on-line format for both classes. This will be the first of the multimedia products created as a result of the research.

Implications and Further Study

There exists a myriad of implications for this study. The Technology in Education course will continue to be restructured and modified as a result of the study. Additional multimedia products will be created by the principle investigators and shared with campus faculty through the university website. As instructors from all levels of education seek effective methods to improve student learning, appropriate use and application of technology in the learning environment will prove invaluable.

The research could be further strengthened through follow-up studies that will involve the retention of online students and FTF students based on the development of learning style strategies utilizing technology. Another aspect of the additional study could address learning style preferences based on each group's birth year, gender and area of education content concentration (elementary education, early childhood and secondary education). Finally, other determining factors in selecting a course on-line rather than the traditional face-to-face version of the same class could be investigated. Assessing student learning styles and the role of these various styles can be explored by comparing changes in computer anxiety levels of participating students. Reflective journal entries of participating students could provide a qualitative element to an additional study.

Conclusion

As contemporary educators seek unique methods to meet the technological challenges of the emerging digital civilization, focused attention must be given to the learner (Becker 99). This study addresses essential elements brought to the learning environment by both the student and the digital tools. Results of the study can assist undergraduate instructors and students in narrowing the digital divide, celebrating the best of times.

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Towards More Independent Learning: A Southern Nevada Perspective

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Abstract: This paper discusses the use of tools that allow the development and presentation of time and place-independent courseware. Such tools make the Internet another valuable delivery method for distance education courses. The use of the tools is discussed in relationship to a course currently being offered at the Community College of Southern Nevada that prepares students to take and pass an industry recognised certification test.

Introduction

The Community College of Southern Nevada (CCSN) is responsible for delivering educational opportunities to a 45,000 square mile area in Southern Nevada. Enrolment at CCSN was approximately 36,000 students for the fall semester 2000 (September through December 2000). To meet the need of so many students, CCSN has built five major and over a dozen outreach campuses. Many students however, are still not able to take classes due to working schedules or distance from one of the campuses.

A continuing option for students who are unable to attend normal classroom instruction has always been distance education (DE). The increased availability and power of computers has created distance education possibilities not available just four years ago. But the use of these components is often sporadic, if they are used at all due to many factors including the cost of entry for the school (Matthews, 1999; Chambers, 1999, Barley, 1999) and possible higher costs for the student (Matthews, 1999; Barley, 1999; Blumenstyk and McCollum, 1999). Many of the distance education modules at CCSN are still delivered in a manner that requires students and instructors to meet at specific times for discussion, interaction and presentation. These modules offer students limited by distance the ability to take modules. However, for students with unusual or irregular work schedules or other time conflicts, such meetings are still constraining and the students may still be unable to take modules. For modules to offer students the two greatest advantages of distance education, modules must offer both time and place flexibility (Shave, 1998; Fender, 1999; Alexander, 1999).

An additional constraint is the lack of technology experience and knowledge that instructors have (Shave, 1998; Mudge, 1999). Technology improvements alone do not offer most instructors the ability to offer distance education modules unless they are familiar and comfortable with the technology (Shave, 1999; Alexander, 1999; Matthews, 1999; Carnevale, 1999; Trinkle, 1999; Grill, 1999; Mudge, 1999). In addition, instructors must have the time and patience to learn how to use the technology. This can include expanding the frame of reference an instructor has from classroom-based instruction to instruction that is independent of place and time. Many instructors find this difficult. The learning curve experienced by instructors can be partially alleviated by a good computer support department at the college or university. However, the use of outside providers can affect a faculty member's control over his or her intellectual property.

Delivery that is independent of time requires the creation of online courses that can be accessed at any time and place, as long as Internet access is available. In order to explore some of the issues involved in distance delivery a particular module was used as a test case. The module selected for use in the work described in this paper was Computer and Information Technology 106B. This module is a preparation course for students who are preparing to take the Computing Technology Industry Association's A+ Core certification test. This test is one of two tests required to become an A+ Certified PC Technician. In order for the module to be as close as possible to the actual on-campus presentation, streaming audio and video were selected so that the classroom lectures could be transmitted over the Internet. This type of technology does not require that files be downloaded before use. In addition, the use of streaming technology does not require specific class meeting times. This module required a means for grading and evaluating a student's knowledge acquisition as well as support options that are also independent of time and place. This does not mean the instructor must be available at all times, but that students have the ability to ask questions whenever the module is being accessed. Such support can be offered using email, voice mail, snail mail, and office visits.

Creating such modules is beyond the ability of many instructors, not necessarily because of ability, but due to time and knowledge constraints. Effective tools can make such development not only easier, but more realistic for non-technical instructors.

Development Process and Tools

Any module requires three components. First, the learning material that is covered needs to be disseminated. Second, communication between the instructor and student for questions and other feedback needs to be set up. Finally, learning must be evaluated and assessed. CCSN adopted a Web development tool set called WebCT. WebCT provides Internet-based tools for testing. While there is a learning curve with WebCT, the curve is similar to the learning curve of a new word processing program instead of a programming language. Once the tests are in place, students can receive immediate feedback after a test is submitted for grading.

A web site was developed to provide communication between the instructor and students. The web site could be used to post messages of concern for all students as well as contain an email link so that students could send the instructor an email during the module's delivery. Additional information could be added to the web site if needed. Students' learning is evaluated and assessed through four tests administered on demand through WebCT. The first three tests are not comprehensive. The fourth test is comprehensive with questions covering all of the learning material presented. The current web site (http://131.216.93.7) contains module syllabi, course information, textbook listings, and certification testing information.

The second and third components used one or two software packages to help facilitate their development. But that was not true with the first component. A number of different tools are needed to develop courseware for streaming. Each tool is required in order to finish with a file that the streaming server can transmit to students on demand. Each tool fits into the development process. The development process is a seven-step sequence. Each step in the sequence uses different tools to provide the needed result. The CIT 106B course was developed using the tools and process that are described below.

Step 1: Recording of lectures and video aspects

Microsoft PowerPoint was selected as the first tool due to its ability to record narration along with the PowerPoint slides. Other presentation software also has this ability, but the author was already familiar with PowerPoint. When narration is recorded, using a standard headset and microphone through the computer's sound card, PowerPoint stores the recorded sound in separate .wav files. One .wav file for each slide. The .wav files are stored using sequential naming so that the order and slide to file relation is simple to follow. These files could be used for transmission over the Internet, but they are quite large and would require a complete download before being playable. In addition, there is no copyright protection for the files. For these reasons the second tool and step are necessary.

Step 2: Conversion of slides to jpg format
A tool is required to take the PowerPoint slides and convert them to a different graphic format (jpg). The new format requires less storage space and is optimised for Internet use. The tool selected was Paint Shop Pro 4. There are other tools available for use at sites like tucows.com and shareware.com. The only requirement is that the program has the ability to accept pasted objects and then save the object in jpg format.

Step 3: Combining of audio and video into a single file format
PowerPoint stores the slides and audio files as separate entities. A tool is required that can take the video slide, combine it with an audio file and create a single audio-visual file, using the avi format. The tool selected is DubIt. The first reason this program was selected was due to its free 30-day evaluation period. The first author was able to complete the conversion of the CIT 106B lectures in the trial period. The first author found the tool so helpful and useful that he purchased it. DubIt combines the slide and associated .wav file and then allows it to be saved as an avi file.

Step 4: Conversion of digitised data to stream data
The tool selected for this step was chosen due to the fact that Real Server was selected to stream the files. Real Systems has other tools available for download that help in the preparation of streaming files. RealProducer is a program that accepts avi files and then converts them to streaming files. The interface is quite understandable and easy to use. The program is free to download with most of the features enabled.

Step 5: Installation of Server software and storage of stream files
A Windows NT Server 4 machine was selected as the Real Server. The Real Server software was purchased and installed. The installation is straight forward and Real Systems provides good technical support if there are any questions during and after installation. Once the server is installed, the files generated in step 4 need to be copied to the selected directory. One important concept is file security. Only the desired amount of access should be granted to the individuals accessing the files. In most cases this would be the permission to read.

Step 6: Creation of front-end delivery site
This step required a great deal of work. The majority of the work was learning HTML for web creation purposes. The HTML editor used was HomeSite 4. The front-end delivery tool selected is Internet Information Server 4, a free add-on from Microsoft to the Windows NT Server 4 platform. Installation of the IIS 4 software is simple and not time consuming. IIS includes a sample Internet site that can be used as a guide for adding connections in step 7. Pages need to be designed that provide access to students.

Step 7: Connecting the front-end delivery site to the stream server and files
The software package used to connect the streaming files and the web site is WebCT, or Web Course Tools. WebCT simplifies the process by providing student management, test generation and offering tools, and grading. Links can be added from the website that provides logon access to the WebCT server. Links in the WebCT server pages connect the user to the Real server. A valuable aspect of WebCT is that the program is free to download and use for development. Licensing is only required when a module is available for student access. This allows an instructor the ability to create and view the module as well as test the various aspects of the presentation. It also provides a good evaluation opportunity for those who are still uncertain about the use of WebCT. If WebCT is used, the license fees are quite reasonable.

The CIT 106B module, developed using the above methodology can be viewed at http://webcampus.ccsn.nevada.edu. Select the "Logon to MyWebCT". The sample ID is tstudent and the password is temp. All lectures will be available, but due to academic constraints, the module tests will not be available. The account above will be active during the EDMEDIA conference.

Lessons Learned and Emerging Guidelines

The development of the module required a large number of new software packages and hardware. The first author was already experienced with computer software and hardware as a senior systems analyst as well as holding certifications from Novell, Microsoft, and CompTIA. However, the amount of knowledge that had to be acquired was daunting. Developing a web-based or multimedia course requires a large amount of development time. The amount of time required can be discouraging for many instructors. If a large amount of time and effort is required, the resultant module needs to be usable for a good period of time. For instance, the British Open University plans courses to last for 8 years (Blumenstyk, 1999). Such a long time frame can be difficult when dealing with topics that change frequently. CompTIA has announced a major revision of the certification program of which the CIT 106B module is part. This will require a complete rewrite of the current module for use in the spring of 2001. The last revision of the certification content was made in 1998.

The development of this project confirmed that there are disadvantages associated with distance education modules, especially those mentioned in section one. A large amount of hardware is required for the creation and maintenance of a distance education module. In many cases it was difficult to procure the required equipment and the first author was required to purchase items so that the module could be created. In addition, the time spent learning the software and hardware was not reimbursed, in any manner, by the college. Many instructors are not willing to invest their own money and other resources to develop modules without reimbursement. Though some instructors might be willing to fund the development of the module so that they can retain ownership. However, if this investment includes items required to deliver the modules the institution benefits at the expense of the instructor.

There was not one specific software package available to create the required media offerings. Instead, one package was used for one part, another package for a second part, and then a requirement for additional software was identified when the shortcomings of the first packages were discovered. This created a steep learning curve for an experienced software engineer, not to mention instructors unfamiliar with the hardware and software required. But once an instructor learns the various hardware items and software packages, subsequent use for module development should not be as time and effort consuming. Some of the disadvantages of distance education are not controllable by the instructor, but rather must be addressed by the institution. This includes the cost of hardware and the support infrastructure required to offer distance education modules. However, institutions can start by offering a limited number of modules and then expand the offerings as demand increases. This will allow the budgeting of support items over a longer period of time.

The learning curve of instructors can be alleviated using mentoring. Instructors who have developed modules can help those who are inexperienced to understand and use the hardware and software tools available for distance education development. CCSN has addressed this issue by offering a number of workshops at the beginning of each semester, as well as others offered during the semester, as needs are identified, that help educate instructors in the use of the tools mentioned above.

Conclusions

The use of technology, along with various tools can make truly independent learning a reality. The offering of a module with time and place flexibility offers opportunity to students who otherwise would not be able to take advantage of higher education. Since the module is delivered via the Internet, learning can take place at home, while traveling, or at an institution's computer lab. The module can also be offered to students not normally included in an institution's audience; a global audience. This type of module offers self-paced study to the learner. Lectures can be repeated multiple times if a student is having difficulty grasping the subject. Something that is not possible in the normal class-room environment. We feel that the advantages associated with this type of distance education module are sufficient motivation to continue the development of more simular modules, with the second module available in Spring 2001.

However, although there are advantages to distance education, there are problems and concerns. The identified concerns must be addressed. Creation of the modules and the supporting web links is a time consuming process even for experienced designers. For normal staff, the time and effort required could seriously affect their other teaching and non-teaching assignments. Institutional support, or at the least, cross department co-operation, is required if such development and presentation options are used in more than isolated instances. Institution-wide tools need to be selected and faculty training provided. If an institution-wide standard is not created, training and support become very difficult, if not impossible. The institution-wide adoption of specific software and hardware platforms also ensures that modules developed and offered to students by different academic departments will be transparent to the students.

While this type of distance education module might not fit all disciplines, the ability to generate and offer such modules is in the reach of all instructors. Despite the technical concerns and instructor learning curve, we believe that the benefits associated with this type of distance education module for the college and the students far outweigh the negative aspects encountered to date. We are optimistic that our development plans for additional modules will provide educational opportunities to students that otherwise would not be able to improve their education.

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TOOLS TO CREATE TIME AND PLACE-INDEPENDENT MODULES
Brief Paper Demonstration
EDMEDIA 2001

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Abstract: One constraint in the development of time and place-independent distance education modules is the lack of technology experience and knowledge instructors have. Many instructors are not familiar and comfortable with technology. Their learning curve can be partially alleviated by a good computer support department. However, the use of outside providers can affect a faculty member's control over intellectual property.

Delivery, independent of time and place, requires the creation of online modules that can be accessed at any time and place through the Internet. Streaming audio and video were selected so that the lectures could be transmitted over the Internet. Understanding the various tools available to create such modules can help instructors expand their instructional offerings, and reach students who otherwise would be unable to attend classroom instruction. This tutorial will take a sample lecture through all steps of development cumulating with the lecture being streamed over the Internet.

Objectives

This demonstration will show attendees how to use tools that create distance education modules that are time and place-independent. Each of the seven development steps will be discussed and illustrated, as time permits. A finished module will be available for review during the conference. The steps discussed and demonstrated include:

1. Create graphics for use in a lecture presentation
2. Record lectures onto a computer system
3. Convert graphics into compressed formats for Internet dispersal
4. Combine audio and graphics into a format for Internet dispersal
5. Convert digitised data to stream format
6. Use of Streaming Server software and where streaming files are stored
7. Basic HTML pages for front-end presentation
8. Connecting the HTML pages to the streaming files

Intended Audience

Anyone interested in developing time and place-independent distance education modules would find this tutorial of value. No experience is required.

Length

The demonstration normally lasts 30 minutes. Internet access via modem or ethernet network is needed.

Outline

Recording of lectures and video aspects

Use Microsoft PowerPoint to create one or two presentations slides with recorded narration for each slide.

Conversion of slides to gif format
Use Paint to convert the PowerPoint slides into a different format.

Combining of audio and video into a single file format
Use DubIt to combine each slide and .wav file into the .avi format.

Conversion of digitised data to stream data
Use Real Systems RealProducer to convert the .avi files into streaming files.

Installation of Server software and storage of stream files
Using a pre-configured server, place the streaming files in the correct directory location on the server.

Creation of front-end delivery site
Create a simple HTML page as a front end connection for the streaming files.

Connecting the front-end delivery site to the stream server and files
Make the links in WebCT for lesson access and create a student account.

Questions and access
Access the file and demonstrate the created lesson. Answer any questions from tutorial attendees.

Access to an actual developed course offered at CCSN will be available to conference attendees during the ED-MEDIA conference.

Instructor Qualifications

Scott Beckstrand is a Professor of Computing and Information Technology (CIT) at the Community College of Southern Nevada (CCSN) in Las Vegas, Nevada, USA. CCSN is a two-year degree granting institution with approximately 36,000 students. The college has five large campuses, and over a dozen outreach-centres in its 45,000 square mile area of responsibility. Professor Beckstrand has been instrumental in developing certification education programs, preparing students for Novell, Microsoft and CompTIA certifications. He currently oversees the Microsoft and CompTIA programs. Professor Beckstrand holds certifications as a Certified Novell Administrator, Certified Novell Engineer, Certified Technical Trainer, Microsoft Certified Trainer, Microsoft Certified Professional plus Internet, Microsoft Certified Systems Engineer, A+ certified PC technician, and Network+ certified technician. Professor Beckstrand also pioneered distance education offerings in the CIT department, as part of a doctoral program he will be concluding in the near future at the University of Teesside, with the creation and successful offering of CIT 106B. This course is wholly presented over the Internet. Additional courses are planned for introduction in 2001.

De Bono's Six Thinking Hats Technique: A Metaphorical Model of Communication in Computer Mediated Classrooms.

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Abstract: In a computer mediated classroom the technology is used both as a medium for transmitting content and a human arena for interaction. The quality of the learning climate of online environments depends on effective communication. The way people think, hence their guiding metaphors, can become either bridges that support or obstacles that impair the human exchange of ideas. Instructors have to manage personal images and can use different techniques to outline group metaphors to facilitate the information exchange and develop the communication framework. De Bono's Six Thinking Hats technique was a successful method to achieve this in the course, Business Information Systems.

Introduction

A Computer Mediated Classroom is a fairly successful model of learning that has been actively practiced for over 20 years (Hiltz, 1997). This model has allowed the technology used to become both a medium for transmitting content and a human arena for interaction. Both learners and instructors report high levels of engagement with the content in courses based on asynchronous conferencing. In this model the integrated use of technology offers many educational opportunities and possibilities. Instructors can use varied instructional delivery formats to provide a richer environment while learners are allowed the freedom to explore alternative pathways to find and construct knowledge and their own style of learning.

Current learning theories state that meaningful learning requires the students to interact with the new information.

Electronic discussion has been a common collaborative learning approach used in this model. Research shows (Savery & Duffy, 1999) that participating in a debate or argument develops the learner's ability to think critically and to view a problem from multiple perspectives. "Other people are the greatest source of alternative views to challenge our current views and hence to serve as a source of puzzlement that stimulates new learning." (vonGlasersfeld, 1989)

That is why it is so important to maintain the quality, quantity, and patterns of communication in the skill set students practice during learning- a change that requires, in many cases, both teachers and students to learn different roles.

The online nature of the model promotes long-distance collaboration between student and content specialists from diverse backgrounds and geographical areas. Therefore embracing communication in a state of resonance where there is respect, tolerance and opportunities for the individuals to pursue their personal interests will be the constant challenge. Evans-Harvey (1995) outlines the importance of promoting and developing a positive learning environment, where instructors meet the specific interests and aspirations of such diverse group of students, as a prerequisite to having them engage in the course content.

Members of a group perceive and describe the learning environment in terms of values of a particular set of characteristics or attributes. Some researchers (Halpin & Croft, 1963, Tagiuri, 1968, Fraser & Wilkinson, 1993) have referred to this process as climate.

Climate has an influence on behavior and has been found to determine the successful achievement of a variety of educational products such as cognitive achievement, satisfaction, motivation, and personal development (Fernández, Asensio, 1981). This influence encourages climate to be a fundamental element on its own.

Instructors can use metaphorical models to facilitate the information exchange and develop the communication framework that promotes a good learning climate.

Communication Metaphors

Metaphors are related to the interaction that takes place between people's communications and to the images they hold around their hearts and minds. People are not always conscious of the way they see things and the guiding metaphors they are using. These can become either bridges that support or obstacles that impair the human exchange of ideas. A metaphor can be deeply flawed if it represents a narrow or shallow view. The inability to articulate it can alienate people (White, 2000).

Every metaphor is best suited to a particular purpose. Each metaphor provides us with a different perspective on information and communication. No perspective provides a complete picture of reality, but different perspectives can complement each other and bring out the excess of other metaphors (Gandenfors, 1995).

Personal Perspectives That Can Affect the Learning Climate

Argumentative: Arguments are means to move forward, but sometimes protagonists get locked into their positions and become more interested in winning or losing than in exploring the subject of discussion.

Ego and performance: Usually ego and performance are so closely tied together that when someone does not like an idea, they will not make any effort to find a point in favor of it.

Persistent negativity: Some people are negative by nature and feel the need to always put forward the possible dangers.

Individuals' perceptions can change if they are encouraged to try. That is why instructors facilitating an online course have to manage the metaphors of communication to maintain the quality of the learning environment.

Role playing, lateral thinking techniques and clear expectations of etiquette are some of the available methods an instructor can use to manage personal perspectives and group metaphors in online interactions.

One technique that has been heavily used, at a metaphorical level, and as a teaching method framework for lateral and creative thinking, is Edward De Bono's Six Thinking Hats.

De Bono's Six Thinking Hats

This technique is used both in schooling and in business management. As a management tool it has been used by many major corporations around the world (e.g. Du Pont, Prudential Insurance, IBM, NTT). As a teaching tool it is used as a teaching method for lateral thinking.

The Six Thinking Hats technique is extremely simple but it is powerful in its simplicity.
Each of the thinking hats has a color: white, red, black, yellow, green and blue. The color of each hat is related to its function.

> *White Hat:* Looks objectively at data and information. Is neutral and concerned with facts and figures.
> *Red Hat:* Legitimizes feelings and gives an emotional view, hunches, and intuition. Red suggests anger (seeing red), rage and emotions.
> *Yellow Hat:* Is positive and constructive. The yellow color symbolizes sunshine, brightness and optimism.
> *Black Hat:* Is logical, negative, judgmental, and cautious. Is gloomy, suggests why it cannot be done.
> *Green Hat:* Is about new ideas and creative thinking. Green suggests vegetation and abundant fertile growth.
> *Blue Hat:* Controls the thinking process. Blue is the color of the sky, which is above everything else. The blue hat is concerned with control and the organization of the thinking process (De Bono, 1985).

The six thinking hats theory works as a teaching method in a metaphorical level because it:

- Allows the legitimate expression of feelings and intuition in-group discussions - without apology or justification. "This is my feeling" or "This is what I feel"
- Allows an 'unbinding' of thinking so that each mode gets full attention. It avoids the confusion of trying to do everything at once.
- Provides a simple and direct way of switching thinking without causing offence: "What about some yellow hat thinking here?"
- Requires all thinkers to use each of the hats instead of sticking to only one type of thinking.
- Separates ego from performance in thinking. Frees able minds to examine a subject more fully.
- Provides a practical method of thinking for using different aspects of thinking in the best possible sequence.
- Gets away from arguments and allows parties to collaborate on constructive exploration.
- Makes for much more productive discussions and group work.

Application

The Course was Business Information Systems of the E-Commerce Program of the University of New Brunswick, offered at the Technical University of British Columbia.

Logistics

Students met with learning staff in a classroom once per week to participate in team-based learning activities. Prior to the class meeting, information was presented to the students through a weekly web presentation, textbook and supplementary readings, processed by students through an electronic discussion in an asynchronous online conference.

To guide the conference discussion the learning staff posted two or three discussion questions based on the information available on the web presentation.

The total duration of the course was 14 weeks. After 4 weeks the learning staff could perceive a communication pattern on the online conference. Before reading the thread they could guess what the answers could be and which metaphors of communication were used by each student. The interactions between students were becoming blunt.

The learning staff decided to use the Six Hats technique to better manage the communication. Each student was assigned a particular colored hat.

Results

In the Online discussion

- Posting reflected that the students were in fact using the hats they had been assigned.
- Because of the hats, postings tended to be broader, going beyond the case study.The initial posting reflected that the students' perspectives had changed.
- Some students responded to "other hats" postings using their own hats.In the face-to-face session:
- Students would start changing or borrowing hats.
- Hats were used as a basis for organizing discussion.
- Students' motivation for participation was increased.
- Hats lead to more balanced participation, especially from those students with a less articulated orientation.

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Flexible Delivery Damaging to Learning?
Lessons from the Canterbury Digital Lectures Project

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Abstract: Preparing courses for flexible delivery and distance education is normally a time-consuming and expensive process. This paper describes the design and evaluation of a system that automatically captures and indexes audio and video streams of traditional university lectures without demanding any changes in the style or tools used by teachers. Using a `wizard-of-oz' technique to simulate the automatic indexing, we ran a four-month trial of the system in a large (746 students) first year Computer Studies course. The results reveal some surprising social implications of making flexible delivery available to students at a residential university. Early in the trial, many students expressed an intention to use the system, but few did. Late in the course, many students stated that they urgently needed the system for revision, but even fewer used it. At the same time, lecture attendance appeared to be lower than normal. We hypothesise that the availability of a flexible alternative to lectures removed the necessity of attending lectures, and that students deceived themselves about their intentions to catch up using the digital medium.

Introduction

'Flexible delivery', 'distance education' and 'virtual learning' have become popular buzzwords within academia. There are, however, many technological, financial and social constraints that limit the practicality of the 'glamorous' visions of virtual learning involving real-time distributed classrooms supported by high-bandwidth multi-party video interaction. High-bandwidth networks will eventually be sufficiently ubiquitous to *enable* rich virtual learning environments with equitable participation possibilities for proximate and remote students, but current implementations are severely constrained by bandwidth and other considerations.

In 1999 the leaders of our university—the University of Canterbury, New Zealand—announced their intention to equip all lecture theatres on campus (approximately 20) with the necessary equipment to support virtual learning. Unsure what this would entail and at what cost, the authors of this paper proposed a trial research project to investigate *practical* methods for flexible delivery of lectures.

Without massive institutional change, it was clear that Canterbury academics would not have time to develop extensive course materials for virtual learning. With this constraint in mind, we focused on designing, implementing and evaluating a system that would maximise the pedagogical benefits to students while minimising (to zero if possible) the additional work for the academics who deliver and administer the courses. Having designed and implemented the system we trailed it as a resource available to the 746 students taking a year-long first year 'Computer Studies' course.

This paper describes the results of the four-month trial of the Canterbury 'Digital Lectures' system. The system was designed to automatically capture and index traditional lecture content without requiring course teachers to change their presentation styles in any way. Students who were unable to attend lectures at their normal time and place would be able to view them by accessing CD-ROMs held at the university library and in computer labs.

The following section provides the background design rationale for our system by reviewing various possible implementations of 'virtual learning'. We then describe our system and its objectives, followed by a discussion of the unexpected findings from the evaluation. The final section concludes the paper.

Dimensions of Virtual Learning

This section presents four dimensions of 'virtual learning' that critically influence the capabilities of technology for enhancing learning.

Learning media

The traditional lecture remains a defining element of most university courses. Although there are many ways to stimulate interaction and small-group work within the lecture environment (for example, see Fischer (1998)) lectures remain, at least on the surface, a largely one-way interaction from the professor to the students. The course notes, readings, and text-book support students in clarifying and elaborating on the 'seeds' of knowledge that are (hopefully) planted during the lecture. Arguably the most valuable part of traditional courses occurs when students actively test, articulate, and manipulate their understanding. This normally occurs in seminars, tutorials, labs, and assignments.

A wide variety of computer-supported media can be used in an attempt to enhance, offer a surrogate for, or replace these traditional 'media'. For example, it is becoming common for students to bring tape-recorders to lectures, but the lack of any indexing into the audio-stream severely inhibits the potential utility of the recordings for a student who 'understood all of a lecture except for the bit on topic *X*'. Systems such as the Classroom 2000 project (Abowd 2000), the Cornell Lecture Browser (Mukhopadhyay and Smith 1999), and our Digital Lectures project aim to overcome these limitations by automatically capturing and indexing lecture content.

A key distinguishing characteristic of new computational learning media is the level of *activity* required from students. Passive media simply provide a static resource for the students. Recording and indexing lectures and the now standard practice of putting course materials on the web are both examples of relatively passive media. Passive approaches to learning media have been criticised as 'gift-wrapping' (Fischer 1998), but it seems reasonable to expect that they can provide improvements to courses at relatively low costs. For example, web-based course handouts can be updated and improved on-demand, and indexed lecture recordings can aid students who were unable to attend the original lecture.

In contrast to passive media, active media provide an interactive resource that students can use to test and build their understanding. There are three types of active educational systems. Firstly, interactive simulation and exploration environments let students explore the effects of changing properties within an interactive space. For example, animations of algorithm execution (see Brown and Sedgewick (1985) for an early example) allow students to explore the algorithm's behaviour by changing data and parameter values and observing the resultant behaviour. Secondly, intelligent tutoring systems (Sleeman and Brown 1982) attempt to model the student's understanding of a problem domain, and then tailor the information they present appropriately. Thirdly, reflection and discussion spaces, such as bulletin board and Net News systems, allow students to build a repository of information that interlinks contributions by a potentially wide range of participants and sources. Examples include the Dynasites system (Fischer 2000) which was explicitly constructed as an environment to support lifelong learning, and a wide range of design-rationale and FAQ type systems such as the Answer Garden (Ackerman and Malone 1990) and gIBIS (Conklin and Begeman 1998).

We do not advocate either an exclusively passive or active approach to computational media in support of learning. Rather we see that the optimal solution will combine and integrate a variety of media to allow users to choose tools that best suit their needs at a particular time.

Time and place of learning

A key feature of 'flexible delivery' through computer supported learning tools is that it frees students from the need to be in a particular place at a particular time.

There are several important implications of this capability. Firstly, the flexibility gained broadens the potential student base, opening a wide range of educational possibilities for 'lifelong learning' for the full-time employed and those with family commitments. Secondly, the perennial problems of time-tabling clashes need not exclude students from particular courses. Thirdly, lecture theatre capacity no longer needs to constrain course sizes. Fourthly, on-line media can be reviewed as many times as the student feels is necessary. Traditional lectures, in contrast, are a once-only medium, and students who missed the lecture or temporarily lost attention have no way to review the real-time explanation. Finally, the freedom from time and place constraints opens the possibility of globally competitive education markets. Commercial Internet-based education resources such as `stanford-online.stanford.edu` and `unext.com` are early entrants into this market.

Support for collaboration

Traditional courses, taught at residential universities, provide a natural infrastructure for supporting and promoting peer learning. One of the risks of 'distance education' is that the lack of physical proximity will act as a barrier to this valuable resource.

On-line systems can support collaboration through simple text-based bulletin boards, through collaborative simulation and exploration environments that explicitly account for multiple users (for example TurboTurtle's synchronous collaboration (Cockburn and Greenberg 1998) and AgentSheet's asynchronous collaboration (Repenning, Ioannidou, and Phillips 1999)), or by supporting collaboration around a passive medium such as recorded lectures. Of particular interest to us is the notion of supporting collaboration around video recordings of lectures. In an early study on video-based instruction, Gibbons, Kincheloe and Down (1977) showed that learning can suffer when students watch lectures individually. However, by supporting discussion and collaboration around the video using the "Tutored Video Instruction" (TVI) model, learning improved over traditional lectures. Subsequent research, such as that reported in Cadiz, Balachandran, Sanocki, Gupta, Grudin, and Jancke, (In Press) has begun to investigate distributed versions of the TVI model, where physically remote students are connected to each other by multiple audio/video feeds.

A final issue is that of equity between students participating remotely and locally. Anecdotal evidence indicates that remote students in 'live' video lectures (one-way video, but two way audio) felt like 'second-rate participants'[1]. Some of the students, however, may value the more relaxed atmosphere of a video-linked lecture—for example, walking out of the theatre mid-lecture without disturbing, or being seen by, the lecturer.

Capital Investment, Effort and Social Factors

The final dimension that critically affects the nature of on-line learning support is the degree of capital investment and effort put into developing the resources.

Institutions with a long history of supporting distance education—for example Stanford University in the U.S. and the Open University in the U.K.—make large capital investments in producing high quality media such as broadcast quality TV lectures/documentaries to support their courses. These financial outlays are then amortised over thousands of students across the entire nation, and over several years.

Clearly, not all teaching institutions can compete for distance learning students against highly commercialised alternatives. The question then becomes the following: how can traditional residential universities *best use their available resources* to enhance their support for learning?

Beyond the resources dedicated to on-line courses, there are also many social factors that must be addressed in preparing courses for flexible delivery. Systems that depend on lecturers and course administrators changing their teaching habits may *promise* a wide range of learning benefits to students, but if the lecturers fail to make the necessary changes then no benefits can be realised. Furthermore, many lecturers have concerns about issues such as copyright, liability and job-protection when every action and utterance in the lecture theatre is captured on multiple media.

Canterbury's Digital Lectures Project

The goal of Canterbury's Digital Lectures project is to develop mechanisms for flexible delivery of conventional lectures that enhance learning while requiring *no* modifications to the lecturer's teaching methods. Like related work on the Cornell Lecture Browser our goal is "to allow a speaker to walk into a lecture hall, press a button, and give a presentation using blackboard, whiteboards, 35mm slides, overheads, or computer projection. An hour later, a structured document based on the presentation will be available [...] for replay on demand" (Mukhopadhyay and Smith 1999).

The main difference between our work and that of the Cornell Lecture Browser is that we focus on the ways in which students used the end-products, while Mukhopadhyay and Smith focus on the technology used to generate the end-product.

The Student's Interface

Figure 1 shows the prototype interface to a digital lecture. In this prototype there are two video streams, represented by the thumbnail images at the top-middle of each window. In Figure 1 the user has chosen to watch a broad video stream showing the front of the lecture theatre, including the lecturer and the overhead projection screen. In Figure 2, the user has clicked on the other thumbnail image to zoom into the text on the overhead material.

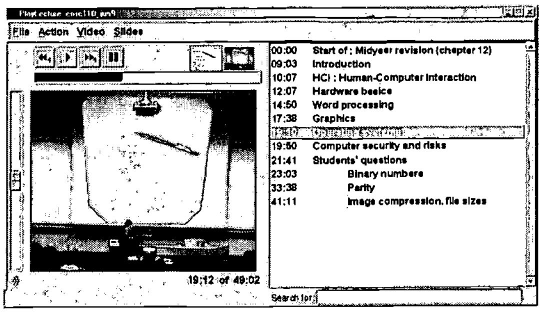

Figure 1: The student's interface showing a broad view of the theatre.

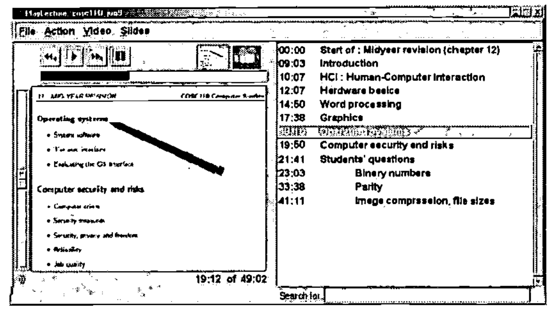

Figure 2: Zoomed into the overhead slide.

-of-oz' technique (Gould, Conti, Hovanyecz, 1983) that used human input to simulate the automatic capture of the digital lecture. The student's interface, however, was unaffected by the 'wizard-of-oz' data capture. During the lecture, a camera-person operated the camera. The feasibility of automated camera management is demonstrated by Liu, Rui, Gupta and Cadiz (2000) who show that most people could not tell whether lecture room video was captured by a person or by an automatic system. After our lectures, an operator ran a series of programs that captured and burnt the lecture contents onto a CD-ROM. The programs translated the digital video (DV) tape into a motion-JPEG stream with a synchronised MP3 audio stream. Finally, the operator watched the video and created hypertext links—identifying topics in the lecture—synchronised with the video stream. Again, the feasibility of automatic techniques is demonstrated by Mukhopadhyay, and Smith (1999) who describe techniques for automatically identifying slide changes and by Wellner (1993*a*, 1993*b*) who discusses techniques for retrieving text from video-images.

The CD-ROMs (one for each lecture throughout the course) were available for students to use in the university library. Using CD-ROMs as a distribution medium allowed us to closely monitor use of the medium, and we required students to complete a questionnaire each time they used a CD-ROM.

Evaluation and Results

In the second semester of the year 2000 academic year (July to October), digital versions of each lecture in the large (746 students) first year Computer Studies course were made available to students. At the start of the study, students who wanted to use the digital lectures were required to sign an ethical consent form. Ninety-four students requested to do so.

Initial use of the system was extremely light, with only four students attempting to use the system throughout July and August. At the same time lecture attendance appeared to be lower than during the previous term.

In September only two people accessed the digital lectures. As a result, the course lecturer sent an email message to the class asking whether it was worthwhile continuing to make digital lectures available. Much to our surprise (given the extremely low use of the system until then), fifty-three students replied, strongly urging us to continue producing the lectures. Comments from the students in their email replies indicate that many had been *intending* to use the digital medium for some time, but had not got around to doing so:

```
> Do you intend to view the Digital Lectures before the COSC110 exam?
Yes I do intend to use the lecture disks but mainly for the lectures I've missed
or need to brush up on (thats probably all of them if I was completely honest)
```

```
> When are you likely to want to view them?
I intend doing this over the next few weeks when time permits (I work full time)
> Have you tried to use the Digital Lectures already?
No I haven't used them at all yet, so I'm one of the guilty that signed up and
not used them.
```

Despite the appeals for us to continue, only seven students subsequently accessed the CD-ROMS.

Discussion

It appears that students deceived themselves about their intentions to catch up on lectures using the digital alternative. We hypothesise that by making lectures available at any time, we removed the need for students to attend the 'live' lecture. Normally, the 'live' lecture is a one-off event, and if students miss it their chance to benefit from it is gone. The damaging part of the digital media (in our experiment), however, is that the students never fulfilled their intention to access it. Gerhard Fischer (private communication) suggested a 'local traveller' analogy to explain this effect. It is not uncommon for residents in an area to have never visited some of the local attractions: they intend to, but the attractions are constantly available, and there is no pressing need to visit them immediately. Tourists visiting the area, however, typically have only one opportunity to see the sights, and consequently make concerted efforts to ensure that they exploit it. By making lectures freely available to the students they were able to postpone viewing the lectures because "they'll still be available tomorrow". Like local residents, these intentions are sometimes postponed indefinitely, or until too late.

Conclusions

Advances in desktop multi-media and the World Wide Web have brought about a wide range of new possibilities for education. Many research projects are exploring the possibilities of the technology while others are deploying first generation systems.

This paper investigated some of the possibilities and problems of virtual learning systems. In particular, we reported the somewhat surprising results of a four-month trial of the Canterbury Digital Lectures Project. In essence, the results of our trial suggest that providing too much flexibility to students at a residential university can have negative learning results. By providing a digital surrogate for 'live' lectures, it appears that students made less effort to attend the lectures, and that they never fulfilled their intention to catch up using the digital media.

In retrospect, it is unsurprising that misplaced technological support can have negative effects on learning (or at least on class participation). In our further work we intend to address the questions that identify the conditions under which learning technology is well placed. For instance, we would like to know whether our technology would have had a positive effect if we had used the web to bring the lectures to students who could not otherwise have participated in classes.

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Urania, The New Technologies for Information and Education in Science

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Abstract: Urania (www.cieloblu.it) is a weekly Web Astronomy and Astronautics news-bulletin, in the Italian language, created by professional astronomers. It is addressed to both young people and adults who are interested in or curious about Science. The users can see Urania and listen to it by connecting with its Real Video version or they can read the news as in a normal Web Site. Urania makes the most of all the Real Video technology to give information in a fast, funny and stimulating way. Its intent is to bring people, in particular young people, closer to this Science, taking in consideration the fact that Astronomy is a challenge and an adventure, still full of unknown and undiscovered aspects.

Introduction

Urania (www.cieloblu.it) is a weekly Web Astronomy and Astronautics news-bulletin, in the Italian language, created by professional astronomers. It is addressed to both young people and adults who are interested in or curious about Science. The users can see Urania and listen to it by connecting with its Real Video version or they can read the news as in a normal Web Site.

Urania is the latest initiative of "Prendi le Stelle nella Rete!" ("catch the stars in the Net! www.lestelle.net for the italian version also available in English language at www.astro2000.org). It is a Web-based project for education and outreach in Astronomy, managed by the Astronomical Observatory of Padua (Italy). Since 1997 this research Institute has been engaged in astronomical Education via the so called new technologies. This is also one of Urania's most important features: for the first time, information for the public is directly produced by experts (astronomers) and not only by professional journalists.

Urania is an innovative way of satisfying the ever increasing interest in Science especially among young people - particularly in Sky and Space – using rapidly evolving technology. The Net and the new technologies are the most used form of media among teen-agers and so, in our opinion, the best for involving them. For this reason Urania can be very useful at School, both as an educational support, and as an informative tool to stimulate curiosity, questions and research.

Furthermore Urania can be considered a "format", that is its design can be used for the outreach in other Sciences and contents, for example video-lessons, distance-learning, and so on.

In addition, Real technology adapts itself to the band-width available: on one hand, it implies that users with low band connection can make use of it. On the other, it is ready to take advantage of the high band connections that will be available in the very near future.

Why Urania?

The interest in Science is growing every day, and more and more space is given to it by the press and TV. Moreover, Science and technology are becoming more important in the culture and daily life of the new millennium. Italy is very involved in astronomical and Space research, even if the Nation doesn't seem to be so informed about it.

Teen-agers are very interested in novelties and are fascinated by Space, which they see as mystery, charm, adventure and discovery. Italian boys and girls read more than the national average (almost 70% of children aged 5-13 have read at least one book during the last year, compared to 41% of adults, Doxa, 2000) and 48% of Italian children use the PC (Istat, 2000). Finally we must point out a fact that is usually forgotten: over 80% of Italian schools, have

multimedia classrooms and over 75% are connected to the Net (MPI, 2000).[1] They don't use often this machinery because of a great lack of contents suitable for the utilisation in the classrooms.
In this situation, Urania was not born with the purpose to teach, but to inform in an exciting way. It uses a different technology from newscasts, radio-news, and also from the Web. For this reason its way of communicating and its language are new and still in evolution. Sentences are short and the style is dynamic. The language is simple, it does not use technical words, but it always keeps its scientific correctness.

What is Urania?

Urania is a weekly Web news-bulletin of Astronomy, space missions, sky events, curiosities. You can read the news-bulletin with a common browser (for example Internet Explorer or Netscape Navigator). To listen to it you need a Multimedia PC and Real Player. If you don't have Real Player, you can download it free from the Net. You can do it very easily, and you can find the instructions on the Urania site itself.
We choose Real Player for different reasons. First, it is one of the most common tool for visualise video and audio information on the Net. Then, it adapts itself to the band-width available so that users with low band connection can make use of it too (actually Urania is optimised for 28.8 Kbps connections, the most widespread in Italy). Finally it is ready to take advantage of the high band connections available in the near future.
Every issue of Urania is the result of a series of intermediate steps. First, every week the staff discusses all the news from reliable and checked sources (Space Agencies like Nasa or Esa, Research Institutes, Scientific Magazines, Press Agencies). Then, the staff chooses the most relevant news in the scientific field and the most curious or fascinating ones.
We give special emphasis to the consequences of astronomical and aerospace research on everyday life, with particular attention to European missions. In addition we try to expose correctly all the information heard on Television and Radio stations by our users, without excessive sensationalism or wrong knowledge.
So, we can satisfy our audience expectations and meanwhile we can give information with a scientific correctness. If possible, we interview astronomers and scientists engaged in such researches.
The news bulletin is made up of four articles, that each last for one minute length. In the Real version there is also some short news. Reading or listening to Urania requires a few minutes, and always less than ten minutes.
The first article is a scientific one: its aim is to deal with a particular concept or astronomical problem. The other ones are more informative.
Every article is illustrated by three images. These images are professional pictures or drawings taken by the most important terrestrial and orbital observatories. The pictures are carefully chosen for their suggestive charm.
The Web version of Urania contains the same four articles. Here, the users find special thematic cards where they can deepen specific arguments (planets, black holes, Big Bang...). All the articles are recorded every week and the users can find them using a temporal index or a special search engine.

Conclusions and future views

Urania makes the most of all the Real Video technology to give information about the astronomical and astronautical news in a fast, funny and stimulating way. Its intent is to bring people, in particular young people, closer to this Science, taking into consideration the fact that Astronomy is a challenge and an adventure, still full of unknown and undiscovered aspects. Therefore we are trying to make Science a natural part of common life, stimulating discussions and investigations at home or at school.
There are many possible developments of Urania. In particular we think that:

- it could become a daily news bulletin, with more integration between Web and Real Audio technologies;
- its format can be used for the outreach of other sciences and contents, for example videolessons, distance-learning, radio, etc... ;
- it can be used to provide teachers, who use Urania in their schools, with monothematic lessons, according to their needs;
- it is ready to take advantage of the high band-width connections, which will be available in the near future.

The Virtual Planetarium: The use and improvement of a Website as a case study of collaboration between Scientists, School Teachers and Students

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Abstract: The "Virtual Planetarium" is an astronomy course on the Web developed in the '98 and refined in the last 3 years with the integration of the experiences gathered in several classrooms over the Country. The course is part of a more complex Project of didactics and outreach of Science (catch the Stars in the Net! www.astro2000.net) via the new technologies. The practice in the use of the network in these years allowed us to develop a new method and approach both to didactics and outreach. The main point is not a technological one, but is represented by the use of a strict and direct collaboration between scientists, teachers and children. All these "actors" are needed to develop a successful piece of multimedia for kids and students.

The "Virtual Planetarium" is part of a more complete and complex project, carried out at the Padua Astronomical Observatory, in Italy.

The "Catch the Stars in the Net!" Project

Catch the Stars in the Net! is an Education and Public Outreach program carried out by the Padua Astronomical Observatory, with the support of the main Italian telephone and Internet Company: Telecom Italia. The Project is in fact based on the Web and the so-called "new technologies" of communication (www.astro2000.net for the international edition or www.lestelle.net for the Italian one). The Project started in 1997, after an Exhibit of Astronomy organised by the Observatory in collaboration with several technological sponsors. The success of the event forced the authors to decide a radical change of approach to the public outreach: to use the Network and other emerging technologies to approach the public, especially young people.

A new working method, more complex and time consuming of the traditional one, but also more interesting and rich of results was adopted. The project produces the Web site, but every initiative, studied and realised by the astronomers, is first of all proposed to a focus group, Schools if didactics is concerned, a group of " typical " users for public outreach. The initial version is given to these users, from which suggestions, criticism and remarks are collected and used for the production of the final release. Only after this procedure a module or an initiative becomes public in the Web site. In other words the Web site only represents the "visible" part of a more complex project of education and popularisation of our Science. The goal is to satisfy the interests of the Internet surfer who wants to learn some Astronomy concepts, or who is simply curious about these themes. At the present, several levels are satisfied: from the Primary School children to the Secondary School students, to adults that want to "know more" about the sky.

The Project received a lot of awards from the public and the critics (i.e. 1998 New Media Prize, 1999 Kidscreen Digital Kids).

Astronomers, Students, Teachers and the Network

In this framework the collaboration between the Public School and the Padua Astronomical Observatory has been of crucial importance for the success of the Project itself.
TeacherS and children collaborate with the Astronomical Observatory of Padua, experiencing, as a "focus group", all the modules of education and public outreach of the project **before** the public release. They tested especially the "Virtual Planetarium", a multimedia course on Astronomy and Astrophysics for the young students (10-13 and 14-18) before the publication in the public Web They used, analysed and criticised all the more than 200 pages of the whole course, in terms of contents, realisation, comprehension, language used etc. In a couple of months the

testing phase became an actual collaboration between "the scientists", the students and the teachers. They became, day by day, co-authors of several initiatives.
The main aim was, at the first attempt , to have a "beta testing" phase of the different modules of our sites for school and public This goal has been of course reached, but both, students and teacher, started in discussing with us on the contents, method etceteras, as from their point of view This criticism and suggestions give us the means to integrate new chunks in the main module, the astronomy course Virtual Planetarium, and then to add new modules to the Website, to ameliorate the language used, to clarify several important points on the target audience In a few words the teacher and the students collaborated with us for all the year, giving a not trivial example of use of multimedia and learning by network capabilities.
We can without any doubt that the Website, that received two Awards in the 98 and 99, is certainly so useful and used by students in Italy also thank to this new method of collaboration between the researcher and the students, via the intelligent action of the teacher The collaboration is still working and the aim is to ameliorate and develop the site also thanks to the suggestions and criticism from these young "consultants"
From 1998 some 20 classes and 500 students studied Astronomy with the Virtual Planetarium and gave their precious criticism, suggestions, results.
In the last year, they collaborated also, via the Net, with a School in Argentina (Liceo Informatico, Santa Rosa, Argentina) that also use the Website, exchanging data, information on different seasons, etc. This collaboration is now widening also to other areas different from astronomy, and a student exchange activity is forecasted next year.
Of course the use of the Website (www lestelle.net or www astro2000 org) is embedded in a didactical layout designed by and with the teacher month by month
We can conclude that students not only learned astronomy, they learned also how to use the Web and to integrate several media (computer and networks, books, lessons of the teacher, hands on of astronomy) in the learning process They learn also to positively criticise the , to discuss with the producers and to explain to the producers themselves how to ameliorate the product, from their point of view.

The Website and the "Virtual Planetarium"

The site is composed of didactic or popular "modules", organised in different levels of complexity and depth, in order to meet the specific interests of the user. Each module presents careful links to the other sections of the Project, thus offering the possibility of going in depth in other Astronomy themes, but without the risk for the user to "lose his bearings" and be overloaded with information.
The site is accessible to everyone, but each modulus is designed with a privileged user in mind (i.e. teachers, students, less than 10 years old children, teens, curious and simply interested). A careful modality of exposition of contents and themes (i.e. didactics, outreach, history, curiosity/news and communication) is used in the design of the site.
For what concerns didactics, we have to spend a word apart for the Virtual Planetarium, a module of the Project that is nowadays an example and reference in the teaching of Sciences via the Internet in our Country. The Virtual Planetarium is in fact used by a lot of schools in their scientific curricula and by individuals. Using this site as a real interactive course of Astronomy, students can experiment with a new way to learn. It is a lively way that surpasses the traditional limitations of texts. This gives the opportunity to learn the arguments following a favourite way and with an adequate rhythm to individual capabilities. You learn by yourself, that is a very good way to learn.

The Virtual Planetarium is an interactive Astronomy course via Internet for 10-18 years old students. It contains 27 didactic chapters, in which there are the main themes of Astronomy, from the Earth and the theory of gravity to the stellar evolution and cosmology.
The course contains more then 800 text pages, hundreds of pictures, movies and animations, and also virtual experiments, all specifically build for the project.
The Virtual Planetarium can be used as a self-learning tool and as an aid to teachers who can adapt it to the scholastic curriculum and to the peculiarity of each class of students.
The chapters are independent, so that they can be explored one by one and then appropriately inserted in the annual curriculum. A peculiar didactic method is used in the teaching of Science (Karplus Cycle), by cutting a priori misconceptions. Wide space is given to the "teacher page", containing the experiences of teachers that have adopted the Virtual Planetarium in the scholastic curriculum.

Education and Information of Architects – New Media for Innovative Solar Architecture

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Abstract: Energy-efficient solar architecture is of great importance for sustainable development of future societies in both meeting tougher energy standards and reducing greenhouse gas emissions. Experiences on passive solar and energy conscious building meanwhile exist due to recent research and technical development programs. The results however are not at all widespread. The software "Interactive Study & Seminar of Innovative Solar Architecture – *ISIS Architecture*" intends to assist education and training of architects with respect to energy-efficient building. *ISIS Architecture* combines lectures on energy-efficient architecture with calculation tools and an encyclopedia to give a feeling for the importance of low energy and solar architecture, to provide basic knowledge of design concepts for innovative building and to allow for direct application of the acquired knowledge to solve practical design tasks.

Introduction

For modern architectural education it is of great importance to integrate new social and technical developments to cope with new ways of designing buildings – naming e.g. revised building energy standards and regulations. Electronic media offer an opportunity to visualize innovative results from R&D-projects, present them in an informative and appealing learning environment and thus give students and professionals the possibility to keep up to date with knowledge needed to solve design tasks.

Content of ISIS Architecture

In a multimedia way *ISIS Architecture* shall firstly introduce learners into the basic principles of energy-efficient building. *ISIS Architecture* explains why there is a necessity to reduce energy consumption and greenhouse gas emissions for buildings during the whole life-cycle of architectural projects. Overviews about global and national energy consumption and greenhouse gas production are linked to topics like building comfort, green building, energy demand and energetic analysis of buildings. Building examples illustrate practical aspects of innovative architecture. Following the design path of architectural projects *ISIS Architecture* goes from general into detail, e.g. from the first draft concerning orientation of zones and façades to lessons on passive solar design of

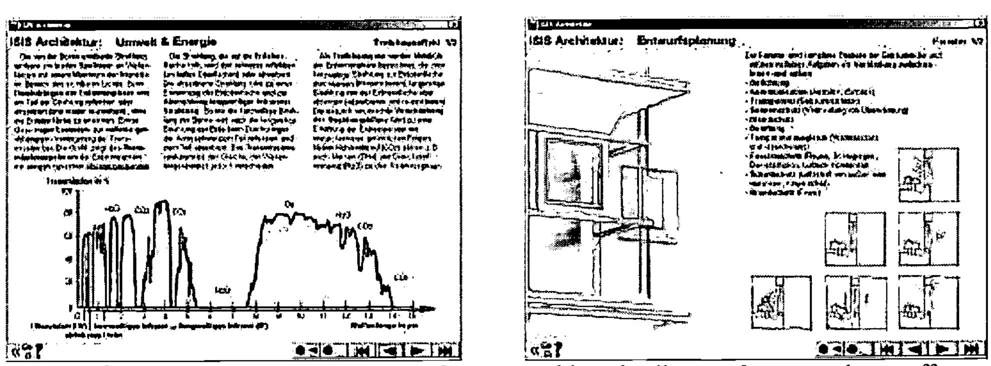

Figure 1: Content of *ISIS Architecture* goes from general into detail – e.g. from greenhouse effects to window design.

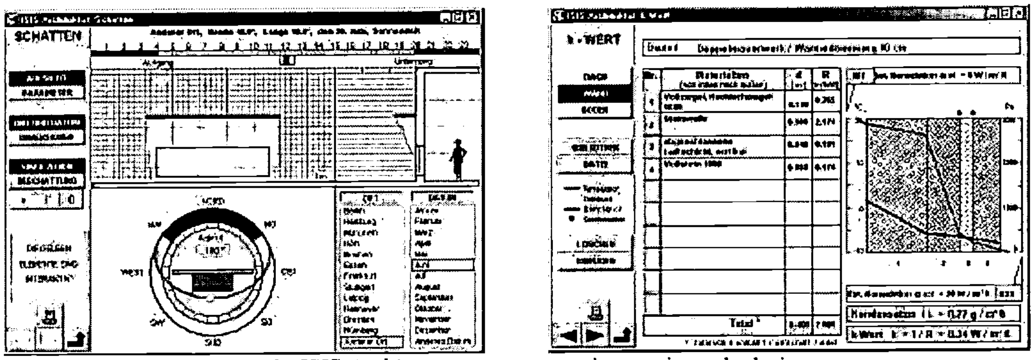

Figure 2: *ISIS Architecture* encourages interactive calculations.

buildings, energetic optimization of components and how to implement low energy technical equipment [Figure 1]. Links between chapters, from chapters to glossaries and also to external resources allow students to choose their own degree of going into detail for their individual learning process.

Interactivity

Calculation tools [Figure 2] are of major importance for the concept of *ISIS Architecture*. Learners shall work on exercises to model buildings or building parts in adaption to real design situations. By the interactive combination of lectural content with practically relevant design tasks the knowledge transferred with the help of *ISIS Architecture* is immediately applied and thus anchored in the learning mind, remembering what Confucius said: "What I hear, I forget. What I see, I remember. What I do, I understand." This is a major advantage of interactive new media over traditional books or lectures. Moreover all calculation tools stay with the learner after completion of classes and prove to be valuable helpers for everyday work. A quiz lets learners check their achieved degree of understanding by recalling relevant facts and definitions and solving illustrative problems.

Distribution to users

ISIS Architecture is available in German language. A free demo version is provided at the website of the Group for Building Physics & Solar Energy, University of Siegen at: *http://nesa1.uni-siegen.de/*. Distribution to other universities takes place within the Universitätsverbund MultiMedia of North Rhine-Westphalia, Germany. The BauNetz – a major Internet content and service provider for the building sector in Germany – intends to integrate *ISIS Architecture* into its web space for architects and other building related professionals.

Conclusion

The authors feel that educational multimedia software like *ISIS Architecture* can efficiently improve architectural education and information regarding low energy and solar architecture aspects, for students as well as for professionals. The concept of *ISIS Architecture* makes it well-suited to play a helpful role in this regard.

Acknowledgements

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Developing Web-based Courses on Computing Using a Hypermedia Model

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Abstract: A large number of courses, teaching several computing and engineering subjects, has been developed using the Web as a delivery medium. New generation material includes features such as a high interactivity and the integration of multimedia educational resources. Moreover, the complexity of teaching new technologies attached to disciplines like Computing, requires the application of modern methodologies to organize the multiple relationships between the information items. This paper proposes the use of the *Labyrinth* hypermedia model to represent the structure of multimedia components involved in a web course and the ways to interact with them. It also introduces the mechanisms to translate this abstract model to an implementation based on open and standard web technologies such as DOM, XML, HTML and Java.

Since its creation, the World Wide Web opened up the possibilities of global training, which can be accessed by any user, at any time, and from any location. This circumstance has determined the development of a lot of courses teaching multiple subjects and using the web as a delivery medium. Web-based courses have been classified (Steed 1999) into three general categories: text and graphics courses, interactive courses and interactive multimedia courses. Most of the current courses fall into the first category and they are close to the traditional book-based courses. Second category shows the importance of interactivity as a way for engaging the user's mind and stimulating the learning. The introduction of multimedia elements in the third category adds richer resources for enhancing the effectiveness of the user learning.

The development of web-based courses in areas such as Computing and other technical subjects shares previous features. Most of them have been developed as a support or a complement for the traditional book-based courses. They are oriented towards university degree students and in this context, it is not frequent the use of specification and design methodologies so the resultant application is hard to keep updated or being reused. However, the topics taught in these courses are associated to complex technologies that combine a lot of concepts that can be viewed from different points and accessed through multiple paths. Hypertext models are good candidates to represent these units of information and their links, but they are unable to describe contents of multimedia information and their temporal and synchronisation relationships. Furthermore, computing courses have experimental and technical features that make interesting the deployment of interactive and multimedia resources as components of the course. More advanced courses introduce this type of resources such as simulations, access to remote laboratories, graphic animations, virtual reality scenarios, ... Such resources enhance the description of a topic but introduce more complex relationships as well. In this context, hypermedia models provide a powerful way to represent this kind of resources and also to model sophisticated navigational capabilities.

There are several hypermedia models but most of them are limited to specific authoring or programming tools. Other models cannot be used to define some features of hypermedia applications such as the heritage of common characteristics between elements of the model or the creation of dynamic links. The current paper proposes the use of Labyrinth hypermedia model (Diaz et al. 1997) for specifying web-based courses on Computing.

An abstract model like Labyrinth is a powerful tool for designing hypermedia applications such as a web course. It provides an unambiguous description of the static components of a multimedia course as well as the definition of the dynamic interactions between these components. The Labyrinth model represents a hypermedia application by means of a *basic hyperdocument*. In addition, each user or group of users can have a personalized hyperdocument in which users can adapt or modify the components of the *basic hyperdocument* to their own requirements (e.g. student's knowledge in order to get an individualized learning). The *basic hyperdocument* is composed by the following elements: Users, Nodes, Contents, Anchors, Links, Attributes and Events. A contribution of the paper is the management of active contents such as simulators and other program based resources, within the Labyrinth model. This includes the management of events to obtain relevant information related to the use of these resources.

In the context of Computing, an example of hyperdocument has been generated to show the application of the former model. It is part of a distance learning project at the School of Computing in the Universidad Politécnica de Valencia. Fig. 1 shows the distribution of elements in the hyperdocument example having a root node ("Introduction Node") which presents the basic concepts of the Memory Management. The first part of the node includes a special type of content (contextual), called "Introduction guide" that acts as the plot of the remainder of contents. The next content is a definition of the memory concept from an operating system point of view. It has attached a graphic animation content that shows a graphic and interactive view of an example of memory area.

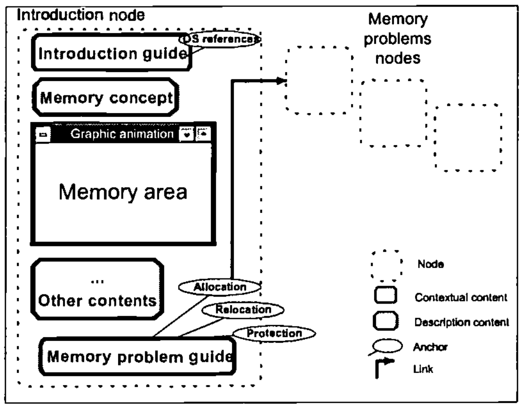

Fig. 1: Example of hyperdocument.

The paper also presents a design strategy to create web-based courses from a hypermedia specification. To date web application development has been focused on the tools and little attention has been paid to the development process itself. In (Fraternali 1999) there is an overview of tools for web development, mainly oriented to data-intensive applications. Other approaches such as the presented in (Conallen 1999) intend to model a web application using a formal notation (e.g. UML). For web applications, there is an object oriented model called DOM (Document Object Model), which is becoming a web standard [http://www.w3.org/DOM/].

The option chosen here is the use of the DOM as the basis to implement Web-courses. Its main purpose is to define "a platform - and language neutral interface - that allows programs and scripts to dynamically access and update the content, structure and style of documents". DOM can use HTML to represent most objects of a Labyrinth course specification. However, the HTML format imposes the presentation aspects when the course document is browsed. In order to separate the course contents from the visual presentation of these contents, a language such as XML (Extensive Markup Language) can be used. XML allows the author to define his own tags and his own document structure. This aspect is fundamental in the course design because in this context, there are multiple sources of information each one with its own structure and characteristics. Some of these sources can have a predefined syntax.

In this work, one of the main contributions is to show how to translate the Labyrinth entities to a model like DOM based on entities such as Document, Nodes, Elements or Attributes. The main problem to apply these design and implementation strategies is the lack of tools to support them. Future works plan to develop this kind of tools.

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Learning About Multimedia Design Through Real-Life Cases

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Abstract: Constructivist and situated approaches to the design of multimedia and Web-based learning environments have sought to engage learners in authentic activities set within meaningful contexts. Real-life cases can be used to support authentic activity by presenting learners with complex, realistic situations. In this study two such cases were developed for analysis by students in a graduate level instructional design subject. A range of data was collected and analysed to gain a fuller understanding of the ways learners engage with the case-based materials and how they use their interpretations to support the design of their own multimedia projects.

Introduction

Providing a meaningful context in which learners can engage in authentic activities has been the aim of many recent applications of constructivist and situated approaches to the design of interactive learning environments. Multimedia and Internet technologies have been used to support such learning experiences by facilitating access to dynamic information and resources (Natesan & Smith, 1998); representing realistic environments and situations (Harper & Hedberg, 1997; Herrington & Oliver, 1997; CGTV, 1997; McLellan, 1991) and; providing access to computer-based cognitive support tools (Jonassen, 1996; Jonassen et. al, 1999).

Within these contextually-rich technology-supported environments, a case-based approach is one way to engage learners with complex, realistic situations (Jonassen, 1999). However despite the historical and continuing popularity of case-based methods there is a significant gap between theory and practice and little is known about how learners build their understanding through cases (Sykes & Bird, 1992).

For instructional designers the task of working in an unfamiliar discipline to help content experts create a learning experience requires them to draw upon both conceptual knowledge of learning theory and its practical application. Design problems are not always well-defined or amenable to rule-based solutions. Instead a range of contextual factors must be taken into account to reach the most appropriate solution (Tessmer & Richey, 1997).

Realistic cases which present design problems and solutions with all their attendant complexity may provide learners with an opportunity to gain an understanding of the context within which a product was developed, thereby providing insights into the process (Ertmer et. al. 1996).

This study aims to explore the ways in which students in a graduate level instructional design subject engage with a case-based learning environment and to discover how they make use of their interpretations in the construction and application of their knowledge. A better understanding of the learner's perspective may suggest improvements to the instructional strategies and support tools used within these kinds of environments.

Case design and implementation

Preparation for this study required the design, development and formative evaluation of suitable case materials. Two cases were chosen for full development, each focusing on a multimedia CD-ROM product developed by the Interactive Multimedia Learning Laboratory at the University of Wollongong. The case materials include an overview of the project, a timeline of major events, interviews with key informants and access to original documents and prototypes. These resources were developed from interviews with project staff and examination of archival materials including project diaries, meeting notes and communication records.

The cases were implemented in a Master of Education subject which focuses on the development of a multimedia product or prototype for a 'real' client. Students worked in teams to develop a concept into a formal design statement and then into an instructional multimedia package. Case analysis and discussion questions were included to assist students develop their understanding of the cases through individual and group activities. Students worked through open-ended questions individually, then took part in small-group and whole-class discussions. These activities ran in parallel with the team development of a multimedia project which addresses a complex, realistic design problem. Finally, project teams prepared a written case documenting and reflecting on their own experience.

Analysis and findings

The subject has been run with two class groups – one based in Wollongong and one based in Hong Kong – comprising 27 students in total. Although the materials and requirements were the same for each group, differences in the schedule of group meetings and access to resources and instructors require that each class be considered and analysed as a separate case.

Assessment tasks, class activities and interviews comprise the primary sources for the rich set of data collected for this case study. Student work has been sourced from writing activities and multimedia design tasks. Semi-structured interviews with half of the participating students provide further insights into the ways learners have interpreted and made use of case materials. Observations made during class meetings, records of electronic discussions and interviews with the main instructor provide additional sources of data which may raise further issues for consideration and provide support for interpreting other data. The researcher's own reflections have also be recorded throughout the investigation.

Upon completion of data collection, student work and interview transcriptions have been coded and analysed to identify categories and themes. Coding schemes for students' written and interview responses were derived from the research questions and other themes which have emerged from the data. Coding for assessment work was also based on the assessment criteria and evaluation protocols from the literature as appropriate.

A comparison of responses given by each student highlights the similarities and differences in their interpretations and experiences, whereas an examination of a student's responses across the data collection phase indicates the changes in their understanding over time. Differences between the two class groups may provide insights into factors such as distance, culture and the role of technology.

Preliminary analysis of students' case analysis responses suggests that these cases encourage learners to focus on the design process rather than on the end-product, and that they use their past experience and interpretation of the literature to frame their analysis of the case events. Further findings will be included in the presentation of this paper.

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Creating An Active Learning Environment Using Digital Video What I Did And How I Did It

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Abstract: This is a case study presentation of an undergraduate experimental course in Religion which uses digital video clips to engage students in conversation and debate on the subject matter. We will consider how the digital video resources were developed, rationale for the course structure and expectations, outcomes and student responses, and finally we will give a short simulation of the class itself. The audience will be invited to join in a conversation regarding the application of these pedagogical resources and strategies to other disciplines.

I The Rationale

In humanities education, student engagement in content questions and issues is often difficult to stimulate because of their perception that theoretical questions are disconnected from everyday life. In particular the study of religion is often assumed to be an exercise in propaganda or a recitation of "unprovable propositions" unrelated to practical life skills. How student perception and expectation influence their ability to learn in any given course is an interesting component of teaching strategy development. Robbins (1991) suggests that the culture of the classroom which is perceived as biased towards theory is at odds with the culture of a working discipline which is oriented towards problem solving (see also Resnick, 1987).

It is clear when one explores the work of dedicated scholars in religious studies that there is a value to their efforts to understand this complex human phenomenon. If a person hopes to be successful in working with Mormons, or Conservative Christians, Moslems, Buddhists or Hindi, it would be useful to understand their "world philosophy." Personal issues of mortality and death often motivate people to explore solutions proposed by religion. Consequently, it is not hard to imagine that contact with these systems in an educational environment would be a worthwhile thing with real and practical consequences.

Most certainly video is a successful medium for taking students into the field to observe facts, processes and emotional events which would otherwise be impossible to see and experience. That is the nature of a good documentary. The dated but very interesting work by Jerry Mander raises several pertinent questions on how television (video didn't really exist then) changes the way people perceive reality (Mander, 1978). It is also a passive medium that implies that students are like sponges absorbing the (often unusual) information served to them by the "film." In the end, this is a rather boring educational strategy. It also implies that getting information is the same as learning. The notion that "Video is now conceived as an information destination. . . where students can go to experience multi-sensory learning synchronously or asynchronously" and using further catch phrases as "information rich environments" seems to suggest no further pedagogical strategies are needed beyond exposure to video (Lynch, 1998). Dr. Thomas Reeves points out that "Technology [including video or even a telephone] is best used as a cognitive tool to learn *with* rather than as a surrogate teacher. Pedagogy and content matter most; technology and media are only vehicles. . . "(Reeves, 1998). And so the thrust of this experimental application focuses on the question, how can the teacher use digital video as an effective learning tool?

It is possible to use video to bring "experts" into the classroom and to use them to change the dynamics of the classroom learning environment (Benney, 1999). Using video to create a dialogue between students and the author of their text, for example, would involve some of the students[1] in an active learning situation and would be a very desirable classroom strategy. Undergraduate students seem not to respond well to courses that are conceptually based in theory or a global setting. But if the beginning point for learning is in some way brought into their classroom and if the data presents a challenge to their commonly accepted "answer," they more readily engage in a learning conversation (Benney, 1996). Milton Glick and others points out ". . . that it is not what the teacher does but what he or she gets the students to do that results in learning" (Glick, 1990).

Finally, videotape programming is unwieldy to use because of the time delay in queuing the tape to the appropriate cut and risking the possibility that it is really the wrong cut! But technology can provide us with an easily developed system for access to video data -- one that anyone can use.

II An Experiment

So why not digitize cuts of scholars commenting on essential questions in their discipline, burn the digitized video onto CD-ROMs, create an index using a common Windows program so that it is easy to que up the response of each expert to a particular question and take the whole package into your classroom. Now create a course in which you ask students to read a text and then introduce them to the author "in person" and allow them to dialogue with the expert with you as the mediator.

At Fairfield University I am teaching an undergraduate course on an experimental basis that focuses on this pedagogical strategy. Using video clips from a database of more than 350 video clip commentaries by notable scholars of religion in America, I have structured the course to alternate between discussion of text and conversation with the scholar who presents his/her ideas via the video clip. Student response has been good.

III Overview

There are two issues central to the experiment. First, the technological "product" must meet a certain standard. Is it possible to produce and process video that is "adequate"? Is it possible without great expense to produce digital video programming, edit and process the programming and burn it onto CD-ROMs and get at least 1/3 screen viewable programming?[2]

The second issue is the question of pedagogical strategies. What can the teacher do with the programming that he/she could not otherwise do? Why video rather than text? Why not web-based exploration? Just looking at "moving pictures" does not in itself do anything more than provide the experience of watching moving pictures – perhaps entertaining, but not by itself educational. It is clear

[1] Based on input from students themselves, I do not think it is reasonable even in an elective course to expect that all who are there are either willing to learn or to participate. Since class participation is evaluated in my classes, students will on a regular basis (about 10%) explain to me that they are "shy" and never participate in class. The actual number who never participate varies, but seems to average around 20%. This certainly needs further study, but it is not reasonable to expect that participation will ever be 100% in most undergraduate classes.

[2] Many video pundits suggest quite strongly that "talking head videos" are of little production value. But with the exception of sports programming and the likes of "action" movies, much of what is available on commercial TV is exactly that. What really seems to matter is whether the "talking heads" are interesting personalities and/or whether the subject of discussion is engaging and perhaps emotional. I would suggest that "Oprah" often satisfies both qualifying factors as do some of the "soaps". The evening news and C-Span occasionally raise interesting topics (the weather) and viewers tune to Jerry Springer for emotional stimulus. Sesame Street showed us that if the cut is short, even not very interesting topics can hold our interest. The seductive nature of TV keeps our attention in the hope that something will eventually happen. So keep the clip short, illustrate the personality of the scholar, and demonstrate the importance of the idea.

that the video programming (almost like the separate segments of Sesame Street) will not stand alone, but must in some way be part of a larger teaching plan/objective. There are two teaching objectives that guide the use of video in this project: to create an environment of contradiction and disagreement that practically forces conversation to understand and explain the controversy; second, to demonstrate that scholarship is not getting neat answers to questions, but is the messy business of trying to figure out and understand the question. The first can be accomplished within a collaborative framework that sees the teacher as part of the community of learners and one of the "experts" in the discussion. Other "experts" are added to the conversation as the course develops because with digital video it is easy to go back to what one of the scholars has said before. The second is more subtle and challenging to the professor. Students tend to take a relativistic view of scholarship. They have often not been taught logic nor analysis and so believe that meanings depend entirely on their interpretation – that what someone intends to say is less important than what the hearer heard them say. This is, of course a relativistic position that is self-defeating: "there are no rules of discourse" which is itself a "rule" or else meaningless. It is essential to hear what the "expert" is saying and to analyze his/her meaning, and then argue in support of or against the conclusion. This "critical thinking" component is in some ways the most important scholarly objective.

Finally, it seems to me that any attempt to evaluate outcomes that stem directly from the use of these video clips would be difficult to impossible. I can demonstrate that student satisfaction is changed by the use of technology,[3] but I do not know if they respond in this fashion because they think they are supposed to or because it is novel (see Najjar, 1996, p.132). It also seems to me that some students resist change in the structure of a class even more so than teachers. They seem to understand education as getting answers to questions that will be on the test rather than engaging in critically thinking through some problem or classic theory. Lenore Langsdorf puts it this way:

> In teaching . . . [students in a required humanities course] I have found a widespread . . . inability to understand and evaluate the ideas presented in the traditional texts of our cultural and philosophical heritage.
> Perhaps the clearest evidence of this inability is that when asked to identify, paraphrase, and evaluate an argument developed over an extended text (for example . . . Descartes' argument for systematic doubt in Discourse on Method), students will usually merely rehearse the conclusion. When pushed on the question of why the author states that conclusion, the almost universal response it that it arises out of the author's "opinion" or "feeling." In other words, students typically do not distinguish between the text's position and the author's opinion (Langsdorf, 1991, pp.47-48).

It might simply be easier to evaluate teacher satisfaction with goals such as student involvement in discussion, willingness to argue a point of view, and curiosity evidenced by questions during or after class. In the case of this project, these elements were numerically more frequent than in a class that did not use technology in this way. But again, the ability of students to explain what the author is saying rather than to impose meaning by personal interpretation (mostly based on their lack of experience in the domain) can be tested. What remains uncertain is whether in the case of video, students defer to what I call "tube
hat we see on television must be true because we are seeing it; the data we receive through the monitor from the web must be true as well because we are seeing it. This is also an interesting item for further research.

[3] Course evaluations for the two sections in which this approach was used showed:

	disliked the video	liked the video	no opinion	total
Spring 00	1	11	11	23
Fall 00	1	17	8	26

Because of other positive remarks, the students who had "no opinion" regarding the video component could not be interpreted as negative.

IV The Process

The process is easier than you might expect; I will explain what I do and how I do it: the hardware and software used and a short illustration of the steps involved. Believe it or not, the key is adequate lighting, clear audio and an uncluttered picture.

+ The Interview/Commentary -- Content: The programming is not really "interview" style, but commentary. Since the producer/director is also the camera operator, any sort of dialogue would be between the subject and a voice "off camera" -- ineffective and really distracting to the future audience. In fact, there often is this sort of dialogue, but the "mystery voice" is eliminated in the editing process sometimes replaced by text.[4] The scholar is asked to respond to a series of seminal questions which he/she sees weeks before the taping. The subject is also told to limit the response to a nominal five minutes (range of 3 to 7). This is done both for the sake of pedagogy as well as technical limitations of the software to handle larger raw video files. Perhaps the most important directive is that the objective of the programming is not actually to answer these (unanswerable) questions, but to highlight the unique approach each scholar takes to the subject. What video can do that text and still image cannot is illustrate the unique individuality of the person and how it is reflected in his/her work.

+ The Interview/Commentary -- Setup

* Lighting: Natural and Tota lights + umbrella - an easy solution; if it is possible to use natural lighting (a north-facing room with large windows on a bright day) this often gives the best results, but the light can change rather quickly because of clouds or time of day. A 250-watt Tota light either reflecting off of the ceiling or an umbrella gives more than adequate light which will remain constant. Very bright lights can create high contrast and dark shadows that are very distracting. Keep the subject far enough from the background so that their shadow does not appear in the picture. Set the camera angle to get the most evenly lit image.

* Audio: Radio Shack to the rescue – sound is often the problem; the longer the cable on the microphone, the more likely it is to pick up hum or noise. There are a variety of ways to get good sound and most of them are expensive. The microphone on the camera is quite sensitive and often will pick up too much. It is possible to attach a directional (shotgun) mic to the camera (Sony makes one for the TRV900, an ECM-HS1), but often the acoustics of the room create a distracting hollow sound with this device. I have had the greatest success with an "Ultra-miniature Tie Clip Microphone" from Radio Shack (# 33-3003). It has a 20-foot cable, great sensitivity at close range and is very quiet.

* Camera: Sony DCR - TRV900 Digital Video Camera - the advantages; this is a three chip camera with the reliable Sony mechanics. The image is superior to an S-VHS camera and each tape will hold an hour's worth of video. Using the camera with the AC power supply occasionally introduces hum on the audio and so I record using battery power (the infolithium 750 gives a recording time of more than two hours). The camera has too many features to report here, but I would mention white balance controls, zebra pattern, large color LCD screen, tape and time counters as well as smooth zoom and focus controls and gain shift adjustment as elements found only on expensive professional video cameras. It is not hard to learn to use these.

+ The Digital Product

* Hardware: Gateway E-5250 - 550 MHz single processor, 256 MB, Viper V770 graphics accelerator, Ultra SCSI internal 9 gig HD, external 18 gig and 1 gig hard drives; the computer is adequate for the capture, editing and processing tasks, but might not be without the SCSI hard drives.
* Software: Windows NT 4.0, ToolBook II, 6.1a, PowerPoint 97;

+ Production

* Capture/edit: Intel Smart Video Recorder III (old, but workable) – this seems to be the weakest link in the hardware. The board is no longer supported and the drivers are old. Occasionally attempts to set up for capture are rewarded with the dreaded "blue screen of death."

[4] The clear advantage of having the content person also direct the filming is that he has control over any accidental or planned diversion. Knowing the work of the scholar allows the director to insert additional questions that can focus the subject's commentary on issues that are peculiar to this individual.

MiroVideo DV300 capture board (could not get it working –VERY poor technical support from Pinnacle Systems) and so do not capture the digital video using "Fire Wire" but use the S-VHS output of the camera. The results are more then adequate.

Adobe Premiere 5.1c (soon to try 6.0); an outstanding capture and editing program.

* Audio/video processing: Media Cleaner Pro 4.0.2
* Compression: Ligos LSX-MPEG Encoder 3.0
* Programming: Adaptec Easy CD Creator plus an Imation CD-R 8x20 Super Recorder

Using the S-VHS cable to the "Smart Video Recorder" and the audio connected through a 15 band equalizer to the "Sound Blaster AWE 64" soundboard, the video clip is captured using the "capture" utility of Premiere. The digitized clip is trimmed and if necessary edited using Premiere. Then the final version is exported to the storage drive (as uncompressed AVI). Next, the clip is processed with Media Cleaner: the audio is normalized and sweetened and if the video needs color or brightness/contrast adjustment it can be done (to a point). It is not really possible to "fix" bad video and this is a common misconception. It is never acceptable to "settle" on poor quality videotape with the expectation that it can be "fixed" by the computer. Finally the processed video is compressed using the Ligos LSX-MPEG encoder. After all the clips have been processed and stored on a dedicated drive, the PowerPoint program is created to manage the video and the CD Master is created.

+ <u>In the Classroom</u> – PowerPoint 97 is used as the presentation/program-management software for classroom applications. It would be desirable to manage the video with an html program, but there are difficulties in playing MPEG video within a browser.

+ <u>Enhancement</u> – It would be very useful to have either a very large (72GB) hard drive or multiple (5/6) CD players so that a greater number and variety of scholars could be instantly accessed. If the professor was very familiar with the archived videos, he/she could easily play a clip on demand that fits a students question or that refutes a students argument/conclusion thereby continuing to create the conflict situation that could encourage debate and discussion.

V Course Structure

The structure of the course is fairly rigorous for an undergraduate program. The class met twice a week for 75 minutes. After seven classes that were introductory and designed to give every student a common vocabulary and historical background, a set routine was followed: the first class on a particular scholar, students would discuss an article they had read and summarized in two pages. The professor would comment on problematic points of the reading and mediate the discussion. Students would annotate their summary papers and turn them in for evaluation. Late papers were rejected as the exercise was considered essential preparation for class participation. The second class on the scholar was spent watching and discussing the short video commentaries by that particular subject. Students handed in a short biography they had done on the scholar. The professor would ask questions regarding the video such as "Why did the scholar not finish this idea? How would you finish it? What is peculiar about this person's work? What problems does he/she raise/cause/solve?"

The opportunity for collaborative learning is clear. But it is important to understand that collaboration here includes the professor whose role as an "expert" is shared with the video subject and, in fact, as the class progresses with all the other "video scholars."

Clearly the pedagogical issue is not whether the video commentaries are designed to deliver content to the student. Reading assignments have already provided students with information and key ideas. The application has more to do with process and such questions as, "What do scholars do?" and "How do the experts arrive at solutions to problems in their field?" If students are expected to develop learning strategies suitable for their own learning goals and if there is more than one way to do this, then illustrating for them some of the possibilities would provide additional support for this objective by:

- Providing differing models of scholarship in their field of study;
- Illustrating the feeling, hesitation, groping for words, logic, asides and distractions that are part of the way scholars work out their understandings in real life;

- Suggesting that there are disagreements about the "solutions".

Again, the issue is to reject the notion that scholarship is getting answers to questions and to foster the understanding that knowledge is the result of critical analysis of data and trial by debate. The most effective use of these video clips is to foster debate among the students by giving them reasons to adopt differing viewpoints as their own and to construct arguments supporting their perspective as well as to create the opportunity for students to develop their analytic skills.

VI Demonstration

As time permits, a short demonstration of the video programming will be given with a view to showing both the quality as well as the versatility of the PowerPoint module. Commentary and discussion will be encouraged first with a view to clarifying this particular course event, but especially with a view to showing how applications in other fields could easily be made using the same digital video techniques.

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Satellite Home Tutorials vs. Satellite Classroom Tutorials

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Abstract: In the present study students who registered for a course at the Open University of Israel could choose the tutorial method they preferred: group face-to-face tutorials with a local tutor in their residential vicinity, tutorials via satellite broadcasting to groups of students around the country, or getting the same satellite tutorial at home on the computer screen. The three groups of students differed in percent of males, age, computer experience, English knowledge, and number of university credits. Satellite classroom tutorials were the least preferred method regarding most dimensions students were questioned about. Satellite home tutorials were preferable because they allow higher concentration, ease of summarizing, more enjoyment and a higher degree of comprehension of the material. The paper concludes with a number of pedagogical and methodological implications regarding research on educational technologies.

Background

Teaching and learning at the Open University of Israel (OUI) are based mainly on textbooks written especially for distance learning. In addition to this written element the component of interaction between students and the teaching staff is essential. In order to remain faithful to the distance teaching emblem and avoid obligating the student to travel to the University campus, this interaction takes place at learning centers distributed throughout the country. Most of the OUI courses offer the students meetings once a week (IT-Intensive Tutoring) or once every three weeks (RT-Regular tutoring), at learning centers in their residential vicinities, conducted by a local tutor.

Indeed, meetings with tutors at learning centers bring the University closer to the students (who can participate in tutorials near their homes). However, these tutorials are not an ideal solution. It is not always possible to find enough expert tutors for all groups of students, there are not always enough registered students in each region to justify opening a group and recruiting a tutor, and this is surely not a solution for those students who cannot leave their homes for one reason or another (temporarily due to childbirth for example, or permanently because of disability).

One of the solutions for these difficulties is making the meeting an asynchronous virtual one through discussion groups on the Internet. Today, the students of the OUI can carry out asynchronous interaction with the University staff by means of an Internet Hebrew study environment, which was developed by the University. Nonetheless, this solution does not respond to the need of most students for synchronic instruction in which there is direct and synchronic contact between the tutor and the students and among the students themselves.

Another solution has been implemented at the OUI, over the last five years in cooperation with Gilat Company. There are two studios operating at the University's central building from which lessons are broadcast, through satellite media, to classrooms throughout the county. This system, designated for synchronous teaching, enables tutors to conduct tutorials and review lessons, experts to give lectures and so forth. The communication between the lecturer and the students is visual, audio and data based. The visual communication is uni-directional, only from the studio to the classrooms. Though the lecturer is seen and heard in all of the classrooms on a TV screen, he can not see the students. The satellite communication is based on a wide broadband. Thus, the lecturer is able to integrate films, presentations, Internet pictures, etc. in the lectures. Audio information is bi-directional (from the studio to the classrooms and from the classrooms to other classrooms and to the studio). The lecturer and the other students can hear the voice of each student that has been given the floor by the lecturer. With respect to data communication, the lecturer can present multiple choice questions to the students, ask them to answer the questions by pressing an appropriate button on the satellite phone, and immediately present the distribution of answers to the students. This teaching system solves the first problem stated above regarding the tutorials at the study centers throughout the country – all students study with the best tutor and are exposed to professional and quality teaching.

This system does not provide a solution for the students who do not reside near centers with classrooms receiving satellite transmission nor for those who are unable to leave their homes. Furthermore, in accordance with the OUI's goal to enable flexibility in study methods and adapt the methods to the learning style of the student, and its belief in student autonomy, students should be allowed to choose the most suitable learning method: to study from home, to study at a study center, to receive abundant tutoring (intensive), a little tutoring (regular) or none at all, to receive face-to-face tutorials (synchronized, at the time and place determined for the student), virtual instruction (synchronized, from afar, at home or in a classroom that receives satellite transmission) or computer-mediated asynchronous tutoring (through the computer and the Internet at a place and time convenient for the student).

The present study was designated to examine the possibility of providing solutions to those students who wish to receive synchronized tutorials but are unable to leave their homes, or prefer to be instructed at home rather than in the classroom. The solution examined was transmission of tutorials from the studio through satellite broadcasting concurrently to classrooms distributed throughout the country and to the homes of students who requested this study method. The aims of the study were:

1. To examine the technical feasibility of transmitting satellite tutorials concurrently to homes and to classrooms.
2. To examine whether students. interested in RT at home differ from those interested in RT in classrooms. Consistent with past research, we hypothesized demographic and achievement differences in preferences of learning environments (e.g. Beyth-Marom et al., 2000; Rosen, Sears, & Weil, 1987; Yaghi & Abu-Saba, 1998).
3. To study the opinions of the classroom students and home students regarding the technical, pedagogical and social aspects of the satellite learning environment.
4. To examine whether tutor-students interaction patterns of students at home differ from those in classrooms.

The present paper will present some of the data concerning aims 2 & 3 and discuss their implications.

Method

The course "Mass Communication" was chosen as a platform for the experiment (delivering satellite tutorials concurrently to classes and to students' homes) since it already had an Internet home site, regular satellite tutorials transmitted to classrooms and its tutor had previously gained technological experience. Cost considerations (loaning the equipment by the students and its installation at their homes) determined the number of home students – between 15 and 20.

Six hundred and twenty four students registered for the course. 555 of them registered for classroom, face-to-face, IT (Intensive Tutoring) and 69 registered for RT (Regular Tutoring). IT is given once a week to groups of students, in study centers, by several tutors. RT is delivered once in two to three weeks to classrooms through satellite communication, by one tutor. The students who registered for RT were sent a letter inviting them to take part in an experiment in which they would participate in tutorials transmitted by the satellite system to their home computers.

Eventually, 16 students volunteered for the experiment, of which only 10 were connected during the second month of the semester. All other RT students (59) got the satellite RT in special classes located at study centers around the country. 555 students received face-to-face IT in conventional classes in the same study centers. Thus, the study involved three groups of students though the first two were the main focus of the study.

Various sources provided information for the diverse goals of the experiment. We will mention here only those relevant to the present report. Information on the participants' characteristics (for the three groups of students) was received from the University's central database. The variables examined for each participant are listed in Table 1. Feedback from students on technical, pedagogical and social aspects of the learning environment they experienced was collected by questionnaires which were sent to the students studying through the satellite system (at home or in the classroom) immediately upon completion of the experiment. The 53 students who registered for RT and didn't volunteer to study at home received a questionnaire regarding their experience with the satellite system. The ten home-students received a similar questionnaire (as they had an experience with the satellite class system before the home-system was installed) and additional questions regarding their experience with the system at home.

Results

Characteristics of Students in Various Types of Tutorial Groups

Table 1 summarizes the data collected about students' characteristics. Columns 2 and 3 compare the satellite home students to the satellite classroom students and columns 4 and 5 compare the satellite students who participated in regular tutorials (at home and in the classroom) to those who participated in face-to-face IT. The numbers in bold signify the differences.

Table 1: Summary of Students' Characteristics in the Three Different Tutorial Groups

1. Variable	Regular Tutorials: 2. Satellite at Home (N=10)	Regular Tutorials: 3. Satellite in the Classroom (N=59)	4. Intensive Tutorials (f2f) (N=555)	5. Regular Satellite Tutorials (N=69)	6. Total (N=624)
Percentage of males	20.0	**40.7**	23.6	37.7**	25.2
Age: average	**30.6**	28.8	28.7	**29.0**	28.7
Percentage up to 20	0.0	**5.1**	0.5	**4.3**	1.0
Percentage between 20 and 30	**80.0**	72.9	**77.4**	73.9	77.0
Percentage above 30	20.0	22.0	22.1	21.7	22.0
Percentage on a Moshav, Kibbutz, rural settlement	11.1	**14.0**	8.2	**13.6**	8.8
Percentage with matriculation certification	70.0	**79.7**	76.6	**78.3**	76.8
Average credit points	**45.6**	39.2	24.8	**40.2***	26.5
Number of courses	**11.0**	9.2	5.7	**9.5***	6.1
Average grade towards the degree (until the present course)	72.0	**74.0**	**74.9***	73.6	74.7
Grade of present course	71.3	**74.1**	**77.6**	73.9	
Percentage that studied computer applications	**30.0**	16.9	9.7	**18.8****	10.7
Percentage that studied statistics or mathematics	50.0	**54.2**	45.0	**53.6**	46.0
Percentage of students with experience in learning through the satellite system.	**40.0**	20.3	5.0	**23.2****	7.1
Percentage that completed English requirements	**40.0**	40.7	20.4	**40.6****	22.6

* Significant difference according to the t-test.
** Significant difference according to the Fischer test.

As the group that studied at home was a very small group, any conclusion derived from its findings can only constitute an assumption for future research. We will therefore only compare the entire group of students who participated in the RT through the satellite system (at home and in classrooms) with the face-to-face IT group (comparison of columns 4 and 5).

The results were similar to those revealed by a previous study (Beyth-Marom et al., 2000) on students choosing computer-mediated technology: the students studying in the regular tutorials (and in the present case those studying through satellite technology) are more veteran students, a greater number of them completed their English requirements, completed a course in Math or Statistics and completed the computers application course. There are also more male students in this group. However, unlike the findings of the previous study (on computer-mediated learning) those who chose RT by satellite are not necessarily better students (as evident in their average grades towards their degree and in the grade of the present course).

Since in the present experiment all the students who chose the regular tutorials studied through satellite (at home or in the classroom), and all those who chose intensive tutorials studied through the face-to-face method, it is impossible to know which variable is responsible for the differences in the characteristics of the two groups. More pedagogical and methodological implications regarding these group differences will be discussed in the last part of the paper.

Students' Opinions regarding Satellite Tutorials

Nineteen of the students in the classroom satellite RT filled in the questionnaires that were sent to them. 15 of those attended at least one tutorial. Four of the students that studied at home also answered questions regarding satellite classroom tutorials in which they took part before they were connected from home. Their data was not included because of their small number. Nine of the ten participants in satellite home tutorials filled in their questionnaire. In the questionnaires students were asked many questions to meet all research aims. We will report only about their opinions regarding the different types of tutorials.

The classroom students were asked to respond to the following statement: "Below are two types of tutorials with which you are acquainted: face-to-face tutorials and satellite classroom tutorials. On the assumption that the same tutor teaches the tutorials, mark with an ✗ under the method that you believe is the best way of learning with respect to the dimensions below." The home students were asked to respond to the same statement but with regard to three types of tutorials: face-to-face classroom tutorials, satellite classroom tutorials and satellite home tutorials. Table 2 presents the distribution of responses in both groups.

Table 2: Percent of students who chose each type of tutorial for classroom students (columns 1 & 2) and home students (columns 3, 4 & 5).

Variable	Classroom Students		Home Students		
	Face-to-Face classroom tutorials – 1	Satellite classroom tutorials –2	Face-to-face classroom tutorials –3	Satellite classroom tutorials – 4	Satellite home tutorials – 5
I understand the tutor better	**81.2**	12.5	**37.5**	12.5	25.0
I concentrate better	**72.2**	22.2	22.2	11.1	**55.5**
It is easier for me to summarize the tutorial	**67.7**	33.3	11.1	11.1	**55.5**
I ask more questions	**100.0**	0.0	**88.9**	0.0	0.0
I answer more questions	**94.1**	5.9	**55.5**	11.1	22.2
I enjoy the lesson more	**80.0**	20.0	11.1	11.1	**55.5**
I understand the material better	**75.0**	25.0	22.2	11.1	**44.4**
The tutor's talk is more comprehensible to me	**60.0**	33.3	33.3	11.1	33.3
The questions I ask get more responses	**50.0**	40.0	22.2	**33.3**	22.2
I feel that I have better control of the situation	64.7	29.4	44.4	11.1	44.4
I feel more obligated to attend the tutorial	**78.6**	14.3	11.1	0.0	**55.5**
I prepare myself better for the tutorial	**72.7**	27.2	**50.0**	0.0	16.7

The comparison between the face-to-face classroom tutorials and satellite classroom virtual tutorials done by the classroom students revealed that face-to-face tutorials were considered to be advantageous with respect to all the cognitive and affective dimensions that the satellite classroom students were asked about.

For the home students who compared the three methods, the satellite classroom remained the least preferred method with respect to all the dimensions (except – "questions I ask get more responses"). However, the results of the comparison between face-to-face classroom tutorials and satellite home tutorials were very interesting: Home students believe that satellite home tutorials are preferable because it is easier to concentrate, to summarize and understand the material, as well as being more enjoyable. However, they have the feeling that they ask more questions in face-to-face classroom tutorials in comparison to home tutorials. In contrast to the satellite classroom group, half of the home students felt that they have good control of the situation, more than in face-to-face or satellite classroom tutorials.

A comparison between the choices of the two groups raises doubts concerning a number of traditional claims regarding satellite tutorials (e.g., it creates a feeling of anonymity and of no control) and shows again that students differ in their preferred learning methods.

Discussion and Conclusions

In the present study an attempt was made to examine a number of pedagogical, methodological and technological issues in the process of launching a new learning technology. In this section we will summarize the main findings and conclusions concerning the pedagogical and methodological issues.

Pedagogical Issues

An examination of the **characteristics of the three groups** of students: those who volunteered for the satellite home experiment, those who chose regular satellite classroom tutorials and all the other students who chose intensive face-to-face tutorials, revealed that each group had unique characteristics.

The group of students studying at home was older and included more veteran students, had more experience with computers and had more experience studying in satellite classrooms in comparison with the satellite classroom students and in comparison with the face-to-face tutorial students. A larger percentage of the students studying at home had an exemption in English. These distinctions are maintained when combining the satellite home students and the satellite classroom students into one group for comparison with the group of students studying intensive face-to-face tutorials.

Since the groups differ not only in the technology but also in the frequency of tutorials – the question arose as to whether the factor distinguishing between the groups was the preference of the technology or the preference of a certain number of tutorial meetings. Only a future examination of the unique differences between students who choose face-to-face regular tutorials and those who choose face-to-face intensive tutorials will provide an answer to this question.

When comparing only face-to-face tutorials to satellite classroom virtual tutorials the later are considered inferior with respect to all the cognitive and affective dimensions about which the satellite classroom students were asked. Satellite classroom tutorials remained the least preferred method regarding most measures also when face-to-face tutorials, satellite classroom tutorials and satellite home tutorials were compared. However, when satellite home tutorials and face-to-face tutorials were compared an interesting finding was revealed: the satellite home tutorial students believe that satellite home tutorials are preferable because they allow higher concentration, ease of summarizing, more enjoyment and a higher degree of comprehension of the material. They also had the feeling that they asked more and received more responses in face-to-face tutorials than in satellite home tutorials. In contrast to the satellite classroom students, half of the satellite home tutorial respondents believe that from home they have good control of the situation, more than in face-to-face classroom tutorials or satellite classroom tutorials.

The responses of the students to the comparison of the various types of tutorials may indicate that in the perception of most students, face-to-face classroom tutorials are the preferred type. If one must compromise on a technology (for various reasons), it is preferable that it reaches the student's home. In a comparison between satellite home tutorials and satellite classroom tutorials, it seems there is no advantage to satellite classroom tutorials. A student who seeks for a peer group of learners prefers the social interaction of a face-to-face tutorial over that in a satellite classroom tutorial.

Students' preferences and their responses, as well as their different characterizations highlight, more than anything else, the individual differences between them. Different students prefer different styles of learning and have different needs, which determine their preferences. If we wish to respond to needs and preferences, it is impossible to search for the best method, but rather to offer the student a variety of methods to choose from.

Methodological Issues

The present experiment raised interesting methodological issues common to many studies on educational technologies. Below are a number of them:

1. The main limitation of many of these studies is their poor design (The Institute for Higher Education Policy, 1999). Very often a comparison is made between two groups which differ in a number of variables, in addition to the one independent variable studied. Such poor design doesn't allow for valid conclusions.

In comparisons between different technologies usually there is no meticulousness regarding intervening variables such as different lecturers, different learning materials, different examinations and different students. As long as the study does not control for such variables, it is impossible to interpret the results. In comparing the two satellite groups (classroom vs. home) in the present experiment, attention was paid to controlling for a number of variables: a. for the kind of material (by ensuring similar tutorials to the two satellite groups- at home and in the classrooms); b. for tutor (by ensuring the same tutor to the two groups) and c. for time (by having the tutorials at the same time in both groups). The groups differed only in the technology (the independent variable that was the focus of the study), as well as students' characteristics.

In a comparison between the satellite tutorial groups (at home and in the classroom) and the face-to-face tutorial group, an additional intervening variable could not be excluded, namely, the frequency of the tutorials. This variable should be controlled for in future studies.

2. A field-study on learning technologies that involves technical, pedagogical, affective and cognitive behavioral aspects requires a multi-operational approach – examining each theoretical variable with various measurement tools in order to guarantee independence between the method of measurement and the findings. This approach was taken in the present study with regard to variables not mentioned in the present report (e.g. Self report on the frequency of the interaction and its efficacy together with the observation and listing of the same interactions).

3. The inclusion of volunteers in an experiment may cause problems which become even more serious when one compares two groups of which only one involves volunteers (Rosenthal & Rosnow, 1969). In this type of experiment three difficulties exist:

a. Volunteers for experiments are substantially different from those who do not volunteer, and thus the two groups are different in regard to variables other than the independent variable under study. The examination of these variables, done in this experiment, is a partial solution. Such examination might reveal differences that may shed more light on the findings.

b. The volunteers in an experiment have a great commitment to it. The relatively high satisfaction with the satellite home communication system may stem from pertinent reasons ("the tool is wonderful and has many possibilities that only technical reasons prevent their full realization at present"). But this satisfaction may also express a type of justification for volunteering, post factum.

c. Volunteers for technological experiments usually receive special treatment. They are in frequent contact with the technical support team (because of technical failures), and with the course team (because of their small number and special problems). Satisfaction with these special treatments may cause some halo-effect and influence the general satisfaction with the experiment and with other aspects of the learning environment.

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The Essen Learning Model - A Step Towards a Representation of Learning Objectives

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Abstract: The importance of the Extensible Markup Language (XML) technology family in the field of Computer Assisted Learning (CAL) can not be denied. The Instructional Management Systems Project (IMS) for example provides a learning resource XML binding specification. Considering this specification and other implementations using XML to represent learning contents in different ways, we developed a new approach to use an XML based representation of learning objectives during the development process of a Computer Supported Learning Environment (CSLE). Identifying and representing learning objectives is an integral part of the Essen Learning Model (ELM), a generic development model supporting developers, educators, and users on different levels of educational activities. We illustrate how to use XML data in the context of learning objectives to support the implementation of learning environments.

Introduction

Due to the enormous interest in the Extensible Markup Language (XML) a variety of approaches in the field of Computer Assisted Learning (CAL) have emerged recently. Current approaches more or less focus on the representation and structuring of learning contents, e.g. the Learning Material Markup Language (LMML) (Suess, 00). Another good example for the increased significance of XML in CAL is the XML binding for the Instructional Management Systems Project (IMS) Learning Resource Meta-data Information Model, which is based on the IEEE Learning Technology Standards Commitee (LTSC) Learning Object Meta-data (LOM) base document (Anderson, Wason, 00).

Textual formulation of learning objectives can only be used to outline a course (Adelsberger, Bick, Pawlowski, 00a). In this paper we will focus on the gathering and classification of learning objectives using XML. A more detailed analysis of those learning objectives, which helps the teacher to find and to design an adequate didactical method is needed to prioritize the contents. Accordingly, we developed the Essen Learning Model (ELM), a generic development model, supporting developers, educators, and users of different levels of educational activities (Pawlowski, 2000).

The ELM application, an advancement of the Essen Learning Model, supports a well-structured classification of learning objectives. Current classifications often show a lack of consistency.

We will present a new approach to classify learning objectives using the Essen Learning Model by explaining our classification and providing our representation using XML. Finally we will review consequential alternatives for the creation of a Computer Supported Learning Environment (CSLE).

Essen Learning Model (ELM)

ELM Development Model

The Essen Learning Model is a modular system (Fig. 1), supporting development processes as well as the system's use on different levels: the support of curriculum design (C-level), the development of learning sequences (D-level), and the development of learning units (E-level) (Pawlowski, 00). We distinguish between three abstraction levels: The *generic development model* provides knowledge for a variety of contexts. This generic model is customized depending on the users' needs and preferences, and transformed into a specific process model for each development project. The *process model* is implemented using the Architecture of Integrated Information Systems (ARIS) and provides a framework for educational technology projects. ARIS is a frame concept for a global description (modeling) of computer supported information systems, covering the whole life-cycle range - from business process design to information technology deployment (Scheer, 98). The third level is the *result* of the development process in the form of certain implementations for each module.

Figure 2 represents the main processes of the Essen Learning Model. The result of ELM-C is a detailed network of learning objectives and goals, determining structure and relations of learning sequences (courses). Based on these results, learning sequences are being developed in ELM-D. The focus of this phase is to find an adequate didactical method together with the right technology depending on learning objectives and user groups. Finally, single learning units are designed and implemented in ELM-E, using the Extensible Markup Language (XML).

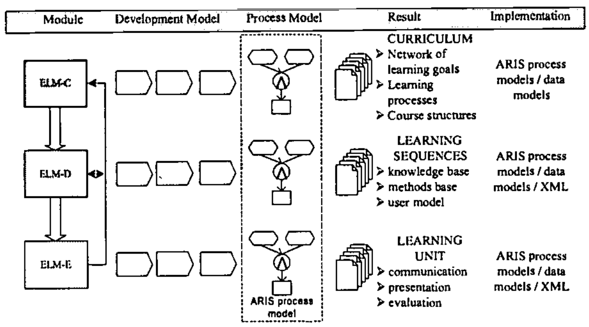

Fig. 1: The Essen Learning Model

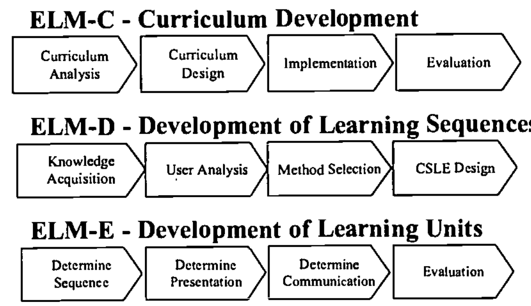

Fig. 2: Main process of ELM

ELM Application

To simplify the complex ELM development process, we developed an application which supports the author, who implements a course or a learning unit (Fig. 3). This application is programmed in JAVA, a language supporting an object-oriented, portable, and architecture-independent approach.

Compliant to the ELM development model the application uses the XML technology family on all of its implementation levels. XML provides the distinction between contents and its representation. Thus it is possible to represent a single contents in different ways (W3C, 98).

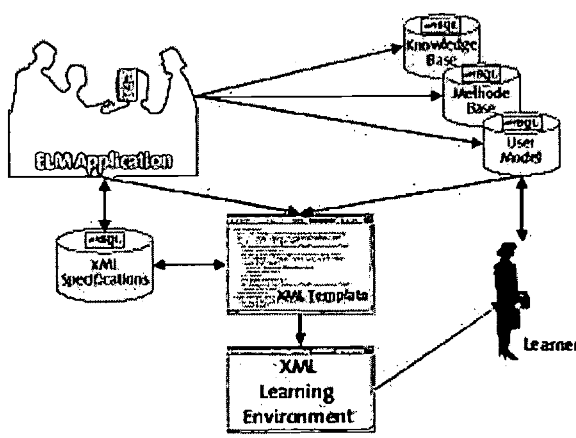

Fig. 3: ELM-Application Architecture

During the CSLE development process, special information about the learning contents and learning objectives is collected. The ELM application supports the author in classifying this information, as part of the *Knowledge Base* and converts it into XML documents. He can select an adequate teaching method according to the learning contents and user preferences (*Methods Base*). For this reason, the *User Model* contains attributes, characteristics, and the knowledge of a user. Ideally, the knowledge is represented adequately in accordance with the User Model, e.g., individual learning pace, preferred learning method, or preferred presentation format.

Considering that information and regarding the XML documents already mentioned, the ELM application generates a template, which could be tailored by the author according to his preferences and experiences. This adapted XML template results in an XML learning environment, which can be used by the learner.

Classification and Representation of Learning Objectives

Learning objectives allow to organize courses, plan teaching strategies, and evaluate testing techniques. Unless a course is defined in terms of learning objectives, a course author has no concrete means to measure the student's success. Without any objectives at all, there is the danger of "teaching A and testing B". Using clear learning objectives, both the students and the instructor know where they are and what needs to be done (CIT, 97).
The textual formulation of learning objectives can only be used for an outline of a course. A more detailed analysis of those learning objectives is needed in order to prioritize the contents. Furthermore, this analysis helps the teacher to find an adequate teaching method.
Unfortunately, a variety of classifications of learning objectives are currently in use, often resulting in inconsistent classifications and terminologies. We suggest to use a classification of learning objectives, containing the criteria *abstraction level*, *dimension*, and *kind of content* in the ELM-Application. Our suggestion is based on the work of (Moeller, 73), (Bloom, 73), and (Baumgartner, Payr, 94).

Classification

(Moeller, 73) distinguishes learning objectives between three different *abstraction levels* according to (UNESCO, 00):

1. *strategic*,
2. *general,* and
3. *specific*.

By means of this abstraction levels, a certain hierarchy concerning the learning objectives can be realized. For example, in the field of simulation, a strategic objective is the optimization of a production planing process. For this purpose, using simulation is a general objective. Finally, performing a simulation study using a specific simulator describes a specific learning objective.

Secondly, we use a classification of *dimensions*. Extending Bloom's classification of intellectual behavior (Bloom, 73), we distinguish between four dimensions:

Dimension	Complexity
• *cognitive*,	1. *knowledge*, 2. *comprehension*, 3. *application*, 4. *analysis*, 5. *synthesis*, and 6. *evaluation*.
• *affective*,	
• *psychomotor*, and	
• *social.*	

The social dimension describes skills like the capacity for teamwork, solving conflict situations, the ability to assert oneself, etc.
In order to identify an adequate didactical method, it is necessary to identify the *complexity* of learning objectives. In our example we focus on the cognitive domain. Bloom identified six levels within this domain, from the simple recall or recognition of facts as the lowest level, through increasingly more complex and abstract mental levels, to the highest level which is classified as evaluation.

The third approach is according to (Baumgartner, Payr, 94) the classification concerning the *kind of learning content*:

1. *learning facts and rules* (remember, receive)
2. *rules, procedures* (apply, imitate)
3. *problem solving* (decide, select)
4. *gestalt perception, pattern recognition* (explore, understand)
5. *complex situation* (invent, master, cooperate)

The first level describes learning environments whose main purpose is to present and transfer contents (verbal, multimedia). The main activity of the user (interaction) is to navigate among pieces of information. The second level typically consists of exercises and tests. The learner acquires and tests procedural knowledge. On the next level, the learner is asked to deal with more complex situations by planning his own procedures. The goal of the fourth level is to perceive and holistically understand processes with their causes and effects, and to discover common characteristics and patterns in various "cases" (Baumgartner, Payr, 98). The experience of complex situations, e.g., in simulation games, offers the student the opportunity to increase his thinking flexibility (Geuting, 89).

Taking into account the criteria of classifying learning objectives (e.g., *abstraction level, dimension, complexity, and learning content*), we specified learning objectives for a computer based simulation course for graduate students of business information systems (Tab. 1). In this course we focus on the basic methods and concepts of simulation. The students learn how to model, implement, and evaluate simulation systems for specific manufacturing problems in selected simulation languages.

abstraction level			dimension	complexity	content
strategic	**general**	**specific**			
Applying the concept of simulation in the context of manufacturing enterprises			*social*: • capacity of teamwork • decision-making ability • performing simulation studies in small teams	evaluation	complex situation
	Definitions, concepts, and applications of simulation		affective	comprehension	facts & rules
		Definition of simulation	cognitive	knowledge	facts & rules
		Fundamental Simulation concepts	cognitive	comprehension	facts & rules / procedure
	Performing a simulation study		cognitive / affective	evaluation	complex situation
		Problem formulation	cognitive	analysis	gestalt perception
		Solution methodology	cognitive	application	problem solving
		System and simulation specification	cognitive	synthesis	rules, procedure / problem solving
		Model formulation and construction	cognitive	synthesis	complex situation
		Verification and validation	cognitive	evaluation	problem solving
		Experimentation and analysis	cognitive	synthesis	problem solving
		Presenting and preserving the results	cognitive	application	problem solving
		Interpreting the results	cognitive / affective	evaluation	gestalt perception
		Comparing and benchmarking of alternative system models	cognitive / affective	evaluation	gestalt perception
	Simulation with SIMAN		cognitive	application	complex situation
		(Primary) SIMAN blocks and elements	cognitive	application	procedures / problem solving
		Basic Interaction	cognitive	application	procedures / problem solving

Table 1: Extract of the Learning Objectives Network

Representation

After presenting our approach to classify learning objectives, we will now lead over to the implementation of them in XML. Besides a multitude of dynamic representation alternatives, XML could be described as a simple dialect of the Standard Generalized Markup Language (SGML).Whilst designed initially for the display of documentation distributed via the World Wide Web (WWW), XML has been widely adopted as

a means of interchanging information between computer applications. XML in particular is widely seen as the best solution for the interchange of meta-data about stored objects and programs (ETHOS, 00).
Obviously, XML is not only a markup language similar to HTML (Hypertext Markup Language), but rather a meta-language, which supports the definition of own "tags" to structure a document.
The existing XML recommendation will be complemented by two extensions. The Extensible Stylesheet Language (XSL) will provide a method to specify the presentation style and control the behavior of XML elements. The Extensible Linking Language (XLink) will enable XML documents to be linked together (ETHOS, 00).
The rather complex process of creating a CSLE and especially the process of creating a learning objectives network is simplified significantly with the use of the ELM application. The conceptual model of the learning objectives network, as shown in Table 1, could be seen as a hierarchical model, which represents data consisting of elements and subelements. XML is most suitable to represent this hierarchy.
In our approach, the process of classifying learning objectives is managed using the ELM application form (Fig. 4). Here, the ELM application stores this data, as shown in Table 1, in an XML document (Fig. 5).

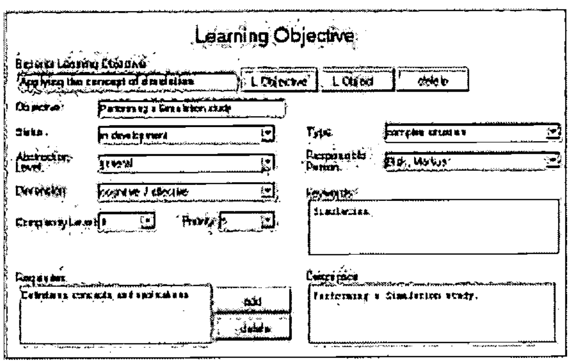

Fig. 4: ELM application form

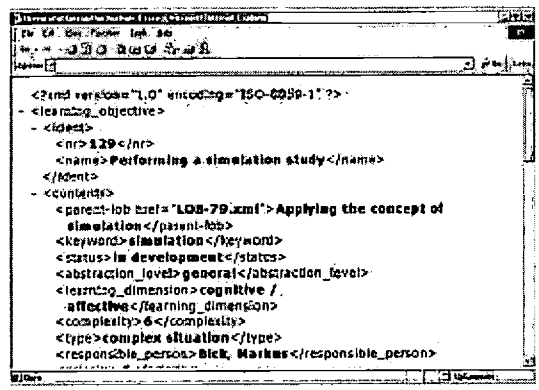

Fig. 5: Learning Objective XML document

Generating a special report, the ELM application offers all people involved, a way to comprehend the learning objectives network implementation process. The generated XML document contains the essential information, it acts as the learning objectives database. This XML document supports the author during the CSLE development process , using the features offered by the XML technology family; on the other hand a report can be generated using the same base document.

Conclusion

We described the importance of identifying and classifying learning objectives. The Essen Learning Model supports a classification approach regarding abstraction level, dimension, complexity, and learning content. Using a multilevel-development model we support the development process for CSLE during the important Curriculum Analysis (Fig. 2). In this paper we focused on classifying learning objectives as well as representing and storing them using the advantages of the XML technology family.
We illustrate how the XML technology family could be utilized during the development process of a CSLE besides the sole structuring and representing of the learning contents. Combining this approach and our related work of a standard model of learning processes (Adelsberger, Bick, Pawlowski, 00b) the development process of a learning environment can certainly be improved. In the next step of development the ELM application will also support the representation of teaching methods using the XML technology family.

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A Scripting Language for Multi-Character Presentation Agent based on Multimodal Presentation Markup Language

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Abstract: This paper proposes an alternative scripting language to control multi-character agent for presentation system. In presentation systems, it is more fascinating when we conduct the presentation stream by the explanation or conversation of presenters. And in order to provide the presentation on demand on the Web, we need character based presentation Agent. There are several ways to control such agents but some are too complex to be used by general users. We try to propose an easy way for the uses. For this purpose, we have developed Multimodal Presentation Markup Language (MPML), which allows many users to write attractive multimodal presentations easily. MPML is a markup language conformed to Extensible Markup Language (XML). It supports functions for controlling verbal presentation and agent behavior. In this paper, we present the specification, related tools, and application of MPML when used as a tool for composing multimodal presentations on the WWW.

Electronic Portfolios in Tenure and Promotion Decisions: Making a Virtual Case

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Abstract: A current problem at many American universities is that tenure and promotion procedures continue to privilege print-based evidence of teaching and research productivity, or do not acknowledge the impact of technology on teaching, scholarship, and service. Despite these problems, this paper makes the case for electronic teaching portfolios as professional development tools for both faculty and graduate students and outlines a range of training and professional development initiatives. As part of the discussion, both advantages and disadvantages of electronic portfolios are discussed. In spite of the possible benefits, institutional education about the potential of electronic portfolios is necessary. Ultimately, such efforts are a way of providing incentive and reward for faculty to utilize technology in ways that genuinely enhance their teaching and overall professional development.

Introduction: The Case for Electronic Portfolios

In their article "Implementing the Seven Principles: Technology as Lever," Arthur Chickering and Stephen Ehrmann (1997) apply Chickering and Gamson's (1987) original principles for good practice in undergraduate education to the use of technology in the classroom. Among those principles are the following: Good practice encourages contacts between students and faculty; develops reciprocity and cooperation among students; uses active learning techniques; gives prompt feedback; and several others related to learning styles and maintaining curricular standards. In their overview of the advances in educational technologies that help to foster some of these goals--including synchronous and asynchronous discussion networks--Chickering and Ehrmann question "How are we to know whether given technologies are as useful in promoting the Seven Principles and learning." Although such a question focuses on the role of technology, faculty are often encouraged to analyze and evaluate the relative effectiveness of any instructional strategy on student learning outcomes, whether it be cooperative learning, service learning, problem-based learning, or more lecture and presentation based modes of content delivery. Thus, in order to document indicators of teaching effectiveness, many universities across the United States have opted for the teaching portfolio, a collection of multi-genred documents that reflect teacher professional development and quality of teaching and learning.

Yet because technological literacy is so much a part of teacher and student professional development, and because of the changing student populations and student needs that call for distance or distributed teaching and learning forums, it is clear that technology plays a large role in the assessment of student learning outcomes and the demonstration of teaching effectiveness, common topics in the general assessment of candidates for tenure and promotion. Despite the significant impact of technology on the professoriate at forums such as the American Association of Higher Education's 2001 Conference on Faculty Roles and Rewards, the manner in which candidates continue to be assessed focuses on activities and genres that are more traditionally researched based, and print-researched based at that. Ironically, as we recognize that student work can be created, delivered, and assessed electronically, and often through an electronic portfolio approach, faculty work—even when technological in nature—is all too frequently reviewed in a print forum and not an electronic one. Consider, for instance, the lessened impact of reviewing a faculty member's online syllabi as "hardcopy" in a portfolio, with departmental and college level review committees unable or unwilling to review materials online and admittedly ill-equipped to do so because of a lack of "local" criteria for evaluating the effectiveness of technological learning spaces.

While Chickering and Ehrmann as well as scholars such as Lawrence Ragan (1999) acknowledge that "good teaching is good teaching," whether it be face to face or technologically mediated, there are some distinctions between how such effectiveness may manifest itself between one environment and another. For instance, Dave Madden's online discussion of the "17 Elements of Good Online Courses" notes a range of indicators for effectiveness, including navigability, usability, and instructional considerations ("material should be presented in such a way that it is compatible with a number of learning styles, "students should be able to readily and easily communicate with the instructor online, and "special attention should be given to testing design and procedures" online). Indeed, in their article "The Electronically Augmented Teaching Portfolio," Lieberman and Rueter (1997) contend that technology offers several options for enhancing the traditional print-based portfolio, including the ability to "capture information about our teaching that previously was not part of our teaching frame of reference" and allowing "efficient means for storing and critiquing the portfolio" itself (p.47).

Regardless of these advantages, tenure and promotion candidates still face difficulties in educating peers and administrators about the impact of technology on teaching, particularly in relation to academic workload. Often those who are designated as "early adopters" of both face-to-face and online educational technologies are tapped as administrative resources as well. Such individuals are frequently called on to serve on committees and to assist in departmental and university-wide faculty development initiatives that are certainly rewarding, although not always "rewarded" at tenure and promotion time, given traditional weightings at many universities that privilege research over teaching and especially over service. Although faculty should be informed about whether and how work with technology and online teaching/scholarship will be considered in the tenure and promotion process, members of tenure and promotion committees, chairs, and deans must educate themselves about candidates' technological work. Thus the importance of such work rests jointly on the committee and the candidate.

Moreover, because it is important that the candidate's work be evaluated in the medium in which it was produced, it is equally important to solicit internal and external reviewers qualified and prepared to review non-traditional sources of evidence, including websites, discussion boards, CD-ROMS, and instructional software. Yet the current problem at many institutions is that tenure, promotion, and merit documents continue to privilege print-based scholarship or do not acknowledge the impact of technology on teaching, scholarship, and service. Despite this continuing problem, this paper outlines a range university-wide training and other faculty development programs implemented at Bowling Green State that support an initiative for electronic teaching portfolios as professional development tools. For Lieberman and Rueter (1997) the advantages of electronic portfolios include more technological work being viewed in its original medium, more types of information being displayed, more immediate access and distribution (via the web and CD-ROM), and more visual and audio documentation appealing to diverse reading and learning styles, as opposed to strictly textual evidence. But despite these possible benefits, it is clear that institutional education about the potential of electronic portfolios is necessary. While technological problems may include the need to provide portfolio readers with appropriate hardware or software to access information on disk, CD or the web, there is also need to de-emphasize the "bells and whistles" of the portfolio to instead using the opportunity for a electronic-based format to support the same educational objectives and curricular contexts as its print-based counterpart. Thus, in addition to training and professional development initiatives, this paper also outlines both candidate and administrative responsibilities in educating peers and reviewers about the role of technology in tenure and promotion. Ultimately, such efforts are a way of providing incentive, support, and reward systems that encourage faculty to utilize technology in ways that genuinely enhance their teaching and overall professional development.

Training and Professional Development Programs

Whether a tenure and promotion portfolio is print-based or electronic, it is clear that a candidate is indeed making a persuasive case about the quality of his or her teaching, scholarship, and service contribution. In the case of teaching with technology, candidates, while they may indeed possess some technological savvy, may not possess the institutional savvy about ways to discuss, organize, document, and distribute electronic materials in tenure and promotion. As a result, faculty development units such as BGSU's Center for Teaching, Learning, & Technology (http://www.bgsu.edu/offices/ctlt), often provide a range of theoretical and hands on training for faculty and graduate student instructors wanting to utilize technology as a teaching and professional development tool. The following are a range of existing programs that can help to contribute to such development.

Technology and Teaching Institutes

In spring 2000 and winter 2001, The Center for Teaching, Learning, & Technology developed a three-day institute "Developing Online Pedagogies: Integrating the How and the Why" for faculty. As a pilot program, the institute was designed to promote technology infusion in an integrated way and serve as a significant professional development and incentive opportunity for faculty. The institute was designed to help participants define and determine the extent to which technology can enhance teaching and learning within their specific curricular contexts and teaching formats. Hands-on sessions helped participants develop a range of technological skills to integrate and manage an online presence and assess its impact on pedagogical goals. Among the hands-on sessions were the following:

- Developing and Managing an Online Presence with Course Management Tools
- Creating and Converting Syllabi with .html and authoring tools
- Delivering Classroom and Web Presentations through Microsoft PowerPoint
- Scanning and Digital Imaging with Adobe Photoshop
- Storing and Distributing Course Materials with CD-ROM Technology

Participants had the opportunity to bring relevant pedagogical materials for use in sessions and to work on independently during several "open-lab" times. Staff consultants were available during sessions to provide both pedagogical and technological support. In addition, luncheon sessions featured faculty from across the university utilizing online pedagogies and addressed issues such as managing and assessing online courses as well as institutional support and reward for technology-based course development. A final session allowed participants to save to CD-ROM all materials produced during the institute and discussed this technology as one mode of delivery of course content for students as well as the tenure and promotion portfolio. In addition to a notebook of useful documentation and articles related to online teaching and learning, including important issues such as copyright and fair use, participants received a follow-up individual consultation session with suggestions for continuing their online work and to work with technological consultants and faculty experts in the area of technology-infused pedagogies.

Portfolios as Professional Development Tools

The Center for Teaching, Learning & Technology also developed a series of workshops on the subject of teaching portfolios for faculty and graduate student instructors, one focusing on print-based portfolios and one focusing on electronic portfolios.

In the case of the print-based workshop, "Teaching Portfolios as Professional Development Tools," general questions addressed were: What is a teaching portfolio? Why should you have one? What documents can/should be included? For whom is such a document produced? A special focus of this session was the "teaching narrative," a vital document that determines what other documents to include as evidence of teaching effectiveness. Participants brainstormed possibilities for their own portfolios based on their particular curricular context.

A second session was titled "Developing your Electronic Portfolio." General questions included: When should a teaching or professional development portfolio be an "electronic portfolio"? Who is the audience for an e-portfolio? How are documents similar to and different from a print-based portfolio? Facilitators overviewed the goals, formats, and delivery options for e-portfolios, including web and CD-ROM and also profiled a range of electronic document formats, including a curriculum vitae in both hypertext markup language (.html) and portable document format (.pdf), and a teaching philosophy in digital video format as a model of the ways an e-portfolio can enhance traditional print-based genres required for tenure and promotion. Participants were asked to bring a copy of their resume or some other document in Microsoft Word to get a sense of how such a document could be easily converted to a format appropriate for web or CD-delivery.

In addition, because our own institution does not currently accept electronic portfolios only, both sessions demonstrated the integration of print and electronic formats, focusing on specific references to URLs in print-based portfolios as well as inclusion of CDs in the overall hardcopy portfolio. Electronic portfolios in CD-format were profiled in both sessions as a way of storing and delivering a range of documents, whether they be print-based or more genuinely electronic document formats. Given the sheer bulk of print-based portfolios and the space and bandwidth restrictions of campus and commercial provider webservers, CD-ROM versions of portfolios were stressed as viable for both internal and external levels of review, particularly because external reviews tend to privilege of traditional model of scholarship that often exclude a range of teaching materials.

Internal and External Grant Initiatives

The importance of grant initiatives cannot be stressed strongly enough, for in addition to providing vital resources in the development of technology-infused curricula, grants are seen as a form of scholarship in many tenure and promotion contexts. At Bowling Green State University, a number of internal and external grant initiatives have helped in this area:

Tech Grants 2000

Promoted as an opportunity to take advantage of new technology infrastructure project at the University, the internal "Tech Grant 2000" program offered a series of three internal grant initiatives designed to help faculty and staff promote creativity in technology to enhance teaching, learning and business operations: Development grants ranging from $1,000 to $10,000 for teaching and learning projects that would be applicable to hardware, software, faculty course reductions, and student/staff technical support; travel grants awarded to faculty and staff for travel to universities and conferences for "best practices" observation of the ways in which technology is used and supported; and laptop grants that allowed faculty and staff to enhance and augment the quality and quantity of technology available to them through their own academic units for both teaching and research. Recipients of these grants totaled over 150 faculty and staff members, including the Center for Teaching, Learning & Technology for developing online training tutorials and best practice travel for two of its staff members.

Ohio Learning Network Faculty Professional Development Grant Program

The Center for Teaching, Learning & Technology applied for and received a $50,000 external grant to help faculty at the University's two-year branch campus receive training and support for distributed learning initiatives. Because the branch campus is 90 miles away from the main campus where the Center is housed, the incentive for this program was the ability to provide onsite and online training for faculty in a way that alleviated the workload for the cadre of primarily pre-tenure faculty awarded mini-grant (similar to the Tech Grant 2000 program) funding through this initiative to develop web-enhanced or fully online courses.

Other grant programs included several in the College of Education that focused on technology-infusion in the all courses required by pre-service teachers as a type of modeling process for this group. Both internal and external grants awarded for technology-based teaching ultimately bridge the gap between traditional research and teaching functions, thus helping to create a culture that fosters the "scholarship of teaching," a concept beneficial to both current and future faculty. Equally important, as more and more faculty adopt technology-based pedagogies, it will become increasingly important to develop policies and templates for helping them to analyze and assess the effectiveness of these pedagogies for the purposes of tenure and promotion.

Tenure, Promotion, and Technology-Infused Course Development

The following points address a range of guiding questions and responsibilities departmental and college review committees should acknowledge in evaluating the role technology plays in teaching, scholarship, and service, as well as in using technology as a medium for such evaluation.

Guiding Questions

- How can/must existing tenure and promotion guidelines regarding teaching effectiveness account for the changing delivery models of technology-based learning?
- How can the concept of "the scholarship of teaching" contribute to better understanding of the ways in which online teaching contributes to teaching, research, and potentially service?
- What constitutes "evidence" of teaching and learning effectiveness in a technology-infused education model?
- How does relying on a primarily print-based review of candidate files hinder understanding of the impact of technology on teaching and learning?
- How does the level of faculty support for course development (course reductions, reduced class size, technical support and team-development models) impact teaching effectiveness?
- What constituencies on campus must be involved in discussions of technology's role in tenure and promotion decisions? (Faculty Development units, Faculty Senate, college technology committees, departmental and college tenure and promotion committees)

Candidate Responsibilities

- To offer commentary within teaching narratives that "guide" internal and external reviewers to weigh and evaluate online course materials and to clearly connect technological initiatives with indicators of student success within that discipline.
- To arrange for "peer observation" and evaluation within an online/distance or any technological setting (Note that options may include virtual observation/participation of online discussions or chats, quantity and quality of course customization, ease of access and navigation to course materials, the extent to which courses account for multiple learning styles, and so forth).
- To provide specific evidence, preferably in its original medium, including transcripts of online discussions, web-syllabi and electronic course content in various media, and student technology projects
- To educate departmental and college review committees about existing guidelines within the discipline and through national distance learning organizations that would support the candidate.

Departmental/College Tenure and Promotion Committee Responsibilities

- To review and revise existing student evaluation forms to account for distributed learning models/technology based teaching
- To commit to review candidate's distance/technology-based teaching in its original medium (Video, Audio, WWW, CD-ROM)
- To collaborate with faculty development and instructional technology specialists and department/college technology committees for training of internal reviewers to review online course materials
- To secure external reviewers knowledgeable about the role of technology in teaching and learning and to provide reviewers with guidelines about departmental/university standards in this area for tenure and promotion
- To explore options for implementing an electronic teaching portfolio program for technology-based teaching and learning

Conclusion: Seeking Institutional Change

As some of the above guidelines indicate, some disciplines have relied on their major professional organizations (e.g., the Modern Language Association and the Conference on College Composition and

Communication) to help define and assess the role of technology in the curriculum. Yet to ensure institutional recognition of the importance of technology in tenure and promotion decisions, these national standards and guidelines must be contextualized around the role technology places in the localized teaching and learning community. For instance, rather than rely on solely on national and disciplinary guidelines, college and academic units can also rely on case studies of actual faculty examples of how technology is employed in the teaching, research, and service roles. This is particularly important at both the College and Provost review levels in which reviewers are outside the discipline and less able to assess how such work is valued within the tenuring unit.

Nevertheless, tenuring units must themselves be prepared to revise traditional teaching review processes, particularly student ratings and peer and supervisor evaluation. Indeed, in their discussion of evaluating online courses, Palloff and Pratt (1999) stress the importance of considering all aspects of the course, including student performance, course design, online conversation, and other elements that usually don't make their way to the standardized rating form. Because the ultimate goal is to help students meet the learning outcomes expected in a multimedia lab-based, significantly web-enhanced, or fully online course formats, tenure and promotion cases that demonstrate as specifically as possible the extent to which these outcomes were met are most likely to be successful ones. Electronic portfolio assessment has incredible potential in this regard. While teaching portfolios, including electronic teaching portfolios, are recommended for all teacher education students by the National Council for the Accreditation of Teacher Education, such professional development tools must be extended to university-level educators. Yet in advocating such an initiative, the material conditions of the institution must be addressed, including issues of access, technical support, learning curve, workload, educational philosophy, and institutional rewards. More than any other group, the college professoriate is charged with educating future teachers and working professionals in the newest technologies of literacy and communication and with meeting the diverse needs of learners both inside and outside the traditional boundaries of academe. Electronic portfolios provide an opportunity to both demonstrate our curricular efforts in this arena and to be rewarded for those efforts. As this paper has stressed, working toward these goals is the collaborative institutional responsibility of faculty, administrators, departmental and college tenure/promotion committees, and faculty development units.

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Building comic strips in a coòperative way: an interdisciplinary experience

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Abstract: This paper presents a software named Tirinha. It is an educational environment to build comics strips in a cooperative way. It was built to assist the teaching-learning process in elementary schools. The environment has a methodological approach that should be followed in order to create the stories. The environment enclosed a tool to match drawings or pictures with texts, a chat tool to support the co-operation process among children, and an edition area to construct the comics.

Introduction

The new medias integrated with new information technologies offer us an opportunity to create new methodologies in order to improve the learning process, and overcome the limitations of traditional methodologies in schools.

Teachers and psychologists have different interpretations about the contribution of comic strips for educational process. They can be used as a teaching-learning resource; their application has been analyzed and evaluated by specialists. Comic strips entail the idea of movement, and are composed by images and texts (Rahde, 1997). In fact, comic strips can be defined like a graphic/literary set formed by image and texts (Luyten, 1985).

The use of images helps the student to understand the process of reading or writing in any language. Thus, the image can be seen as a new resource to support Portuguese learning (or others fields) and as a source to develop interdisciplinary activities. In our methodology, the teacher proposes a specific subject that will work as a common theme to be discussed by students. They will interact in order to create and organize the script, characters, and other details that will compose the story, generating a comic strip as a final result.

We believe that teachers need to create and apply new methodologies in order to promote a more efficient learning proccess. So, an educational environment must provide the teachers tools to explore different tasks using methodologies that allow the students to explore the domain, and understand the way they acquire knowledge about something, in other words, a "learn-to-learn" approach. To achieve this we need to offer open environments that allow teacher and students to test hypotheses, and create alternatives to better understand the different possibilities that arise from a specific domain exploration.

This paper is organized as follows: section 2 presents some issues to be considered when building comic strips in a cooperative way, and methodological aspects of comic strips building; section 3 describes the Tirinha environment; section 4 presents the preliminary results, and future work.

Methodological Aspects of Comic Strips Building

Piaget and Vygotsky have emphasized that social abilities (e.g. communication, cultural inheritance) promote the development of comprehension and help the learning process. Collective activities are usually separated in two different categories: collaborative and cooperative learning. In this paper, we use Barros' (Barros, 1994) definition, because the cooperative concept presented has a wider scope. Moreover, it considers collaboration as being an assumption for co-operation. The result of à cooperative work consists of the individual contributions discussed among the group members in order to create a final work where it is not possible to identify the contributions of each group member. Co-operation implies the existence of collaboration.

We have developed a survey with Portuguese language teachers in elementary schools. The goal of this survey was to elicit the teachers' profile concerning: software selection, methodologies adopted when using comics strips as a complementary activity for their classes, and their opinion about resources that could be included in an environment that intends to support cooperative comics strips production. Out of a universe of twenty schools, we have selected just four. This is due to the fact that we needed schools where teachers were using new teaching methodologies, as well as performing interdisciplinary activities. Nine teachers answered our questionnaire. When we proposed the research, we thought we would have around fifteen teachers collaborating with us. However, in fact, our expectations were not fulfilled. Most of them did not answer the questionnaire and said that they are not available for interviews.

This small number of participants needs further reflections from Education/Psychologist specialists. The reasons of this behavior need much more reflection, because it seems to us typical of teachers from the elementary level. We developed in our group other survey with the same target public, and we found the same problems.

In this survey we have observed that private schools normally use educational software in classrooms and comic strips to support Portuguese language teaching. This methodology (the use of educational software and comic strips) can be enriched via a computational cooperative environment where students are not space limited and can use the Internet, educational software and where there are software resources to be used together.

The Tirinha Environment

The Tirinha environment was designed under the computational and pedagogical viewpoints that we identify on a previous survey with correlated environments. We evaluate two commercial products developed to support the children comic strips building, Microsoft Fine Artist (http://www.microsoft.com/brasil/produtos) and Quadrinhos Turma da Mônica (http://www.monica.com.br), from Mauricio de Souza Produções. These products were selected because they were mentioned during our survey in schools.

Tirinha has a set of tools that makes it possible to create comic strips in a cooperative way. This set consists of a chat tool, a whiteboard to visualize the chosen images (pictures or drawings made by the student) and the current version of each picture that compose the comic strip. The images are stored in a shared database and are accessed through an editing window.

Tirinha has several activities that can be accomplished individually (activities like creating student's database of pictures) and others that can be performed co-operatively (like making decisions about the comic strip's pictures, texts, and so on). The interface has the following resources:

- Chat Tool;
- Access to shared and distributed databases;

In the database management each student has his/her own database that can be shared among the workgroup and with images ready to use.

- Window for comic strips' picture edition;
- Group members' visualization ;
- Visualization of the available comics in the shared databases;
- A whiteboard for cooperative pictures edition.

The work resulting from student's activities is a set of HTML pages. Students can also create presentations, for example, in the Microsoft Power Point tool pattern.

The Tirinha environment was design to get objects (images, pictures) that are distributed at students computers and include them in the whiteboard tool. The students can get the images to put in the comic built in a cooperative way. The whiteboard tool was developed by Delphi language and it has the features of insertion of rectangles, circles, text and images. Also it is possible to print the comic, to open an old comic, save and edit a new comic. The comic construction is made in a cooperative way, and all participants connected in the same server can receive the alterations occurred in the screen. When a student make an interaction in the whiteboard tool, for example, writing a text or drawing, happens an image lock and this image is free when the student when the student release the mouse button. After the edition, the image co-ordinations are transfer through the server to the clients.

The clients applications are developed by Delphi language and have both applications in it: whiteboard and chat. The server application was developed in Java language and uses the sockets feature to communicate with clients.

The chat tool has features like: communication with all session participants, send messages just for a person or a selected group of people connected in the same server and save a log file to retrieve the interactions.

The Tirinha environment integrates, in the same interface, the whiteboard and chat tool to allow the cooperative comics construction. The Fig. 2 shows the Tirinha interface with four main regions:

(1) comic construction area;
(2) area that shows the students interaction through the chat tool (example in Portuguese);
(3) area when the students type the interaction to send to other students and
(4) open picture button to select and add images in the whiteboard screen.

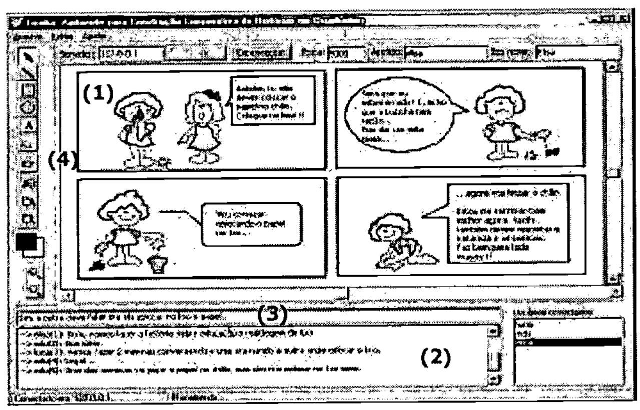

Figure 1: Tirinha's interface

Besides the computational environment support, Tirinha has a methodological support to help the teaching activity. A homepage was built to assist teachers in their classes. In this homepage is available some suggested methodologies to use the Tirinha computational tool. Also, you can find system documentation, correlated works and the prototype of Tirinha's download.

After the survey conducted at schools and interviews with specialists, we can select some methodologies used by teachers in the their classes (Boff & Giraffa, 2000) and suggest any other. Other methodologies can and must be suggested by teachers, because the Tirinha environment was conceived to be used in different ways.

Preliminary Results and Future Works

The internet and the associated technologies (e.g., local area networks) brought something really good for educational environments: they enabled us to do much more than just transport traditional methodologies to virtual classes. The need to create new environments and methodologies that allow teachers to explore different possibilities to improve the educational process is something very exciting, and the big challenge for educational researches. Only teachers can create new methodologies, computers just enlarges the set of tools available for the teachers. To better explore the environment possibilities it is necessary to have a creative and a participative teacher.

The results of this project allow us to demonstrate the enrichment that comes from the cooperative work when we combine different research lines with a multidisciplinary approach. Besides, we believe that the main contribution of this work is also the environment that allows students to build cooperative comic strips supported by a proper methodology with an integrated interface.

We have tested the different tools that were developed (chat, whiteboard, and database). These results show us the potential of the environment. To better achieve a good design for it, a specialist in comic strips supervised our prototypes, and helped us to test the available possibilities with the children. Also, teachers were interviewed to provide information about methodologies and comic strips usage in the teachers classes. The design, the implicit methodology, and all the aspects that are found in our environment were possible because we work in an interdisciplinary team. The system validation was made with the teachers that supporting us during the environment design and it shows the system potential. In the future, we intend to make the system validation with children at schools and provide the tool feature of comic (scenarios, character) edition.

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E-LEARNING: CHALLENGES AND INHIBITORS

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Abstract: E-Learning has become a major drive in some institutions of higher education. E-Learning programmes need management and faculty participation to succeed. In this paper some of the methodologies in the implementation of E-learning is explained. The use of ICT in teaching is too an important issue to be left to individuals and should be managed university wide.

INTRODUCTION

E-Learning is fast becoming a mainstream activity of many universities. To promote educational excellence the strive is for education innovation involving all faculty staff members. It is not just creating course material on the Web and making it available in the case of MIT free charge to everyone. E-Learning involves more than transferring information in electronic form. It involves teaching strategies like communication [discussion, chat, questions and answers]; formative assessment, participation, case studies and problem solving, assignments, demonstrations, simulations and record keeping. E-Learning as mainstream activity should be an integrated solution to some of the problems of contact tuition, but cannot in anyway exclude or supersede contact teaching.

METHODOLOGIES

Some of the methodologies in the implementation of E-Learning at the University of Pretoria are:

Combining top-down and bottom-up approaches

In June 1997 the Council of the University adopted a resolution to make telematic education part of the main-stream teaching activity. Simultaneously every academic school was asked to draw up education innovation plans following a general guideline document that was drawn up by the senior management of the University "University-wide Education Innovation: points of departure and guidelines". Deans were asked to identify champions who could start E-Learning by putting their material on the Web and experimenting with new ways of teaching and learning.

Change management plans

Schools were asked to send faculty members to change management workshops. Every school appointed education innovation managers/coordinators. These people report directly to deans who take the overall responsibility for education innovation in their schools.

Seed funding

Champions draw up project proposals and business plans. Seed money was made available for every project according to specific needs in schools. The big advantage of this money lies in the fact that project managers were able to attract people and other resources like graphic artists and instructional designers over and above their normal resources.

Project management

This proved to be a very important part of the success the University had so far. Every programme that is put on the Web is managed according to project management principles. The Department of Telematic Learning and Education Innovation appointed project managers in collaboration with faculty members.

Involvement of management and academic staff members

It is sometimes difficult to involve busy academic managers. Seed money was only made available after a decision of the relevant pro-vice-chancellor. He/she is kept up to date in terms of the progress of every project.

VIRTUAL CAMPUS

A Virtual campus was created using the WebCT platform and integrating academic support services: the library, admissions, e-pay, student administration, etc. 7 500 students are now following more than 100 programs on the Web through the virtual campus. The virtual campus has been running since October 1988. Band width and communication problems were and still is our biggest headache. Integrating the academic information service/library has been the biggest success. Students are now able to retrieve full text materials without coming to the library. Online communication between students and lecturers [discussion groups, chat rooms, etc.] is working although lecturers have to adopt to their new role of learning facilitator/coach.

INHIBITIVE FACTORS

Inhibiting factors that hamper us in rolling out e-learning with adopters and late adopters are:

general perception that quality of teaching is not so important;
established formula for resource allocation;
time to develop content in appropriate form for E-learning;
workload;
new role of the lecturer; and
need for instruction in E-learning [just in time]

A number of strategies are being developed to overcome some of these factors.

Supporting Developers by Building-Block Methods: The Case of the Templates

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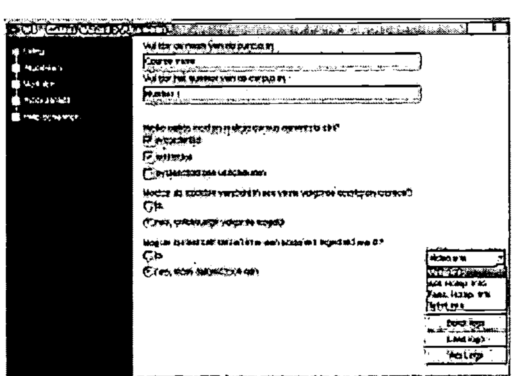
Abstract: *The development of advanced learning environments requires a considerable level of technical and didactical expertise. Also, the time and costs of the development process is often substantial. In order to promote development by Subject Matter Experts (SME's) and instructors, we have suggested using building-block methods that provide pre-structured software templates (Boot & Barnard, 2000). We have started a number of projects to investigate this issue. The first project, the Templates-project, has shown that it is possible to support developers in creating courseware for relatively simple learning objectives but with a high level of technical complexity and interactivity. The second project, the BAOZ-project has shown that it is also possible to embed more advanced didactical functionality such as case-based learning into templates. In the current project, the TOP-project, we investigate these issues in the context of telelearning. Amongst others, we focus on integrating work and learning by using real work-related material into case-based learning templates, and the reuse of learning material by means of standardized meta-data structures.*

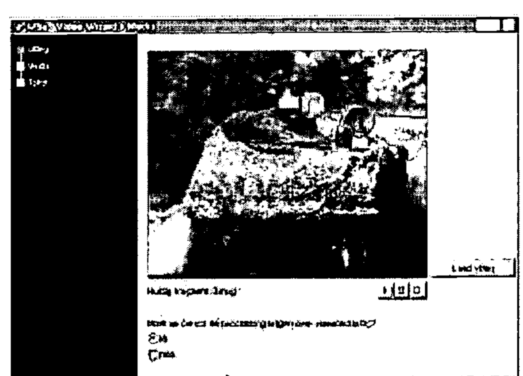
Introduction

The development of advanced learning environments requires a considerable level of technical and didactical expertise. Also, the time and costs of the development process is often substantial. In order to promote development by Subject Matter Experts (SME's) and instructors, we have suggested using building-block methods that provide pre-structured software templates. These should be able to scaffold the development process by offering pieces of program flow and user interface components, that can be filled with learning content and multimedia components. Connected to each other, they constitute a complete courseware program. This development process can be guided by means of wizards (see Boot & Barnard, 2000). We have started a number of projects to investigate these issues. In this paper, these projects will be presented and discussed.

The Template project

The first project is aimed at supporting courseware developers within the Royal Netherlands Army (RNLA). In general, these developers are instructors and SME's, and don't have much experience in programming, multimedia development and instructional technology. Most often, they develop courseware for relatively simple learning objectives such as operating procedures, the organizational structure of the army, and recognition of material such as tanks and airplanes. It is their desire to make the courseware appealing (by means of multimedia), interactive (by means of many learning activities) and manageable (by means of Computer Managed Instruction (CMI)). These requirements cause a high level of technical complexity of the courseware and courseware production. To lower this level of complexity, we developed courseware templates that a) guides them through the development process by means of wizards and b) offers automated construction of the course structure, interactivity and embedded multimedia elements. The templates are created with Authorware®'s Knowledge Objects.





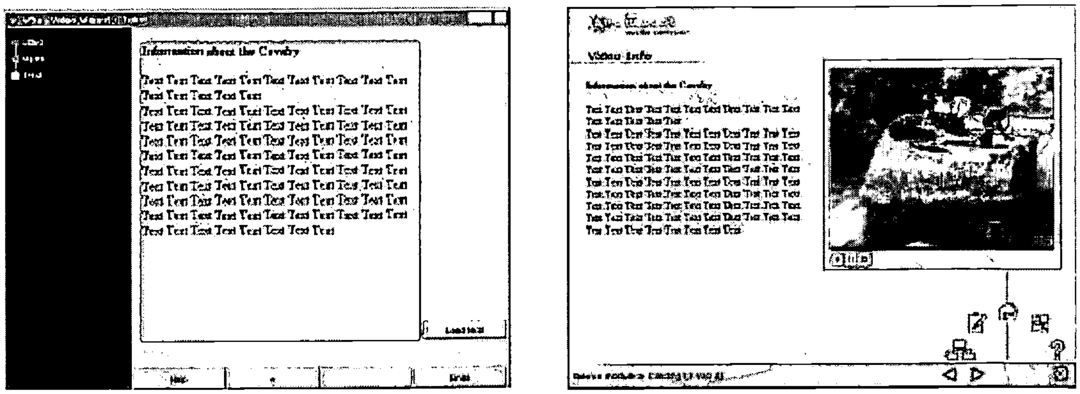


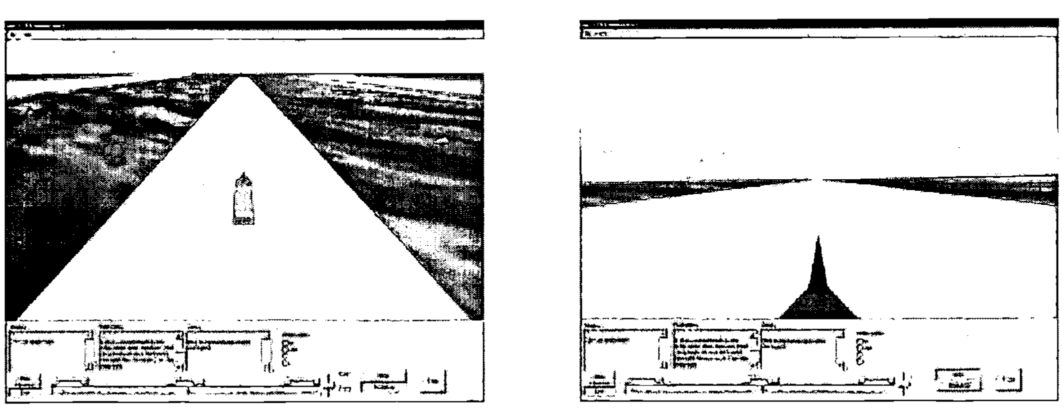
Figure 1: Three examples of wizards that guide the construction of the course structure and the embedding of video and text and the resulting courseware program.

The BAOZ project

In the second project, we focus also on the application of more advanced didactical functionality such as case-based learning into templates. The Royal Netherlands Navy (RNLN) experienced problems in educating cadets the Rules of Engagement at Sea (in Dutch: Bepalingen ter voorkoming van Aanvaringen op Zee (BAOZ)). These Rules are very judicial and cadets have trouble in applying these formal rules correctly and optimally in real life situations. In bridging the gap between classroom lessons and simulated- and real navigation lessons, we suggested using courseware based upon case-based learning. Case-based learning is especially beneficial for acquiring complex, cognitive skills in domains that have no equivocal, straightforward solutions (Schank, 1997; Spiro & Feltovich, 1991; Spiro, Feltovich, Jacobson, & Coulson, 1992). Cases present realistic problem situations that evoke authentic learning activities, that guide the transfer of learning formal knowledge (the Rules) into application of that knowledge in fuzzy, uncertain and unpredictable real-life situations.

Unfortunately, implementing case-based learning into courseware is difficult and often very expensive. Furthermore, the RNLA does not have professional expertise in courseware- and multimedia development available. However, considering their desire that officers and instructors should be able to adapt the courseware and cases to their specific requirements, complete development of a course by a third party is not a good option. Therefore, we developed case-based templates, which allow RNLA officers and instructors to create problem situations within cases, and build courses based upon series of cases.

The case-based templates provide cases that contain a generic navigational problem that unfolds itself within a simulated situation. Within each case, the cadets are confronted with questions about the problem situation, and can adjust their point of view (egocentric vs. different helicopter views) and the speed of the ships. The RNLA officers and instructors can adjust different parameters that configure each case within a Scenario Editor. Context parameters define the kind of surrounding (harbors, open sea), kind of ships, waypoints for the routes of each ship etc. Case parameters define the kind of questions that are asked, the Rules that are presented, the answers that are suggested and the feedback on those answers. Course parameters define how the series of cases constitute a course. This enables the officers and instructors to courses and cases based upon the rules as well as their own experiences in difficult navigational problems.



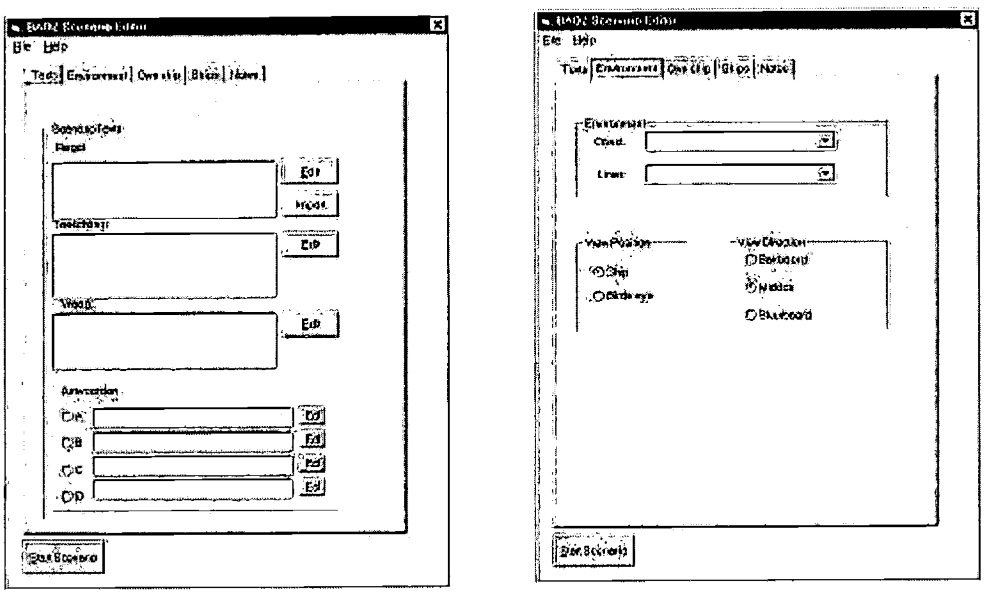


Figure 2. Four screendumps of the BAOZ program; two views on the case presented to the learner and two aspects of the Scenario Editor.

Future developments

To conclude, both projects have shown that it is possible to a) build templates that lower the technical complexity of the development process and b) incorporate advanced didactical models into templates. In a current project, the TOP-project, we investigate the issues presented in this paper in the context of telelearning. Telelearning offers possibilities to extend case-based learning by interacting time- and place independent with information sources, experts, coaches and other learners. Amongst others, we focus on integrating work and learning by using real work-related material into case-based learning templates, and the reuse of learning material by means of databases and standardized meta-data structures.

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Using Databases in Teaching Advanced Mathematics Courses

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Abstract: This paper is a follow up of the papers that discussed how information technologies could be used in teaching Advanced Mathematics (Bouniaev, 1995) and in developing general logic actions (Bouniaev, 1999). Here we discuss the possibility of using databases in teaching Advanced Calculus. The psychological foundations of our considerations are Stage-by-Stage Development of Mental Actions Theory.

Introduction

This paper is a follow-up of research contained in the paper "Some Psychological Aspects of Developing Computer Based Instruction in Undergraduate Advanced Mathematics" (Bouniaev, 1995) as well as in "Computer Based Instruction and General Logic Action Development In Teaching Mathematics" (Bouniaev, 1999) In these papers, we mainly discussed the methodology of using Information Technology (IT) in studying such disciplines as Calculus and Foundations of Algebra and Analysis. They focused on the development of elementary general logic actions such as classification and attributing to a concept. The psychological foundation of the above-mentioned papers was Stage by Stage Development of Mental Actions Theory (SSDMA theory).

Since the first paper in the series was published, long discussions and collaborations with M. Connell led us to the conclusion that SSDMA prescripts for organizing a learning process practically coincide with those of the constructivism (Connell & Bouniaev, 1996).

Thus we would like to emphasize that although we still explicitly proceed from the concepts and recommendations of the SSDMA theory, implicitly there are no contradictions with the theory and practice of constructivism. Proceeding from the above-mentioned psychological theories as a fundamental basis for using information technologies (IT) in this paper we discuss the possibilities of using databases in organizing instruction process of such an abstract discipline as Advanced Calculus. This discipline is a part of most math teacher training curricula and can substantially impact the efficiency of teaching Calculus in high schools.

As theoretical and experimental research shows (Bouniaev , 1994) databases and bases of knowledge (complete with a designed interface) can serve as construct frameworks for implementation of basic theses and prescriptions of the SSDMA theory of developing mental actions in organizing interactive computer oriented instruction. Therefore, theories of artificial intelligence and data and knowledge representation were used (see Durkin, 1994; Haes-Roth et al, 1983) in this research.

Newman et al (1989) emphasized that Intelligent Tutoring systems cannot substitute teacher's performance which is certainly indisputable. However, a current tendency to present knowledge in Artificial Intelligence format makes a substantial impact on instructional software design which does not formally belong to Artificial Intelligence Systems. We consider the frame structure of knowledge presentation very useful for our purposes.

Basic concepts of the SSDMA theory

This paragraph is based on the monograph of Talysyna (Talysyna, 1975). According to this theory the major goal of instruction is developing mental actions with objects of the studied field. Instruction is viewed as controlling students' activities and hence controlling the process of development. Thus, instruction efficiency is determined to a great extent by a well-developed system of control.

All actions can be referred to two categories: general logic actions and specific actions. General logic actions are inherent in every subject field and are different only in objects at which they are directed. Examples of such type of actions are qualification; break up into classes, comparison, contributing to a concept, action of proof. For example, qualification as a type of action exists in mathematics (qualification of the conics and differential equations) as well as in other disciplines. Specific actions are basically inherent to a given subject field. For example, in mathematics they are arithmetic operations, differentiation, etc.

The SSDMA theory specifies four independent characteristics of any action used to judge the level of development of an action:

An action can be in a materialized (material), speech or mental form. A materialized form of action is connected with manual activities (manipulation, hand-on activities, etc.); objects of action (or their models) are presented in a material form; results of action should be real transformations of these objects or of their models. There is no need to discuss the speech form of action. However, it should be noted that according to the SSDMA theory, writing belongs to the same speech form. Mental form of action is the highest form of action development. An action in this form is imperceptible for one's associates and its results are also recorded in an imperceptible for others form. For example, in considering a specific problem a task of qualifying conics may arise, which is a subsidiary problem with respect to the main one. If a number of conics presented for qualification is not excessive then any mathematician can perform this action in his/her head and record its results in memory. As experiments show, for students studying the theory of Conic Sections it is difficult to perform this action in their heads (even if the number of conics at the beginning of study is 3 or 4). The mental form of action also means that its objects are representations, notions, concepts and all operations are performed in the mental form. The ability to perform a whole action in the mental form indicates that it has gone through all the stages of development and interiorization.

- Each of the described forms of actions has another three independent characteristics: (a) degree of generalization; (b) degree of completeness; (c) degree of assimilation.

(a) Generalization of an action means ability to apply it to objects of a different nature. If the degree of generalization is high enough a person can easily apply this action to different objects, or example, if the action of qualification of conics is developed with a high degree of generalization then it can be applied to a similar problem in three-dimensional space. In this case a person has developed some general ideas how to perform a qualification action.

(b) The degree of completeness indicates if all the operations that were to be performed in the process of performing an action have been actually completed. For example, in teaching the action of qualification of animals an operation to be performed is obtaining enough specific characteristics to be able to refer an object to a particular class. It is evident that sometimes all the answers can be correct but based on superficial characteristics which indicates that in the process of performing an action either wrong operations were made, or the order of operations was wrong, or not all of the necessary operations were performed. The common method of establishing the degree of completeness of an action is restoration of all the operations necessary to perform it.

The degree of assimilation, as a rule is connected with such indicators as the speed of performing an action, technical errors and mistakes, the level of automatism, etc. It should be noted that drill-and-practice software first of all is aimed at developing certain actions with a high degree of assimilation.

The SSDMA theory singles out five stages in the process of instruction. Detailed analysis of each of the stages in organizing a computer oriented learning environment is given in "Development of multifunctional dialogue CAT programs " (Bouniaev, 1991), therefore here we will provide just a brief outline of these stages.

The first stage deals with the presentation of the material to students and description of an action to be developed. Note that passive reception of knowledge by students is not performing an action. The second stage consists of developing actions in the materialized form. The third stage deals with developing an action in the speech form (both oral and written). The fourth stage is beginning interiorization. Each of us probably noticed that before performing an action to make it easier we tend to speak it out to ourselves. Speaking out to ourselves is the fourth stage of development. At the fifth, final stage, the action is developed in a mental form. Note that at each of the last four stages the action is developed at a certain given level of generalization, completeness and assimilation.

Construction of materialized objects in studying advanced mathematics

As it follows from most modern psychological theories, for example, constructivism or SSDMA theory, at the initial stage of instruction the object of action should be presented in a material or materialized form of action (Bouniaev & Connell, 1996). Moreover, this action should be developed at a high enough level of generalization, completeness and assimilation. As a rule it is not hard to do when we deal with development of arithmetic or algebraic actions. But the more abstract the material, the more difficult it is to present the object of action in a material or materialized form. Thus in organizing the instruction of more advanced math courses it is common practice to start right from developing the action in the mental form. This negatively affects the level of student's knowledge in abstract math disciplines.

The math teacher curriculum traditionally includes such disciplines as College Algebra, Calculus, Linear Algebra, Foundations of Algebra and Analysis, Abstract Algebra and Advanced Calculus. In training a math teacher each of the above-mentioned courses plays its particular role. A change of this role in studying more advanced courses significantly affects the character of didactic goals to be achieved in the process of instruction. This change can be easily observed in changes in wording of the exercises of the above-mentioned courses.

Thus in College Algebra and Calculus I the majority of exercises deal with finding a new object. For example, find a sum of two algebraic fractious, find a derivative or an integral, etc. At the final stage of instruction of Calculus and in teaching Linear Algebra the number of problems dealing with finding new objects is balanced by the number of classification or attributing to the concept problems. For example, to prove that the given series converges (in Calculus), or to prove that the given system of vectors forms a basis (in Linear Algebra). So we see a new type of problems, however, as we already mentioned they deal with development of elementary logic actions.

As a rule, the object of action of this type of problems can be easily presented in the material or materialized form. For example, it is easy to represent the terms of converging series as a sequence of dots on the plane. However, it should be noted that a model presentation of an abstract notion that looks superficially good is not always helpful in doing a specific problem.

Development of logic actions such as classification is connected with construction of materialized models that physically may not look like the respective actions but present in the materialized form the structure of such actions. For instance, tables can be used that students fill in while doing specific problems. It is also expedient to use electronic text fragments, which can be moved to different places on the screen. The details of using IT in solving this type of problem can be found in (Bouniaev, 1999). Therefore we are not going to elaborate it here.

At the next stage in teaching such courses as Advanced Calculus and Abstract Algebra besides simplest logical actions such as classification and attributing to the concept we have to develop more complicated logic actions such as the action of proof. Bearing in mind that in studying Calculus students have mastered the simplest "transformation problems" like finding a derivative or an integral, then in Advanced Calculus development of the action of proof becomes the major goal of instruction. And not only development of the action of proof, but proof of statements applicable to the whole class or classes of objects. In this case the object of action is a theoretical abstract concept, which makes it significantly different from the situation when the object of action is a particular function even if the action itself is an action of proof.

Thus for example the task to prove that function six x is continuous is significantly different from the one to prove that any continuous on the closed interval function is bounded. In the first case the object of action has materialized representation both in the form of a formula connected with numerous trigonometric identities and in the form of a graphic using which all the actions performed in the course of proof can be "materialized". In the second case the object of action is a math abstract notion for which it is difficult to find a materialized representation. Any continuous function viewed as an illustration is just an example of an object coming under this notion and thus cannot claim to be a materialized representation of a math abstract notion.

Besides that, math abstract notion itself significantly depends on the level of development of an individual in whose mind it exists. For example, the notion of continuity exists both in the mind of a freshman before studying Calculus I and in the mind of a senior ready to study Advanced Calculus. At the same time in the framework of the studied course (Calculus or Advanced Calculus) further development of abstract notions determines different actions that are objects of these abstract concepts.

For example, in Calculus I to develop the notion of continuous function it is enough to use the action of classification of pictures illustrating graphics of continuous and discontinuous functions. We can also effectively use pictures in a formal proof of continuity. However, in the proof of theorems in which continuity is a premise or a result, an illustration may help but it cannot serve as a materialized model of proof. A model should reflect not a particular case of the proof of continuity but general characteristics of any proof. In the framework of the model needed for instruction, "proof" and "proof of continuity" are related as general and particular. As the conducted experiments showed databases or bases of knowledge can serve as materialized models in teaching proofs.

Databases in the Study of Advanced Calculus

A natural information model of any subject field including mathematical theories is a database or a base of knowledge. We consider databases a named complex of data reflecting a stage of an object or a number of objects, their properties and relationships. In fact a database can be viewed as an information model of a given object, and effectiveness of the control system of the object depends on its preciseness and authenticity.

Using databases or bases of knowledge in the process of instruction is not something new. Already ten years ago reference and information systems built within the framework of prevalent databases constituted about one third of all the databases used in teaching math. However, we offer much more than just using databases for reference and information purposes although we do not exclude it either. Let us consider the possibilities of using databases at every of the five recommended by SSDMA theory stages of developing mental actions based on the organized process of instruction of Advanced Calculus.

According to the SSDMA theory at the first stage of instruction a student gets necessary information about a goal of action and its objects. The instructor in familiar from previous courses terms explains a system of reference points (prompts that help the student to master the studied material.) He/she also discusses the content of the studied material. It should be mentioned that even at this early stage of instruction, certain difficulties arise first of all because it is hard to explain to a student what the goal and object of instruction are. The thing is that students have been studying Calculus for three semesters but they still have a very vague idea of theoretical math fundamentals thus making it very difficult for them to understand what kind of proof they are going to deal with in this course. For the majority of students at this level, math is associated first of all with such words as find, calculate, etc. Problems of existence and therefore of proof are still completely alien for them. It becomes even more confusing since in most traditional advanced calculus textbooks the problems (especially in the beginning) are worded in the same way as they are formulated in their Calculus textbooks.

Questionnaires to monitor the students response that we have been distributing and analyzing during the last ten years of teaching Advanced Calculus invariably indicate that even after two or three weeks of instruction students were confused about what is required from them to succeed. At the same time most Advanced Calculus students already took courses incorporating databases. Thus terms associated with them such as table, record, form, report, query, relationship, etc., are familiar to them and do not provoke psychological rejection.

Using this previous experience with databases as an advantage we determine the goals of instruction as structuring the material contained in the textbook and explained in class. By structuring we mean constructing databases using the studied material of the course. Naturally the structure of any database significantly depends on what kind of information this database is used for. Therefore as points of reference for constructing databases we offer students typical questions that will be part of the test. Naturally, the most important points of reference are the examples of proofs discussed in class. By no means we imply by this that this is enough to teach students the action of proof. At the same time we include into the system of prompts questions like: "how to build a database so that using it one could reproduce the proof presented in class?" We also linked questions that students had to answer using their own constructed databases to the points of references. It was mentioned that the tests would include the following questions.

1. Formulate the theorem. 2. What is the theorem's premise? 3.What is its conclusion? 4. What

notions are used in the theorem's formulation and what is their meaning? 5.What theorems were used in the proof of the given theorem? 6. Give examples of problems, which are based on solving this theorem. 7. What theorems need to be used to do this problem? 8. Is the conclusion true in absence of any of the premises? 9.Are all the premises necessary for the conclusion to be true? 10. If you answered, "yes" in 9, demonstrate it. 11. Give an example of an object that can be attributed to this concept. 12. Give an example of an object that cannot be attributed to this concept. 13.Prove this theorem. 14. Solve a proof problem.

It should be noted that at this stage of instruction students are not yet involved in performing the action or they perform it in a perceptive form, i.e. students just observe how it is performed. Besides, in the process of demonstration /observation points of reference (prompts) are determined that help to develop the action at the next stages. At this stage the instructor can also use his/ her own prepared database as an information system to get illustrations of examples, links with respective sites in the Internet, etc. Certain fields in such a database can be "objects" representing different program packages. At the second stage proofs are developed in the materialized form. In the course of experiment the entire group (about 30 students) was divided into subgroups of three. Students took decisions concerning the structure and elements of databases independently. It was assumed that any member of the group could use this database during the test.

At the same time there were certain limitations to the base itself and ways of its use. First, none of the fields could contain more than 50 symbols; second, none of the fields should contain a statement that could be divided into two conjunctive statements. For example, none of the fields could contain the statement "continuous on the closed interval function". Such field should be broken up into three: a) function domain is interval; b) function is continuous; c). interval is closed. This way the students could not record the whole theorem in one field. This requirement also makes students seriously contemplate the possibilities of structuring any material.

The next set of requirements deals with the possibility of using databases during tests. First, students should act quite fast since the number of problems presupposed certain operational speed. Second, to speed up the process, the students could print out certain forms from databases but only those that closely followed the question in the premise of the problem and contained no additional information. That demonstrates how at the second stage of developing the action of proof we used the materialized form to enhance the instruction process. Students worked with texts and databases. The texts were given but they constructed the databases independently. We also focused on all the characteristics of developing the action of proof in the materialized form to ensure its success – generalization, completeness, and assimilation.

A high enough degree of generalization was achieved by involving students in the action of determining for themselves fields of records in a universal way so that they accommodate analysis of all other theorems as well. If the fields of record determined for one group didn't accommodate a new theorem then the whole group had to be reviewed. A high degree of completeness was provided by the process when all the activities were broken up into two classes - determining the structure of databases and creation of new records, queries, filters and relationships. The first part implied breaking up an action into all the included operations and the second enabled its performance in the automatic regime. And finally, a high degree of assimilation was provided by the necessity to structure quite a lot of instructional information. Besides, one of the factors of successful use of databases was the speed of acquiring and utilizing necessary information.

As we already noted, the students themselves determined the structure of databases, fields, records, etc. However, at the beginning of this experiment we had a certain database structure in mind. First of all since we deal with development of the action of proof, it seems expedient to have a table of theorems, with the following fields: "Name of the theorem" (for example "Intermediate value theorem"); " Object o
function f"); "Premise 1" (for example "Domain is an interval <a, b>"); " Premise 2" (for example " Continuous on the interval"); " Premise 3" (for example "Domain is a closed set"); "Premise 4" (For example "f (a)<C<f
"Premise N"; Conclusion 1" (for example "There is a point "c" between "a" and "b" such that f (c)=C);...; Conclusion N"; " Concept 1 used in the theorem statement" (for example "Continuity on a set"); ...;"Concept N used in the theorem statement"; "Model Problem 1";...;"Model Problem N".

It also seems useful to have a table "Theorem Proofs" including the following fields: "Name of the Theorem"; "Object of the Theorem"; "Definition of Concept 1 used in the proof";" Definition of Concept N used in
eorem 1 used in the proof";..." Theorem N used in the proof"; Transformation 1 of the proof";...
"Transformation N of the proof"; " Proof structure".

We also believe it would be helpful to create such tables as "Concepts and their definitions", " Model Problems", etc. Creating queries plays an important role in the instruction process. As with tables the students make decisions what queries to create independently. It looks expedient to create queries that provide access to all the records (or their parts) that have the same conclusion; like " sequences converge" It is also useful to create queries enabling to find a model problem solution proceeding from the problem being solved.

The third and fourth stages of action devolvement are designed to develop an action in external and internal speech forms. As we already noted, results of students activity at this stage should be either articulated out loud or written down. If at the previous stages in organizing the instruction process we focused on determining the structure of databases and building them then at this stage it already played a secondary role. At the same time, naturally, in the course of study new records were created and added. As a task, the students were required more and more often to write a standard proof using information from the student databases. If in the first test questions 1-12 were prevalent, then in the second test we included questions immediately related to proofs (13-14) and the third test consisted mostly of proofs with access to databases.

At the last stage the action should be developed in the mental form. At this stage students continued to replenish their databases, however, their use as an information system was limited to an emergency. Using databases during the test was penalized, though insignificantly.

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Aspects of a Collaborative Learning Environment using Distributed Virtual Environments

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Abstract: A decisive factor for new technologies is always the added value with respect to the efficiency and capacity of traditional technologies. This also is true when considering the impact of new technologies in training applications. New types of applications have been developed along the last few years to incorporate information technology in the learning environment. The growing need for communication, visualisation and organisation features in the field of learning and training environments, the e-learning approach, has led to the application of virtual reality and the use of multi-user real-time communication platforms to support these needs. This paper presents the first approach of such a system as well as useful technologies and standards for its implementation.

Introduction

The implementation of an attractive, user-friendly and effective teamwork oriented learning environment, to offer synchronous and asynchronous training services, includes many technological and pedagogical issues. In this section a short description of the basic components, issues and requirements of Networked and Learning Virtual Environments (LVEs) are presented.

A simple Virtual Environment (VE) is a computer system, which generates a 3-D virtual environment, with which the user can interact and receive real time feedback (Normand et.al. 1999). If multiple are connected and interact to each other the above definition is extended to multi-user or Shared VE (SVE). A Collaborative VE-system (CVE) is an SVE aimed at a collaborative task. A Learning Virtual Environment is a CVE that is designed to offer additional educational tasks such as synchronous and asynchronous learning (Bouras & Philopoulos & Tsiatsos 2000) and (Bouras & Tsiatsos 2000). A LVE is a set of virtual worlds or a virtual world, enhanced with educational functionality.

The users are represented by avatars (graphically) that populate the LVE and can be provided with additional behaviour such as gestures, interaction, movements and sound. Every LVE must comply with a set of requirements in order to be used widely.

Users are offered a high level of presence through their representation by an avatar of his choice, which simulates some basic realistic actions, such as gestures and movement, giving them a shared sense of space, presence and time (Singhal & Zyda 1999). Users are also able to navigate in a 3D shared space in order to access the content provided, to examine their knowledge, to interact with each other, to exercise their skills and to

receive the information provided. Furthermore the user is informed for the presence of other users (avatars), of their arrival in the LVE and their leave.
A LVE must also provide their users with many types of interaction in order to enhance the development of users as autonomous active learners both in the immediate learning context and in the longer term. Two types of interaction is defined in a LVE:

- Multi-modal user-to-user interaction: chat, voice communication and gestures. This type of interaction is supported by manipulation of shared 3D objects. Real time applications such as audio communication, application sharing and whiteboard functionality are important features.
- User-system interaction, which is based on navigational aid and commands that the system provides to the user for a specific function as well as the manipulation of 3D objects. Furthermore, the users must be able to insert and change objects in the 3D world, sharing these activities with the other users. This type of interaction offers the user the capability to customise the total design and outlook of the VEs according to the needs of their specific themes. Therefore the user-system type of interaction satisfies the need for customisation.

Although immersive applications are more effective in the use of VR technology, the main feature of educational VR applications is the interactivity and not the immersion (Youngblut 1998, Sutherland 1968). Moreover, a VR application, which is designed for educational use should be suitable for widespread use and mature in the part of the technology. Considering these requirements, immersive VR technology is not mature and it is expensive. On the other hand desktop VR is more suitable for widespread use regarding the hardware and software requirements (Youngblut 1998).
A LVE must be scalable to a large number of users in order to support large virtual educational communities. This set of users can be divided in each virtual world that is a part of a virtual educational community, which is able to support a maximum number of simultaneous users. The LVE must be able to integrate any digital material into the platform.
Two other features of the LVEs are consistency and coherence. Consistency is realised by distributing and synchronising user input as well as user independent behaviour in order to achieve the impression of a single shared world. Coherence is used with the sense of a uniform structure of the provided services, concerning mainly the functional and operational characteristics rather than its visual representation in the VEs.
Except the advanced features that a LVE must support, it should also be able to run under a variety of hardware and software platforms, support different formats/protocols and provide adequate security mechanisms. The system must offer an easy and complete administration mechanism allowing easy management of training material and users.
The remainder of this paper is structured as follows. In the next section we describe a European project in the area of the collaborative learning environments for distance education and our vision for its implementation. We then present a review of tools, technologies and standards, which are useful for the implementation of such a project. Finally we present some concluding remarks.

Intelligent Distributed Virtual Training Environment Project

INVITE (Intelligent Distributed Virtual Training Environment)[1] is a project in the framework of the Information Society Technology (IST) Programme of the European Commission. It started in February 2000, and it will run for almost 3 years.
The main aim of the project is to build a platform for synchronous tele-learning which can be interfaced with standardised content management and/or instructional management systems. In order to reach this aim the following objectives have been set:

- Identification of the relevant cognitive and social processes in collaborative learning situation and extraction of those factors into user requirements.
- Development of an integrated system based on distributed virtual environment technologies, including intelligent agents' real-time translation facilities, realistic avatar representation and enhanced interactivity of avatars.
- Evaluation of the prototype within different learning contexts.
- Research results on social learning processes within virtual environments.

INVITE provides the user with VR experience so it will be built over a 3D VRML multi-user environment with smooth movements, extensive textures, 3D icons for manipulation and interaction within the environment and stereoscopic visualisation options. A virtual model will be used for the construction of the worlds. The user interface will be enhanced through the integration of 2D video and 3D worlds.
Full body-photo realistic avatars will be used for representing the user since they seem to be more effective when used in a collaborative environment offering gestures like waving, nodding, bowing, disagreeing etc. The possibility for using talking avatars (text-to-speech lip synchronisation, driven in real-time from voice) with movement capabilities and voice driven emotions will be investigated during the project.
In order to offer asynchronous learning services INVITE will integrate available asynchronous learning systems and support audio/video streaming of available content. Additionally, in order to manage the documents and other educational material a document repository will be implemented, to facilitate data visualisation and implementation of structured search engines. A common habit in training sessions is that all participants take notes on paper copies of the training material and usually the trainer presents his material in slides and allows access to it.
User interaction will be realised by voice/text chat, and online translation. Users will be supported through the application of intelligent knowledge based agents thus providing tools for personalised searching and facilitate the organisation of background information. In (Fig. 1) the main components of a virtual collaborative learning environment are presented (Triantafillou & Tsiatsos 2000).

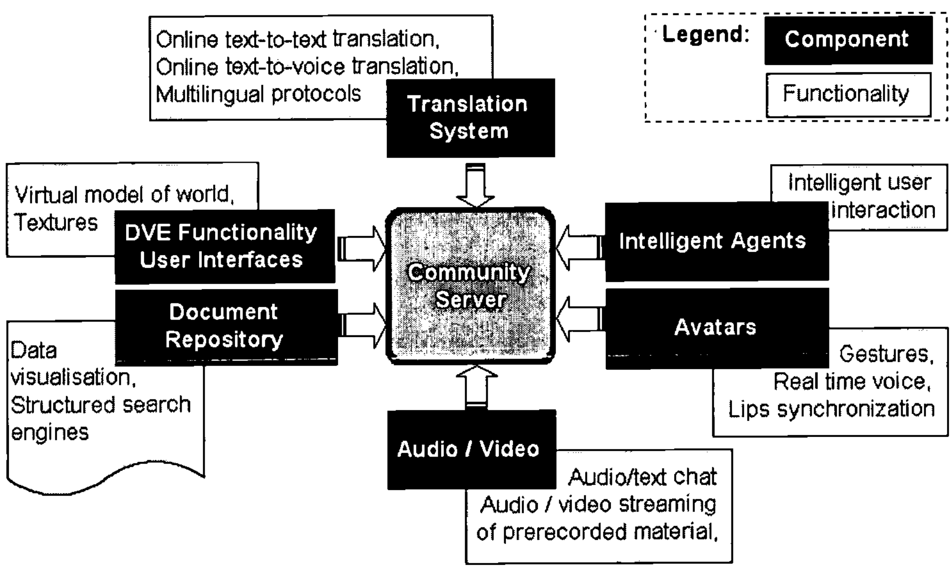

Figure 1: Basic Components of Virtual Collaborative Learning environment

Technologies

The range of technologies available for developing collaborative virtual learning environments is more varied than ever. The exchange and presentation of web based material, 3D content and the transmission of audio/video streams, of high quality, are now supported by a variety of technologies and tools. Integrated platforms consisting of a server for the virtual environment and a client for the presentation of the 3D graphics are now available. Efficient user-system interaction is supported by a variety of intelligent agents. On-line translation tools for text communication and text-to-speech translation allow multilingual user interaction.
VRML97 (Virtual Reality Modelling Language) and X3D (Extensible 3D) will be used for handling multimedia, 3D objects and shared virtual worlds over the Internet due to their platform independence and their capability to allow scripts to be embedded adding more functionality in the 3D scene. External user and 3D-scene interaction will be supported by VRML-EAI (External Authoring Interface).
In order to ensure maximum performance a commercial platform must be used. Such a platform should be open, allowing easy integration with other platforms and technologies, mature (since the whole project will be based

on the platform), offer full support of VRML and other relevant technologies (HTML, Java) and run on a variety of systems/servers without major modifications to the code. The most promising platform seems to be the blaxxun Community Platform that complies with main features such as: full compatibility with VRML, audio/visual interaction, chat facilities, Java, JavaScript and EAI, 3D rendering and SDK support.
Rapid prototype development of the virtual environments can be supported by Parallel Graphics' ISB and ISA which seem to be the most suitable application tools to be used since they support the VRML 97 standard. X3D-Edit can be used as a graphics file editor for editing, authoring and validation of X3D files. AvatarMe' s technology (AvatarBooth) will be used for the capturing and creation of photo-realistic avatars.
Educational material (except documents) involves pre-recorded audio and video (streaming media). Most of the tools that facilitate real time support and electronic conferencing can be used to support communication between participants in a learning session thus covering the user demand for additional synchronous learning support. Microsoft Exchange 2000 Conferencing Server and Meeting Point since are open, offer a variety of features, conform to conferencing standards and can run over various platforms. OnLive platform supports only audio conferencing but its client can be used as plug-in in a web page. RealNetworks solution can facilitate pre-recorded streaming multimedia delivery and synchronisation.
User-system interaction in computer based learning systems is provided through intelligent agents (Fabri et. al. 1999). In INVITE a set of functions, like avatar and object handling, mobile communication interaction and collaboration will be programmed through intelligent agents. Also agents can be reminders, guides, guards and translators of the users. The use of declarative language implementations provide more advantages than procedural ones and for that reason the tool to be used should support KQML (Knowledge Query and Manipulation Language) for communication between the different agents. Java based tools (JAFMAS, IBM Aglets and AgentBuilder) have an advantage over other tools since they have the ability to run over different platforms.
HTML and XML will be used for their capability to facilitate efficient document exchange over the Web. XML offers more capabilities than HTML and can be used to provide metadata and various types of data on the Web. An efficient database management system will be used in INVITE to manage documents, user profiles and educational material. Since one of the main objectives of INVITE is to provide a tool that can run over a number of different platforms this consideration limits our choices concerning the DBMS to be used in INVITE. Oracle' s solution runs under different platforms and provides a number of important features like security, XML support, capabilities for producing dynamic XML or HTML documents from SQL queries over the Internet.
On of the most attractive functionality, which must be provided, is the capability for multilingual text communication and text-to-speech translation. In order to provide such functionality the system will interact with text-to-text and text-to-speech engines. The most advanced text-to-speech translation tool seems to be Speech Cube with the capability of running under different platforms allowing a wide variety of languages but the actual choice of the tool to be applied will depend on its openness and the cost. The most common used system for text-to-text translation is SYSTRAN, which also can run under a variety of platforms and translate from and to a number of several languages. Linguatec offers a flexible solution for text-to-text translation that can be used over the Web.

Standards

The efficient integration of systems relies on the application of world wide accepted standards. A number of organisations (public, private) are active in this field of technical standards like sub committees of the Joint Technical Committee of ISO (SC24, SC29, SC34), IETF WebDAV group, and the World Wide Web Consortium (W3C). In learning technology, interoperability standards and models for learning systems specific recommendations have been suggested the last few years and a number of committees and projects have worked towards that direction (IEEE LTSC LOM, CEN/ISSS, CENELEC, ETSI, PROMETEUS).
XML will be used to facilitate the efficient document exchange over the Web and XSL will support the creation of virtual XML documents and the presentation of these documents of different media types. The distribution of interactive multimedia/hypermedia applications in client/server architecture across different platforms of different types and media will be based on MPEG 7 standard. MPEG-7 will be used to describe the various types of multimedia information and their relationships using a description language.
Information retrieval will be based on the application of Metadata to identify features shared by different documents. Metadata for learning material have also been specified such as: LOM, Dublin Core and ARIADNE. The approach of XMI, which specifies an open interchange model, will support the ability to exchange

programming data between tools, applications and repositories. Learning technology standards will be used for the organisation and presentation of the learning material as well as a basis for the user interaction specifications. In this context the IMS specifications defined for easy discovering of data, data sharing over different platforms, operating systems and tools and ensure reusability will be considered.

User-system interaction will be based on the use of intelligent agents. KQML supports the communication between the different agents and the implementation of the performatives defined by KQML. KIF (Knowledge Interchange Format) (Ginsberg 1991) supports the interchange of knowledge among disparate programs.

User-to-user interaction in a LVE will be mainly supported by avatars and chat communication. The integration of avatars in VE will take into account the specifications for a standard humanoid (H-anim Group). In case these capabilities are not available electronic conferencing can be used. ITU's T120 and H.323 will be used for audio, video and data conferencing over the Internet.

Asynchronous learning services to the users will be supported by the delivery of pre-recorded educational material (audio & video) through the application of real time protocols. (RSVP, RTP RTSP).

The core module in INVITE is the virtual environment since it provides the main functionality and all modules will use this environment to interact through it. VRML standards for incorporating MPEG-4 technologies (face and body animation, streamed video and audio etc.) and the recommendations for SQL database access in VRML will be considered in the development practice of the project.

Communication between the different components of INVITE will lie on the protocols which support client, server, multicast streaming and network capabilities (VRTP) (Brutzman et. al. 1997), real time interaction (ISTP) (Waters et. al. 1997), and multi-user participation in virtual worlds (VIP).

Text-to-text and text-to-speech translation standards are set up for lexical resources and language engineering. In INVITE guidelines from currently advancing initiatives (e.g ISLE and XLT) which produce standards in the areas of multilingual lexicons, natural interaction, multi-modality, interchange of data among lexical resources from various translation systems will be used.

In the following table (Tab. 1) summarises the components of an LVE, useful technologies and tools for its implementation, as well as standards, protocols and specifications to ensure openness and interoperability.

Components	Technologies, Tools	Standards, Protocols, Specifications
Avatars	Avatar Studio, Spazz 3D, ICA, Avatarme' s AvatarBooth	H-anim
Real time Audio/Video conferencing	Microsoft Exchange 200 Conferencing Server, MeetingPoint	H.323, T.120
Streaming Video	RealNetworks solution	RTP, RTCP, RSVP, RTSP, MPEG
Document Repository	XML, MPEG 7, medatada, Oracle 8i	LOM, Dublin Core, XML, XMI, ARIADNE specifications, IMS specifications
DVE functionality - User Interfaces	ISB, ISA, Java, VRML	VRML 97, VRML-EAI, VRML-MPEG4, X3D
Intelligent Agents	JAFMAS, IBM Aglets, AgentBuilder	KQML, KIF, OMG and FIPA specifications
Translation system	SYSTRAN, Linguatec' s Personal Translator 2000, SpeechCube	ISLE, XLT
3D Community	blaxxun community server	VRML97, Java, EAI, X3D

Table 1: Components of a LVE, useful technologies, tools and standards

Conclusion

INVITE aims at the development of a collaborative learning environment for distance education (reflecting real life collaboration) using distributed virtual environments. INVITE fills in a gap, concerning Networked Virtual Learning Environments, both in terms of functionality and technology approach. INVITE is a real-time educational environment, where presence and attendance to the lectures could be made compulsory for inscribed students with Internet access. The students have the opportunity to participate at the real event of the lecture, with the ability to raise questions to real professors, or at a specially arranged and recorded event, where the lecturers are represented by intelligent agents that can be trained to ask commonly asked questions and problems. INVITE establishes virtual communities with a theme, rules, roles and moderation where useful services can be employed to facilitate educational procedures. INVITE will provide a tool aiming in reflecting real life collaboration into a network virtual environment.

The added value of INVITE is in both the technological and the pedagogical field. INVITE is capable of running on the average users' PC and is compatible with standards like VRML enduring openness and portability of the application. Also, INVITE will facilitate the inclusion of many real world features allowing manipulation of objects and exchange of information with objects and users. All interfaces between the different modules of the system are based on mature standards and INVITE is an open system, which can be interfaced with standard instructional management systems and data representation schemes.

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The Development of an Online Course for a Virtual University

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Abstract: Universities are under increasing pressure to develop a virtual presence in the face of widespread global competition. Online courseware development and delivery presents many exciting opportunities, and brings with it a number of challenges to be overcome. This case study describes some of the experiences of the EU funded TISCAM project, which developed an online masters-level course in supply chain management for work-based learners. The project involved a number of partners and multiple development teams working in parallel. Some of the issues and challenges faced as a result of this development model will be discussed, and resulting lessons presented.

Introduction

This case study outlines the development of online course materials within the context of a virtual university. The transformation of traditionally delivered courses into online versions can be a steep learning curve for all concerned. This paper will illustrate some of the experiences and lessons that have emerged from this research project. It should provide valuable insights for those engaging in large-scale virtual university development and delivery.

There are a number of significant challenges that the project had to face.

- The scale of the project, involving a number of partners and universities in the UK and in Europe, with a number of authors developing the material.
- Many of the authors were subject specialists, but did not necessarily have experience of producing courseware that could be delivered effectively online.
- The materials had to be vocationally relevant, academically rigorous, and allow pathways for learners to seek accreditation for their studies. The resulting course had to be capable of online delivery to learners in their workplace.
- There is a tension between the desire to design innovative systems and materials, and at the same time to maintain a realistic and practical hold on the project and the achievement of its goals.

This paper will discuss these challenges and how they were tackled.

The TISCAM Project

The TISCAM project (Training for Innovation in Supply Chain Management) is a large European-funded initiative involving a number of partners. It offers masters-level courses in supply chain management to learners in the workplace. Delivered through a virtual university framework, learners have access to materials, expertise and tuition from some of the key university providers in this field, irrespective of their geographical location. The target learners are managers in small and medium sized enterprises (SMEs), who are generally characterised by having small training budgets and limited release time to study full-time or block release courses away from work. The modular structure devised, allows a number of study pathways to be followed. Managers may have a specific personal or organisational training need within the context of supply chain management, or they may want to gain an accredited award – either can be accommodated.

Course materials were developed by a series of expert teams (see Fig. 1 below for an illustration of this structure). A central management team was responsible for the overall management and scheduling of the project. Authors from a number of universities produced the material, with guidance and support from development teams. The pedagogy support team provided advice and quality control on the effectiveness of the learning materials produced. The academic review team approved material for its curriculum suitability, and monitored subject coverage from one module to another. The technical team developed the delivery system, and worked with authors on the technical development of their materials, transforming them for online delivery, after approval by the pedagogic and academic reviewers.

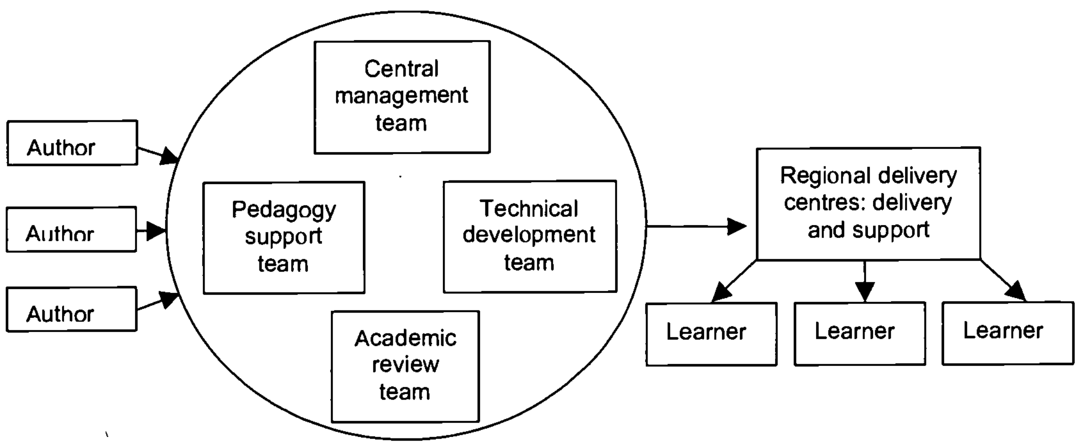

Figure 1: The development and delivery model

Learners receive support from a range of specialists, each with their own expertise (Anderson & Oliver, 1999). They register at a Regional Delivery Centre where guidance is provided. Online support is available from a tutor with subject-specific expertise, and also from specialists providing technical and administrative support. In-company support is provided by a mentor, who gives guidance and support on work-based issues, helping the learner complete work-based activities, and to apply what they are learning within their company.

Initially, 12 modules were developed. Each module constitutes 100 hours of study, and is broken down into 10 units, of approximately 10 hours study time each. This includes: working through the materials; carrying out and completing activities and assessments; building up a portfolio; engaging in online discussion groups; reading case studies and related materials.

In developing processes to meet these developmental aims and characteristics of the project, a number of issues emerged. The paper will discuss some of these issues and challenges and how they were met. This discussion is organised around two main themes: developing large-scale online courses, and the reality of developing materials for an innovative delivery system, given the scale and constraints of the project. It will then move on to describe the resulting system and materials, and conclude with the key lessons learnt.

Large-scale Distributed Development of Online Courses

The project required a development process that could accommodate large-scale distributed development. The expert teams were based in separate geographical locations, as were the authors. In some universities there was a team of authors working on each module, requiring a co-ordinator to liaise between the individual authors and the development teams. The development process adopted was an 'industrialised model', in which a chain of experts each plays their part in the process. This is in contrast to the 'craft' model more familiar to lecturers, who are accustomed to designing and delivering traditional courses themselves (Peters, 1998).

Authors were selected on the basis of their subject expertise, and were invariably lecturers or researchers, who lacked hands-on experience of online courseware design. In view of this, they required ongoing help and guidance during the authoring process. Early on in the project a series of meetings were held, in which the pedagogy support team, technical development team, authors and project managers met. These meetings began to formulate operational frameworks and agree methods of working. Communication and distribution of materials was largely conducted by email, with face-to-face meetings held in a central location at periodic intervals.

The development of a pedagogic framework was identified as being important to underpin development in what, for many authors, was a new medium for learning delivery, and this became a subject of much discussion in early meetings. The pedagogy support team presented a number of approaches that could be adopted by the project, following an analysis of learner needs. This emphasised the need for motivating, vocationally relevant learning that could be undertaken in short periods of 'release' time within the company environment. A socio-constructivist approach was eventually adopted, which drew on Laurillard's conversational framework (Laurillard, 1993), but was adapted for course design (Conole & Oliver, 1998).

To enhance shared understanding amongst the project teams, a series of guidelines were produced for each key player: for authors (Oliver & Conole, 1999), tutors, in-company mentors, regional facilitators (Anderson & Oliver, 1999) and also for the learners (Anderson & Oliver, 2000). These guidelines gave an agreed description of each role, and acted as minimum specifications for delivery, based on existing good practice drawn from the field of distance and online learning.

The guidelines for authors were designed to perform a crucial role in helping them to work with the new challenges they faced in developing online courseware. They incorporated:

- The context of authoring for the project
- The pedagogic framework
- The learner support framework
- Guidance on preparing units, using multimedia, incorporating peer group discussion, designing activities and assessment methods
- A template for specifying the aims, objectives, learning outcomes, learning methods and assessment methods of each unit
- The process for submitting drafts and acceptable formats.

The authoring process devised incorporated a number of stages. Authors draft units were submitted to the pedagogic and academic review teams for approval that the required standards had been met. The academic reviewer checked that the subject matter was adequately covered, and didn't overlap significantly with other modules. The pedagogic review examined the draft in terms of its effectiveness as learning material, and feedback was provided to reinforce successful attributes and suggest improvements to address weaknesses. At the same time the technical developers reviewed the material, to ensure that authors were making appropriate and realistic uses of the available technologies. If revisions were required, the author was responsible for undertaking them, and re-submitting the unit for approval. Once each unit had been 'signed off' by each reviewer, it was passed to the technical development team to transform it into online material. Peer review amongst authors was also encouraged, enabling them to share experiences and learn from each other's practice.

The Reality of Developing Materials for an Innovative Delivery System

On receipt of the first few drafts, it became apparent that authors were not designing materials according to the guidelines, continuing to work in the style most familiar to them. Much of the material resembled extended text books or teaching notes, with notable exceptions from authors with wider experiences of different teaching and learning practices. This resulted in an interesting diversity of materials, but an overall lack of consistency from one module to another. It emerged that one reason for the lack of a common approach was that the pedagogic model adopted, based on Laurillard's conversational framework, was unfamiliar to the authors (Laurillard, 1993). It was agreed that the model used should provide concrete recommendations on the structure of the materials, and should be familiar to all authors. Instead, Kolb's experiential learning cycle was adopted as the basis for unit development (Kolb, 1984). However, even after this, authors differed significantly in the material they produced - a clear example of the difference between espoused theories and theories-in-use.

The whole drafting and review process took longer than was anticipated, and threatened to extend beyond the time-scale permitted by the project. Authors' drafts took longer to produce, and the pedagogic reviewers found they needed to make a lot of suggestions for improvements to the materials. A number of solutions were devised to improve the situation. Firstly the author's guidelines were tightened to incorporate a more clearly defined specification for authors, including structural considerations for the online delivery system, and criteria they should meet for the pedagogic and academic reviews. The amount of support and guidance for authors was increased. Meetings for authors and the development teams were held more frequently, giving opportunities for development workshops to be held and more time for the discussion of guidelines and issues being encountered. Examples of good practice were shared amongst authors, to help them to overcome common areas of difficulty, e.g. good examples of model activity answers and self-assessment questions.

A further development was that the technical team devised a set of templates for activities that could be re-used within the materials. This served three purposes. Firstly, it provided examples of how web technologies could be utilised to produce more interactive and visual forms of activities for authors who were struggling to make full use of the capabilities of the online medium. Secondly, it made it easier for authors to incorporate self-assessment activities which had computer generated feedback. Thirdly, it helped cut down the development time required for the technical team, as they could re-use the basic structure and code from one unit to another.

Maintaining the schedule and balance of the workflow became critical at times during the development process. Authors had agreed deadlines for the submission of units with the project manager, and the whole process was designed on the premise that they would submit units on an individual and regular basis. This enabled the reviewers to complete their task within the agreed time-scale of 10 working days and the technical team to have a steady flow of material to develop. However, some authors submitted several units together, which for the pedagogic review could make the process easier, as authors invariably developed a style, and units were likely to have common strengths and weaknesses which enabled common feedback to be given across a number of units. Any corrective action required of authors however, could result in substantial revision across a number of units. Several authors also fell behind schedule, so that when the final submission deadline arrived, they suddenly submitted their outstanding units en masse. This created a bottleneck at the review stage, resulting in a delay in the provision of feedback. At times when the flow of materials was not steady, the result was that there was not enough material to keep the review and technical teams fully employed, or alternatively, there was too much. There was a need for tighter control of the workflow, coupled with a greater awareness amongst all the development teams of the effects of missing deadlines on the balance of the entire production process.

Any project of this scale which attempts to develop innovative delivery systems based on good practice models will inevitably need to keep a close eye on practical concerns as development progresses. Initial ideals may need to be scaled down to suit practical and operational requirements and plans will constantly need to be evaluated and refined as issues arise and deadlines approach.

The Results

The technical development team created a bespoke online delivery system, providing the course materials with an overall consistent structure and functionality. Each module unit was divided into a number of sections, ideally between 4 and 6, which provided manageable amounts of material for individual learning sessions, around a particular topic. Within each section the material is separated into content, related material, case studies and activities, each accessible through a series of 'tabs' along the top of the screen. Other tabs provide access to additional services for learners: 'community' includes communication facilities between the tutor and contains the learner's portfolio compiled from their activity responses, a study guide and access to support services.

This structure enables learners to construct their own pathways through the materials. The author guides the learners through the material according to their suggested route, but learners can also make their own choices of what material they look at and when they look at it. Because content, activities and related materials are presented separately, learners can for example choose to attempt all the activities first if they have a lot of experience in that area, or they can skim through the content and go straight to the case studies to find out about real-life examples. The result is a hyperstructure, a highly user-centred model which allows the users to have considerable freedom of access through a network of nodes of content and to pursue non-linear pathways through it (Boyle, 1997).

Orientation is provided for users in a number of ways, helping them to identify their location within the materials. The system only allows access through the tabs to materials within that section, so the user can't accidentally navigate off to another part of the unit. Information at the bottom of the screen tells the user which module, unit and section they are currently accessing.

Technically, the materials utilise widely available web technologies to enhance and support the learning process. Graphics are animated where this is appropriate, for example to illustrate process flows. Activities include text input boxes, or allow attached files to be uploaded to the system database. Learner's responses to activities are automatically stored in their portfolio, which is available for them, their tutor, or their mentor to view through the 'student services' tab. The development of a portfolio allows learners to build up a record of their work on the course and their achievements, which is common practice in vocational training.

Conclusions

A number of lessons can be drawn from this project which will be helpful for anyone engaged in the large-scale development of on-line courses. The production and delivery of online courseware can impose a steep learning curve for all concerned. New skills and expertise may need to be developed by a number of participants in a range of areas, and the sharing of expertise, in conjunction with ongoing guidance and support is important to ensure success.

Development models and processes need to be established which meet the diverse needs of project partners and the project as a whole. However, these may be alien to some participants, and it is important that shared understanding is achieved, and to acknowledge that refinement may be necessary if this does not result. Participants also need to understand and respect the roles and requirements of others within the process, so that schedules and work flows are maintained and the shared goals of the project can be achieved.

Ultimately, compromises between the pursuit of innovation and the achievement of effective delivery inevitably have to be made, in order that such a project meets its objectives within the resources and time-scale permitted.

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The HyperSkript Authoring Environment—An Integrated Approach for Producing, Maintaining, and Using Multimedia Lecture Material

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Abstract: Based on a technical infrastructure that supports face-to-face university teaching, we have developed an environment that enables small groups of lecturers to develop and maintain lecture material co-operatively. In order to allow for a flexible use, only few formal workflows are imposed on the users while co-operation is supported by easy-to-use mechanisms. We have extended the functionality of an existing web server to support and integrate individual, distributed, and co-operative processes that are involved in the production and maintenance of multimedia lecture material.

Introduction

Traditionally, multimedia material that is being used in university teaching has been pre-produced by a single author or a team of authors. Students may then work with this material independent of place and time. The main goals of using technology are on the one hand to produce material that fosters learning by providing interactive techniques, animations, and simulations. On the other hand, communication tools are used to improve the contact between lecturers and students. The authoring tools with which the multimedia material is produced usually impose a strict separation of production and reception. Communication channels, if they are established at all, only serve as means for the distribution of material and information.

In this contribution we present an approach that transcends the one-way street of creation and reception. Instead, it promotes the distributed, yet integrated production, maintenance, and use of multimedia material. The conventional group of authors who produce for unknown learners is replaced by a group of authors who are at the same time teachers that use the material which has been produced jointly. They use the material in their own lectures and improve it based on their teaching experiences—in nearly the same way as they would do with conventional lecture notes. Thus, in addition to enhance lecture material multimedially, an integrated environment is provided that enables lecturers and students to work with own as well as pre-produced material. Our distributed multimedia lecture material (or HyperSkript, for short) allows for more flexibility in the use without raising the expenditure of producing the material significantly.

In order to allow for a most flexible use of the HyperSkript, authors may largely use the tools they are accustomed to, which is to say that standard technologies are employed to the largest possible extent. In addition to the authoring environment described in this contribution, a teaching environment and a number of supplementary tools have been developed some of which support the production of multimedia material—like interactive animations or the audio annotations described in (Grimm & Hoff-Holtmanns 1999)—while others simplify the use of the material by allowing users to create their own views on the documents. Semantic maps for example enable users to create a graphical overview on a specific subject. They act as a navigation tool. Individual copies of the maps can be modified by the learners and adopted to their actual knowledge (see Klemme et al. 1998 and Hampel & Selke 1999). The overall structure of the HyperSkript is shown in Fig. 1.

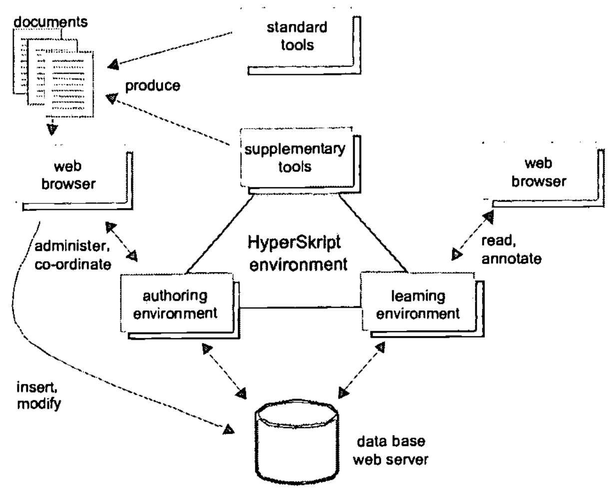

Figure 1: The HyperSkript environment extends standard web technology by providing functions for the co-operative production of documents (authoring environment), functions for the active use of material (learning environment), and supplementary tools for the production of multimedia documents. The authoring as well as the learning environment are accessed via standard web browsers.

Requirements for the authoring environment

The experiences made in several years of using new media in university teaching (as described in Brennecke & Keil-Slawik 1995, Brennecke et al. 1997, e.g.) served as a starting point for the implementation of a new authoring environment. After having established an infrastructure that enabled users to work with electronic material at all locations where learning takes place (at home or in the library as well as in the rooms where tutorials and lectures are held), the production and maintenance of this web based material should be supported efficiently. Additionally, there was the idea of co-operating with a lecturer from another university in a way that allowed to create and maintain the material for lectures and use it at different universities while still teaching students in an individual way.

The HyperSkript contains all documents necessary for a course on a specific subject. This material is produced by several authors and integrates documents that all authors have agreed upon as being relevant for the context as well as documents that reflect their particular competencies and preferences. In that way, the material may be used in different courses while still allowing to present individual lecturing approaches. To allow this, the lecturers create different views for each single course by selecting the appropriate material. The material within the document base remains unmodified but may be supplemented by additional documents.

Co-operative development and maintenance are also important factors in rationalising the process of producing multimedia material which is a crucial aspect when it comes to working with such material on an every-day basis. The material needs to be structured in a way that it can be easily adapted or extended to integrate new results from research or simply modify the course to better meet the students' goals. The latter goes along with the requirement that not only the lecturers but also the students may individualise the material according to their needs and preferences. Thus, the students should also be able to work with the documents within the HyperSkript while leaving the original material in a consistent state.

As a result, the lecture material is designed to incorporate a high-quality core of material that has been produced co-operatively. This core is then surrounded by individual, sometimes short-lived, material like additional documents for a particular course, complementary notes, personal annotations of the students, or audio-annotations of a lecture. The different user groups (authors and students of different courses) thus need to be presented different views onto the material. The material should be structured in a modular way to allow for easier maintenance on the one hand and multiple use in different contexts on the other hand.

HyperSkript Architecture

Like in a textbook written by a group of authors, the authors have to co-operate on the question which contents to include in the HyperSkript and on the way these are broken down into modules as well as the multimedia and pedagogic design. The topic modules may consist of documents of various types ranging from images and texts to sets of slides, animations, or even CBTs. However, to guarantee that the material may be used in flexible ways and easily combined with other modules, each module should be self-contained and contain all documents necessary for dealing with that particular topic. These modules are stored in the so-called compound layer of the HyperSkript which is being produced and maintained co-operatively by the participating authors. For each module a "main author" may be specified who is responsible for editing the content of that module. However, a module may only be released, i.e. given read access by the students, when all authors have agreed on it. Each module may also contain meta-data, in order to generate data according to the LOM standard.

The material in the compound layer may be complemented by background material like, e.g., journal and conference papers, images, or movie clips illustrating a relevant aspect. As this material is "objective" in the sense that it does uring approach but rather documents that have been produced in a different context, the authors need not agree on the content. The authors may thus decide to distribute the maintenance of these documents—stored in the so-called base layer—in order to reduce the amount of work for each single author. The base layer is therefore sub-divided into areas, each of which is administered by one responsible author who alone may change or update content in this area. The other participating authors are notified of all relevant changes in any area of the base layer.

Finally, the topic modules and the background material have to be integrated with course-specific documents which finally make up the particular course—usually held by one of the authors. The assembly is done within the so-called course layer which is administered individually by the respective author according to the context in which the course is given. The architecture is shown in Fig. 2. The HyperSkript authoring environment aims at efficiently supporting the authors in creating, maintaining and updating the shared documents within the compound layer co-operatively and within the base layer in a distributed manner.

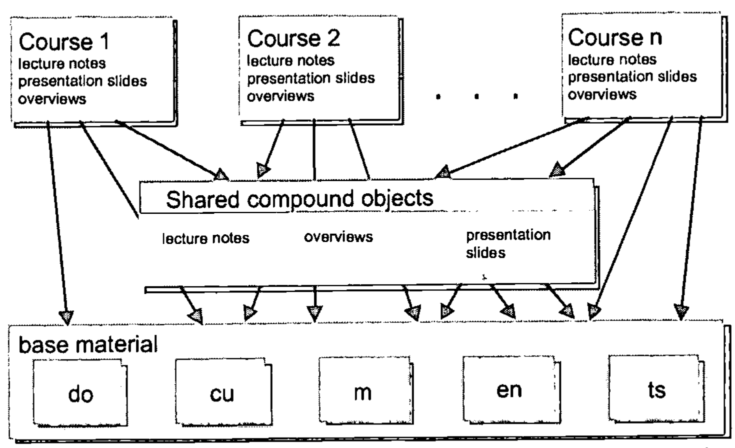

Figure 2: A HyperSkript consists of three layers which reflect different kinds of co-operation.

As opposed to systems that support co-operation in large distributed organisations which aim at the co-ordination of work processes by the implementation of formal workflows, a HyperSkript is produced by a small team of authors who co-operate voluntarily to achieve a common goal: the efficient production and maintenance of lecture notes that make use of multimedia and are of a high quality. In that sense, producing a HyperSkript is comparable to a group of lecturers and their assistants editing a textbook for university teaching. Therefore, the HyperSkript authoring environment does not implement any formal procedures but rather guarantees that the processes of creating and updating the material are transparent to all participating authors. For small groups of authors who trust each others, an optimistic "relaxed mode" allows the authors, e.g., to agree on updating a particular piece of text while in a meeting or even when talking to each others on the phone. Within the authoring environment one of the authors may then sign the agreement in the name of another author. However, it will be stored who actually signed in the name of which author. Where such informal co-operation seems inappropriate, a "strict mode" requires each of the authors to log in to the authoring environment and sign the agreement themselves.

In the co-operation, the authors may use software they are accustomed to to the largest possible extent. They may use any kind of synchronous or asynchronous communication; the authoring environment simply allows to easily access these external tools or the necessary contact information. While the production of material is external to the authoring environment, it allows the authors to efficiently manage the documents, guaranteeing that students always see a consistent version of the lecture notes while the authors may create new versions of topic modules in a special editing area. All documents—including those in the course layer which may also be produced by the students—need to be managed within the system.

Using the learning environment (cf. Bader et al. 1999 and Meier & Holl 2000), the students work with the material in a way very different from the way the authors edit the material with the authoring environment. They access the HyperSkript from an entry point in the course layer which the lecturer supplies. The learning environment then allows each student individually to restructure the documents according to their own preferences, complement them with their own documents, and annotate existing documents. Students may also form groups and create their own private workspaces. While they have read access to all material of the HyperSkript which the lecturer decides to present, the internal HyperSkript architecture with its three layers is invisible to them.

HyperSkript Realisation

The HyperSkript authoring environment has been implemented on top of the Hyperwave Information Server—a specialised web server—which was chosen because of its strong orientation towards document management, its support for asynchronous co-operation and its extensibility on the server side as well as the client side. The latter allows for different user interfaces reflecting the special needs of authors and readers respectively while managing all documents within a single database. The mechanisms needed have been implemented using the Hyperwave Application Programmer's Interface in Server Side JavaScript.

In order to achieve an optimal integration into the authors' workplace, all functions of the authoring environment can be accessed with web clients of the fourth generation. Documents can be integrated into the environment using any of the Hyperwave clients, which again means using a web browser or one of the extensions to MS Windows programmes like the Virtual Folders which allow to access a Hyperwave Server from the Windows Explorer in a way similar to accessing a file system.

Within the authoring environment, documents of different kinds can be maintained and edited co-operatively. In addition to atomic documents, like texts, images, or audio clips, complex objects consisting of several basic documents like multimedia applications or hypertexts are supported. The authoring environment only implements the mechanisms related to co-operative document management (finding new or modified documents, releasing documents, creating draft versions etc.). The editing of the individual documents is done using the usual tools like HTML editors or office suites.

HyperSkript layer	type of work	material
course layer	individual	course-specific
compound layer	co-operative	transferable
base layer	distributed	universal

Table 1: The layers within the HyperSkript architecture reflect different types of working and different levels of co-operation.

As depicted in Tab. 1, the HyperSkript layers each require different mechanisms to support the co-operation needs. Presenting and editing the material within the *course layer* is done *individually* and thus does not need any kind of co-operation within the authoring environment. However, it needs to be guaranteed that students always see the latest released version of any document. In addition to basic mechanisms such as access control and locking mechanisms to prevent simultaneous write accesses, both other layers require specific kinds of co-operation support. When editing documents of the *compound layer*, a draft version must be created which can then be worked upon. The older version remains visible to the readers of the HyperSkript as long as this draft has not been signed for release by all team members in a *co-operative* process. In a similar way, new topic modules are always created in a special area which is invisible to the readers. Because production and administration are *distributed* among the authors in the *base layer* by division of labour, there is basically the need for notification as described above.

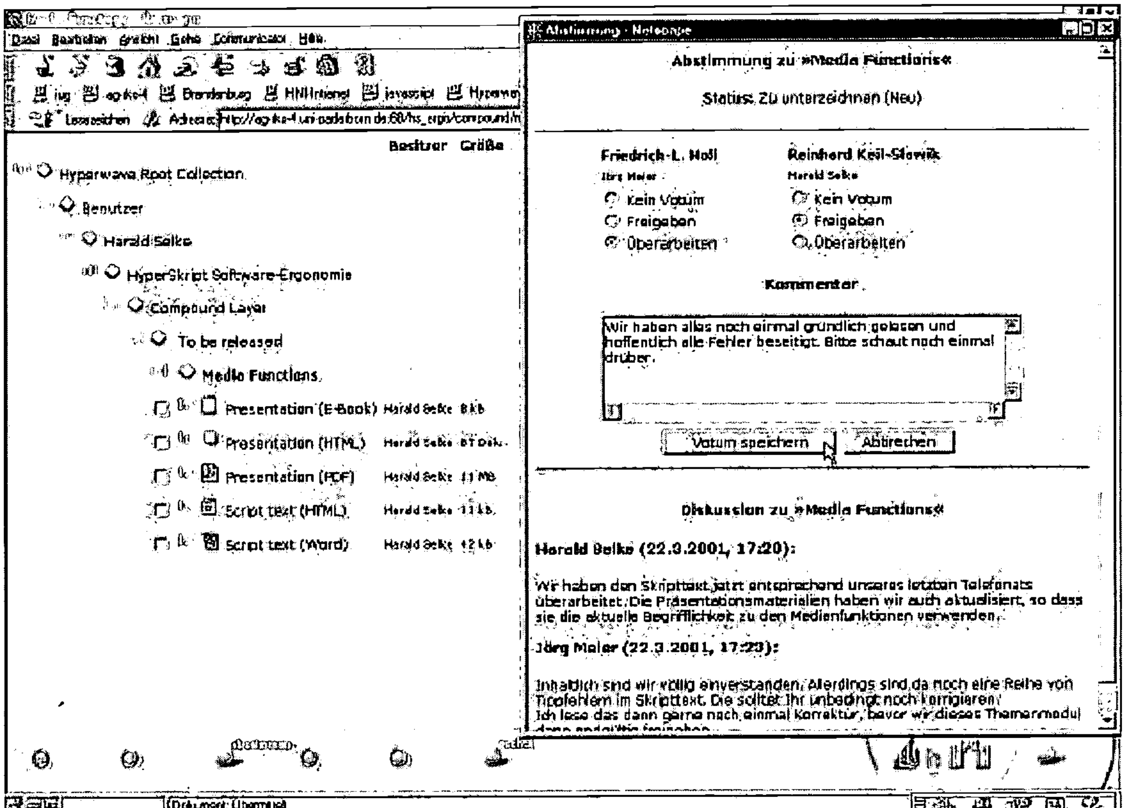

Figure 3: Discussing a topic module. The current state of agreement is stored along with a single-threaded discussion. An author can agree or disagree using the radio buttons in the top part of the dialog.

In order to efficiently support the different aspects of co-operation, certain awareness information is needed. According to Gutwin and Greenberg (Gutwin & Greenberg 1997), the following questions are crucial:

- Who is currently working with the system? A list of the team members who are currently logged in is visible to the authors. These team members may then be contacted easily by synchronous communication means such as a chat, a phone call, or a video conference. Given appropriate conferencing software, synchronous editing using a shared application is also possible. The HyperSkript authoring environment itself allows to specify any such contact information within a special user object. It does not implement any tools for synchronous communication but rather allows to easily access them via external tools from within the environment.
- Who is currently working on which documents? An author might want to contact another team member who is working on a particular document synchronously, e.g. because both are working on documents that belong together. This kind of awareness information is currently not supported by the HyperSkript authoring environment.
- Which documents have been modified or newly created by other authors? This vital information can either be distributed by notifications to the other team members—e.g. by sending an e-mail with a list of new or modified documents—or be gathered by each of the team members individually by using an appropriate search query. Currently, the HyperSkript authoring environment only supports a manual notification mechanism in addition to a flag shown next to edited or new documents. Because we expect that there will be many minor changes—such as the correction of typos—we decided not to rely on an automatic notification mechanism but rather log important events and leave it to the authors to send this log to other team members when appropriate. However, a search mechanism will be provided in the next version. In contrast to ordinary workflow systems within our "relaxed mode" each author has to decide which modification may be important enough to inform the other

authors respectively which one have to be agreed by the others. (The correction of orthographic mistakes typically requires no reaction from the co-authors e.g.)

- Which state is a document currently in? At any point, the team members need to be provided with versioning and editing information. For that purpose, draft (or experimental) versions carry a certain attribute and are stored in designated areas of the data base. For new and revised topic modules of the compound, a voting mechanism is supplied where each author can state their agreement or disagreement on including the document in the current version into the HyperSkript. An author can decide to release a topic module for which he is responsible within the compound layer at any time. However, before it is actually released, all other authors have to agree on releasing that version. In addition to the current vote (who has agreed, who has disagreed, who has not cast a vote yet), there is a basic type of discussion forum that allows to make comments and suggestions for improvement. As soon as all authors have agreed on releasing the module, it is integrated into the HyperSkript and thus becomes accessible for the readers. The discussion is stored in an archive; older versions or drafts that have not been released may be archived. Fig. 3 shows the discussion of a topic module within our HyperSkript authoring environment.

Conclusions

The HyperSkript authoring environment supports teams of university lecturers who wish to co-operate in the production of multimedia lecture notes emphasising the need for developing and maintaining documents on a long-term perspective. A web based document management server has been extended to support co-operation processes in distributed authoring. Important features include awareness information, notification and voting mechanisms, creation of draft versions and easy-to-use release mechanisms. By integrating these new functions into an environment of standard software that is used in the every-day work processes of the lecturers, the HyperSkript approach seems to be a suitable tool for individual, co-operative, and distributed production, maintenance, and use of multimedia lecture material.

The authoring environment described in this contribution is integrated into the HyperSkript project in which an additional learning environment and supplemental tools have been developed. A prototypical script for courses on software ergonomics and design of multimedia systems has been produced, improved continually over two years by two authors, and used at two universities in different courses. Evaluation so far shows that students rate the material as becoming better over time. However, this good result may also have been influenced by other improvements in the accessibility of the material and requires a more detailed evaluation.

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The SALSA Animation System: Simply Generating Java Applets to Learn with Basic Animations

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Abstract: The effective preparation of multimedia applications still remains a problem when using new media in teaching and learning processes. When using the Java technology which becomes increasingly important within the internet, the programming of Java applets is especially expensive. To reduce this disadvantage, we have developed a tool which supports the easy production of Java applets for a special class of animations which we characterise as basic animations.

Basic animations are interactive two dimensional animations intended to visualise facts as well as dynamic processes and to make them easier to understand. They are dynamic and controllable illustrations. Basic animations are constructed hierarchically from simple objects in such a fashion that the animation as a whole, or parts thereof, can be used within other basic animations. (Greiving 1999) Such simple animations with illustrative and explanatory character are helpful to demonstrate temporal processes. Apart from being simple run downs they also should allow for interactive control. Therefore, the possibilities of *basic animations* lie between simple animation sequences and more complex multimedia applications such as CBT programs or *explorations* (Hampel, Keil-Slawik, Ferber 1999).

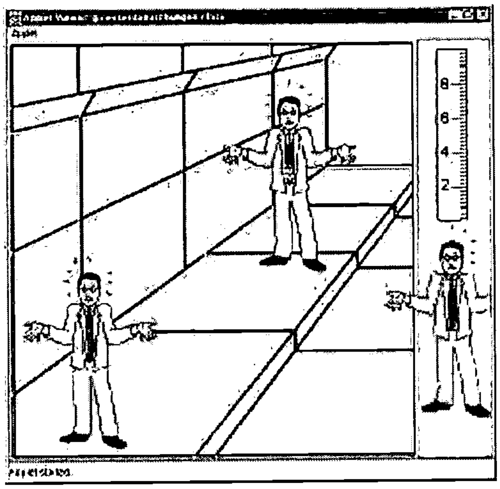
Although there are many authoring tools for multimedia applications, no single one fit our goal to implement a hierarchical animation concept. Furthermore, we wanted to use animations within the internet and, if possible, without special plugins. Java applets fulfil these demands but their development effort is enormous. Therefore, we built a tool which generates Java applets from simple textual descriptions. Our system is based on the concepts of programming language-like animation systems such as XTANGO, POLKA, Goofy, SAMBA, or Lambada (see Stasko 1990, Ford 1993, or Mitchener 1996). These were designed in the 1990's, mainly to visualise the actions of computer algorithms. At first, Lambada or the XtangoAnimator seemed suitable because of their implementation in Java. However, both are based on Java 1.x versions whereas our hierarchical concept as well as the desired interactivity required a modified structure. In addition, the Java platform 2 contains fundamentally useful extensions (JFC/Swing components and Java 2D API) which should be used.

Therefore, we designed a new Java class hierarchy which provides a set of instructions to implement our basic animation concept. For simplification, a translator was developed to convert textual descriptions of animations into Java code and to generate executable Java applets. Although the class hierarchy can, of course, be used within any Java program, the emphasis is on the simple creation of animations—also for non-programmers. In the tradition of the naming of POLKA, SAMBA, etc. (i.e. according to dances) we called our tool the SALSA animation system. Basic animations should be small multimedia building blocks which can be described in a special SALSA syntax which defines and connects the different object types.

- *Basic objects* are the fundamental parts of SALSA animations. Geometric figures (squares, rectangles, circles, polygons, ...) are basic objects as are bitmaps or text. Their attributes (position, size, geometry, colour, texture, ified to obtain animation effects.
- *Modifiers* are used to change the attributes of basic objects as well as of composed objects. The application of a modifier (moving, rotation, scaling, ..., or changing of colour, texture, transparency, and level) on a basic object already defines a simple animation.
- *Compositions (spatial and temporal structures)* allow the concatenation of objects and the production of complex animations. Spatial structures (groups, couples, collections) combine several objects and make it possible to apply modifiers to complex structures. The time flow of animations is controlled by temporal structures (synchronisation, asynchronous run, sequence).

- *Control elements* enable the interactive manipulation of animations. Buttons can be used to start animations and sliders can control the time flow. Furthermore, objects and animations can be manipulated directly with the mouse if the corresponding attributes were set for interactive control.

The SALSA concept offers a proper hierarchical composition of animations. All objects represent executable animations. Modifiers, combinations, or control elements can be applied to every animation. Animations therefore can be described as a tree where modifiers, combinations, and control elements represent the nodes while basic objects represent the leaves. A special start object embodies the root of an animation tree. If parts of the tree are to be used several times, the tree can be extended to a directed acyclic graph (DAG). To illustrate its simplicity, Fig. 1 shows a simple SALSA animation and its defining textual description.



```
appletsize 600 521
rectangle background 0 0 600 521
    setFillColor background gray
bitmap sidewalk 0 0 sidewalk.jpg
bitmap man1 550 350 man.gif
    setInteractive man1 MOVE
bitmap man2 550 350 man.gif
    setInteractive man2 MOVE
bitmap man3 550 350 man.gif
    setInteractive man3 MOVE
bitmap ruler 550 120 ruler.gif
    setInteractive ruler MOVE
collection collect background sidewalk
man1 man2 man3 ruler
```

Figure 1: A Java applet generated with the SALSA system to show the size constancy illusion. (The human visual system assumes that figures in the upper right corner are larger because the background image feigns a three dimensional scene.) Students can interactively move both the figures to different positions as well as the ruler in order to check their actual size. On the right, the SALSA code for the animation is shown. Each line begins with a SALSA command and is followed by object names and/or attribute values.

The SALSA translator was extended by a graphical interface, also implemented in Java. A special text editor supports the creation of SALSA code. Syntactical correct textual constructs can be chosen from a menu. A colour and a font chooser as well as a file selection box (e.g. for bitmaps) support the setting of attributes. Second, parsing, translating and testing can be controlled interactively. A special log screen shows all actions or syntactic errors. The execution of the animation can be tested in a special runtime environment. Finally, a graphical editor supports the drawing of basic objects as well as an interactive scaling or grouping instead of textual descriptions. In this manner, the building of graphical scenes is substantially simplified.

The SALSA animation system is not a universal authoring tool for multimedia applications. Especially the time control cannot yet be represented and defined graphically. So far, SALSA is restricted to the concept of basic animations but the consequent hierarchical structure seems to be a reasonable approach for more complex animations, too. Main advantages are the simple generation of Java applets and the reuseability of animations or parts thereof.

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Learning Contracts – a Measure to Set Up a Framework for Communication and Cooperation in E-Learning?

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Abstract: In a learning contract concluded between learners and teachers resp. between learners, stipulated learning and teaching activities are fixed. The purpose of a learning contract for e-learning is to clarify the innovative organizational structure and to give hints about how learners and teachers have to behave, to communicate, and to cooperate. Cooperation becomes easier when all participants know to which forms of communication and cooperation learners and teachers/tutors have committed themselves. In two of our projects, we gained experiences with this didactical and organizational method.

Introduction

In the „Mercur"-project and in the project „Meisterassistent im Handwerk" (assistant master craftsman), we utilize learning contracts in a telematics-based advanced vocational training measure.
Our learning contract

- gives hints about how learners and teachers have to behave, to communicate, and to cooperate, thus establishes a framework for communication and cooperation between the learners as well as between learners and teachers/tutors,
- clarifies the innovative organizational structure with a combination of face-to-face sessions and phases of telelearning to the learners and the teachers as well as binds them to its didactical implications.

Cooperation and communication becomes easier when all participants know to which forms of communication and cooperation learners and teachers/tutors have committed themselves.

Even though the experiences we gained were gathered in the field of vocational training, they can easily be transformed and used for education at other levels and with different target groups.

In the "Mercur"-project (http://www.mercur.de), forward-looking possibilities and limits of the use of tele-communication technologies for further training in the craft trades have to be researched, developed and tested with the scheme „Betriebswirt/in des Handwerks" (business administration in the craft trades). This course is aimed at master craftsmen and is held by several chambers of handicrafts and the guilds.

The project „Flexible Zusatzqualifizierung (Meisterassistent/in im Handwerk)" (flexible additional qualification as assistant master craftsman; http://www.uni-koeln.de/wiso-fak/fbh/MAH.html) is designed to research, develop and test possibilities and limitations for the acquisition of additional qualifications in the course of initial vocational training for the craft trades with the use of ICT.

In both projects, the www-based learning platform ILIAS is used. ILIAS was developed by the University of Cologne, faculty for economics, business administration and social sciences. As a workplace on the web ILIAS brings together tools for learning, authoring, information access, and co-operative work. It is in use since summer 1998, and more than 5000 students are registered. ILIAS is an open source software since September 2000 and can be downloaded (http://www.ilias.uni-koeln.de) without costs.

Contract Learning in Theory and Practice

In general, learning contracts are agreements between a student and a teacher that provide a framework for describing what a student will learn as a result of a specified learning activity. Though not binding in a strictly legal sense, learning contracts are statements of agreement on at least four elements (see Asselmeyer 1981, Boak 1998, Brambleby & Coates 1997, Caffarella & Caffarella 1986, Dohmen 1999, Feeney & Riley 1975, Knowles 1986, O'Donnell & Caffarella, 1990):

- learning objectives
- learning resources and strategies
- evaluations of learning activities
- a time line for completion

The term contract learning is known since the beginning of the last century. Learning contracts demonstrably exist since the 1960s in the United States, where they are usually used in a university context.(see Chickering 1975, Weingartz 1991)

With the signature of the contract, both parties accept an obligation:

- the learner commits to work with the material and to learn the content
- the teacher/tutor commits to provide material, to be ready for support and consulting, and to answer to questions as previously agreed upon.

The contract can easily be modified during the runtime. By the use of the contract, learners and teachers/tutors appear formally as emancipated, what can improve their relationship (see Holmberg 1989).

Learning Contracts and E-Learning

In addition to the "normal" problems of conventional trainings (e.g. newly learned skills of the employees are not transferred to the workplace), in e-learning individual learners as well as learners and teachers are spatially and temporally severed. Adult learners are often not used to learn in a self-directed way with telematics-based media. Furthermore, the problems of computer-mediated communication, e.g. the reduction of communication channels, the lack of social context cues (Kiesler & Siegel & McGuire 1984), or social information processing (Walther 1994) are well-known (Bruhn & Gräsel & Mandl 1997). A very busy adult learner will not send an e-mail with a question to another learner or to a teacher or tutor from whom he or she does not know when he or she reads it and answers the request. The acceptance of a new learning method depends strongly on reducing the incertitude of the learners. Also a lot of teachers are not used to utilize the new forms of teaching and communication in a telematics-based setting.

The learning contract we designed for our courses eliminates the obscurities right from the beginning by describing some of the attitudes of learners and teachers that differ in comparison to a conventional course. In both projects, face-to-face sessions and phases of telelearning are combined. Learners and teachers declare in the learning contract

- at which point of time the substitution of face-to-face sessions with telelearning is pronounced,
- what the learners are expected to do with regard to their communication and cooperation behaviour,
- what and when learners and teachers are expected to respond,
- when the teachers are to provide materials,
- which organizational rules learners and teachers have to observe, etc.

Experiences with Learning Contracts and E-Learning

According to the experiences in our courses, this using this method in e-learning achieves the following objectives (Breuer & Schaumann 2000, Breuer 2000b):

- the constitution of an organizational model for the steering of the teaching and learning progress, that is declared by teachers and learners.
  In the learning contracts, stipulated learning and teaching activities are fixed, e.g. appointments for the answer of questions posed by e-mail. Learners are provided with supplemental course information that outlines course objectives, concepts, and ideas.

- intensification of the individualisation and the autonomy of the activities of the learners.
  The learners are motivated to design their learning activities on their own. Learners in further trainings in the craft trades often do not attend and utilize the opportunities and the necessity to design their success in learning on their own. By the use of learning contracts, this can easily be demonstrated and requested.

- support and maintenance of a suitable form of communication and cooperation between learners as well as between teachers and learners, particularly during phases of e-learning.
  We combine face-to-face sessions and phases of e-learning. In our judgement, also with the possibilities of telecommunication, a great amount of face-to-face sessions is needed (Breuer 2000a). Because of this organizational division of the learning situation, a permanent synchronous communication between the learners and between learners and a teacher/tutor is neither possible nor intended. The asynchronous forms of communication have to establish a didactical added value concerning the achievement of a success in learning. In general, learners in telematics-based education forms think that timely feedback to assignments and questions is a significant factor of success (The Institute for Higher Education Policy 2000). In our courses, everybody knows to which forms of communication and cooperation learners and teachers/tutors have committed themselves. According to this, learners and teachers do use the possibilities of communication and cooperation (like e-mails, discussion boards) in our system.

We utilized learning contracts for the first time in a course that started in February 2000 and ended in February 2001. This course had very few participants, and the experiences concerning the achievement of the objectives we gained were gathered by interviews with the participants. Further empirical studies will follow with learners of a second course (start: July 2000, end: July 2001). At the conference in Tampere, further results will be presented.

In addition to the objectives mentioned above, learning contracts should not be used independent of an analysis of the target group. Against the background of specific didactical and organizational considerations, they always have to be adapted to the specific needs and requirements of the target group. For example, the learners in the project „Flexible Zusatzqualifizierung (Meisterassistent im Handwerk)" need more elements that stimulate their motivation and give orientation, because of their minor age and their smaller experiences with self-directed learning, both in comparison with the learners in the "Mercur"-Project. In the learning contract, such elements can be integrated.

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Problem Solving Strategies – Is there a better way?

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Abstract: Research on strategy use in problem solving has undergone considerable development in the last decade with the emphasis on the solving of complex and ill-structured problems. In this study, the problem solving strategy used by novice learners was investigated. The purpose of such an investigation was to develop a better understanding of how learners engage problems in technology supported learning environments with the view of developing a cognitive tool(s) to support students in the problem solving process. The problems investigated focus on environmental issues in the context of river catchment systems. The problem solving process requires clarification and understanding of the problem, collection of supporting information and data, and the application of analysis and reasoning to generate a solution. This paper reports on the initial outcomes of the study and its implications for the development of supportive frameworks for problem solving.

Background to the Study

In recent years a major growth in the development and application of technology supported resources for learning has occurred through changes in information technology, specifically related to CD -ROM and Web based development The development of these interactive learning environments has eventuated because of the belief that students need to be engaged in complex, authentic tasks that demand higher level thinking and active learning. By presenting scenarios containing ill-structured (Jonassen, 1997) or open-ended problems (Land & Hannafin, 1996) students define issue(s), create hypotheses, locate and evaluate information and present their argument(s). However, the development of such higher order thinking skills is a complex process that is currently the subject of much research and theorising. Constructs such as 'active' and 'inert' knowledge, learner scaffolding and metacognition are frameworks on which these ideas are being developed.

Initial investigations to examine student perceptions of the problem solving process and the strategies they employ in moving from novice learners to expert practitioners have indicated considerable differences in problem solving skills between students (Brickell, 1998). Even though the majority of students studied appeared to be competent users of the technology, difficulties were experienced in defining the problem and developing a plan of action towards achieving a 'solution'. Little evidence of re-checking or detailed analysis of the problem was observed. Most students reported they had little difficulty in developing a solution and understood, from the introduction to the ill-structured problem, what the issues were. However, analysis of their 'solutions' did not support this view illustrating both a lack of structure and a lack of clarity of ideas in their written responses. This study sought to examine the 'theories and actions' (Land & Hannafin, 1996) learners use, in problem solving, when provided with a range of supportive mechanisms that help organise ideas and focus possible problem solving hypotheses.

Research Questions

The main emphasis of the research addressed the focus question:

How can learners be supported in problem solving within technology supported learning environments?

To support this objective the following sub-questions were used in guiding the research:

When provided with a supportive framework, what 'theories and actions' do learners use in solving ill-structured problems within a technology supported learning environment?

What variety of strategies do learners use in accessing and making effective use of information when completing a specific task?

Research Design

Participants of this study (N = 32) were volunteers drawn from a first year undergraduate information technology class in the Faculty of Education at the University of Wollongong during Spring Session. Of the participants in the study, 27 were female and 5 male. The age of the participants ranged from 18-45 years. The study used the software *Exploring the Nardoo(*1996*)* CD-ROM, a constructivist learning environment designed for high school students. This resource introduced scenarios that encourage students in developing a plan to solve the problem(s). Experimentation, lateral thinking, acquisition of stored information, reflection and analysis, or combinations of these processes, are involved in promoting the problem-solving approach and developing students with a higher level of cognitive skill.

The study took place over a ten-week period. Initially all subjects were given an overview of the CD-ROM and randomly assigned to one of four groups (see Table 1). The subjects were asked to participate in the following sessions as part of the data collection process:-

1. Strategy tutorial: each group was instructed on the basic principles of their designated support strategy through modelling by the researcher then practised by the participants, with guided instruction, using both paper-based and CD-ROM based examples. All group members were issued with the strategy tutorial outline in written form and given time to work on example problems using their assigned strategy.
2. CD-ROM tutorial: all groups were instructed on the use of the investigating tool to develop their skills, with both the software and their assigned strategy, using alternative problems to those used in the study.
3. Problem investigation: all participants were assigned two problems to solve on an individual basis. This was carried out in two stages with revision of the assigned strategy prior to each problem solving session.

Tutorial Group	Assigned Strategy	Strategy Tutorial	CD – ROM Tutorial	Problem 1 Investigation	Problem 2 Investigation
1	Concept Map (Novak,1990)	2 Hours	2 Hours	1 Hour	1 Hour
2	Critical Thinking (Ennis, 1995)	2 Hours	2 Hours	1 Hour	1 Hour
3	Six Thinking Hats (de Bono, 1992)	2 Hours	2 Hours	1 Hour	1 Hour
4	Venn Diagram (Gunstone,1986)	2 Hours	2 Hours	1 Hour	1 Hour

Table 1. Time Allocation for Stages 1 & 2.

Data Collection

The research followed two stages of development. The first stage involved participant familiarisation with the assigned support framework and the operation of the CD-ROM. The second stage of the research involved the researcher as a participant observer within the student group. Each student was allocated the same problem to solve and asked to prepare her/his solution using the support of the CD-ROM and the paper-based support framework. During the process observational field notes on student activity and interaction were taken.
The primary sources of data collection were: student work, audio transcripts of student comments, observational records and student interviews. Student work comprised answers submitted to the assigned problems together with field notes collected on their PDA, and hand written notes compiled while completing the problem. Participants were asked to verbalise their actions in the methods they employed in 'solving' the problem.

Results.

Even though participants gathered a number of pieces of evidence it appeared that in constructing their responses they preferentially consider one or two pieces of information rather than a variety of issues. In addition not all supporting evidence was accessed by a number of students with essential articles being 'missed' in the information gathering process, resulting in the formation of 'weak' responses when developing an argument to support the solving of the problem. Participants used a combination of their personal and their assigned strategy. Many still exhibit underdeveloped skills in adopting a systematic approach to both information gathering and in the analysis and comparing of supporting information for the problem under investigation. However, both these skills tended to improve with the second problem under investigation. With both experiments, a variety of strategies were used in accessing information, in the pattern of exploration in developing mental representations of the problem, in the use of the media elements and in the use of the guides in directing the focus of investigation.
Based on the four problem solving frameworks used in the study, the following generalisations are made: the two strategies Six Hats and Critical Thinking provide stimulus for students to seek out data and make some preliminary analysis of the suitability of the data in addressing a possible solution to the problem. Participants using these strategies presented clearer representations and better argued solutions to the problem. The other two strategies, Venn Diagram and Concept Mapping, focussed more on the organization of ideas once they were identified. In either case, students, when taught one strategy and then asked to use it for problem solving, did so with greater allegiance for the first two strategies than the second two. It is conjectured that this was due to the focus of the strategy on data identification.

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The Clipper Project: An Introduction to the Impact of Web-based Courses on Pre-Baccalaureate Students

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Abstract: The emergence of the World Wide Web as a valued medium for delivering instruction is sparking an interesting change in education on all levels. Universities, in particular, are investigating ways to exploit the power of new technologies in education. Yet, few have engaged in empirically-based investigation of the true costs and benefits for students -and teachers - actively engaged in online course experiences. The Clipper Project is a research endeavor designed to study the effects of Web-based learning on pre-college students. The project coordinators hope to provide baseline information to inform future developers and providers of online education and guide them toward the provision of informed, responsible learning experiences for students. This paper describes the aims, goals, objectives, and design of this web-based research initiative.

Introduction

The acceptance of the World Wide Web as a reasonable medium for delivering instruction is sparking an interesting change in education on all levels. It has been argued that Web-based technology has a positive effect on student learning (see Oliver, Omari, & Herrington 1998; Magalhaes & Schiel 1997). Yet, despite the universal call for Web-enabled learning, there exists little research regarding what, exactly, constitutes effective and appropriate practice in online education.

Few have engaged in empirically-based investigation of the true costs and benefits for students -and teachers - actively engaged in online course experiences. A recent review (DiPerna & Volpe 2000) of evaluation of Web-based instruction found only a dozen articles (from a pool of nearly 250) that include some form of data-driven investigation. Of the twelve, *all but one* relied solely on students' self-reported attitudes or perceptions regarding Web-based instruction. Whereas anecdotal accounts of successful online classes and reports that draw upon commonly shared theory are useful, they are not sufficient alone as proof of effectiveness. The kind of understanding needed to make truly informed decisions about the value of online education requires more varied and rigorous investigation.

The Project

The Clipper Project is designed to study the effects of Web-based learning on pre-college students. High school students accepting early decision to Lehigh University are eligible while still in high school to complete college courses offered online. The students may take Web-based courses in chemistry, calculus, economics, engineering, and English. The courses are taught by Lehigh faculty, follow a semester schedule, and carry with them all of the responsibilities, activities and expectations one would find in a face-to-face course. The faculty member who designs the course is also be responsible for interacting with students enrolled in the Web-based versions. This interaction is an imperative component of these courses, and is facilitated via a combination of discussion groups, chat rooms, email, and other media.

Researchers directing the project are carrying forth a longitudinal quasi-experimental study with both qualitative and quantitative measures to determine the behavior of students during the Web-based instruction, the extent to which this instruction has prepared them for advanced instruction, whether this vehicle indeed opens broader learning experiences to them, and the effects of such a project on the faculty engaged in the process. This project is intended to enhance the collegiate experience of Lehigh freshman students by accelerating their entry into advanced studies in their specialties and in complementary fields. The purpose of this project is to provide empirically-based insight into what factors impact success within a Web-based learning environment by investigating the following factors:

1. **Implementation/Transformation Considerations**--computer access, scheduling, assessment
2. **Cost Considerations**--time, money, and personnel budget impact during development *and* delivery
3. **Student Learning Outcomes**—grades, number/quality of online communications, achievement in consequent courses related to content area(s)
4. **Faculty Teaching Outcomes**—impact on pedagogy of on-campus as well as on-line courses

Researchers are utilizing transcripts, focus groups, journals, activity logs, observations and student performance artifacts (e.g., grades, transcripts, reports) as the primary sources of data for measuring student and faculty behaviors.

Participants include students (current and prospective) as well as faculty at Lehigh University. Across the lifespan of the project, no fewer than 900 students will participate. High school participants are solicited through informational brochures sent to seniors who are granted Early Decision status at Lehigh. Student participants on campus are solicited through a variety of means including information shared with advisors and emails distributed to first year students.

The First Cohort

The first cohort of students began in February 2001. Of the 309 students offered early admission, 88 applied to one of the two Clipper Project courses (course offerings are staggered, with Calculus and Economics online first and the other three to be added in year two). At the 10-week point, the Calculus course has a 90% retention rate, and the economics course maintained an 85% rate. Participation has been steady, as well. Each student has maintained an active access rate for the course materials and each has participated in the mandatory assignments, as well as the optional chat sessions.

An interesting impact point that has emerged is the value of the online community itself in promoting success within Web-based course environments. That is, the more facilitative structures provided, the more comfortable the participants appear to be with not only the courses themselves, but also with the impending transition to the university. As the project matures, it appears the construction and maintenance of an active community of learners among the online participants - a community that spans across the courses themselves and includes opportunities for students to interact with one another, as well as with students, faculty, and other campus leaders - before making the physical transition from high school to college life will be an important factor for success.

Conclusion

Many universities are spending a great deal of time and money augmenting traditional curricula with distance education classes and Web-based instruction without investigating the most effective ways to develop and deliver the courses. It is often assumed that technology will automatically expedite learning - making learning easier and faster. Yet, we have no reason to believe instruction has improved simply because course information has been placed on the Web and students are working on their computers. As more learning becomes digitized, it becomes imperative that we understand what factors influence success. Given the pace of change and potential impact of distributed learning on higher education, we must now undertake due diligence and begin investigating empirically the exact impacts--if any--technology-based coursework has on teaching and learning at the university.

The National Commission on the High School Senior Year (NCHSSY) recently reported that more than a quarter of the freshmen at four-year colleges do not make it to their sophomore year. In addition, at selective four-year colleges and universities, only about half of college freshmen earn a bachelor's degree in about six years (NCHSSY, 2001). One of the problems the Commission focused on was how colleges can retain their students to improve graduation rates. One aspect of introducing a program like the Clipper Project is getting students motivated and committed to college classes before moving to campus.

The next phase for the Clipper Project will be guided primarily by the students' interest in developing a community of learners. Establishing relationships between on-line classmates seems an important factor in facilitating success. As the Clipper Project moves forward, initial feedback suggests that efforts spent on forming informal chat sessions, Web-casts, and discussion boards that extend to topics outside course material is likely to contribute to the overall effectiveness of the online academic experience. We may find that Clipper students have less anxiety over classes (already having completed a Lehigh course), transition easier to living away from home, have parents less anxious about their children living away from home, or feel connected to their University earlier than traditional freshmen. As the Clipper Community continues to evolve, it is becoming clear that understanding these factors will be instrumental in providing a picture of the true impacts of learning online.

By examining the impact a Web-based course has on a student population, the Clipper Project can determine characteristics of successful online course offerings. We hope to provide baseline data to inform future developers and providers of online education and guide them toward the provision of informed, responsible learning experiences for students. Rather than investing time and money into instructional design that we hope works, we will be able to concentrate funds on what we know works. This is a constructive step towards effective Web-based instruction that will lead to a positive learning experience for students and faculty alike.

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Recognition of Cross-Cultural Meaning When Developing Online Web Displays

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Abstract

The perceptions and practical experiences are important influences when creating and developing online learning experiences in cross cultural contexts. In this study fifteen educational designers studying for their Masters Degree were asked to contribute their interpretations to an ongoing study of what meaning and interpretations were generated from a series of different learning environments offered via the Web. Course materials were designed in Australia and delivered into Hong Kong, SAR, China. Students did not always interpret the visual information in the manner expected by the original designers. This paper discusses the outcomes of the investigation in relation to student's perceptions of the appropriateness of the interface design guidelines when applied to a number of exemplary WWW sites, highlighting the cultural differences encountered.

As tertiary studies turn to on-line delivery and courses become truly global, educators, course designers and instructional designers must now transcend national boundaries and cater for their 'new' clients those with backgrounds as diverse as the cultures they live in. The increasing popularity and utilisation of the World Wide Web (WWW), has led to a proliferation of course offerings which explore web design and construction. It is timely for principles, priorities and values to be examined closely in order to evaluate the appropriateness of the content presented. Questions can be raised whether meaning and communication between cultures can be achieved in relation to the material being presented. As Duffy and Cunningham (1996:171) warn 'idiosyncrasies of construction lead to an inability to communicate'.

As educators we know that all students come to subjects with different thinking and learning styles but now as we approach this unique learning situation the diversity is much more transparent, as we attempt to realise the needs of students from other countries and cultures. At times the lack of shared meaning can make communication difficult for people of different cultures. (Duffy and Cunningham, 1996). Content is often developed for courses assuming that a common culture exists.

According to AlHunaiyyan, Hewitt and Jones (1999), 'culture is a discernible variable in interface acceptance and interfaces should be designed to accommodate users' cultures'. This sentiment has been echoed by several other authors including Del Galdo, 1996; Fernandes, 1995; Uren, E.; Howard, R.; & Perinotti, T. 1993. In an effort to examine whether this statement is true and, if the content and learning experiences presented for WWW courses is authentic and appropriate, this study sought to uncover any anomalies that may exist in the area of interface design. Within the post-graduate Master of Education program an on-line subject, Cognition and Interface Design, was presented for students from both the Wollongong, Australia campus and the Hong Kong, SAR campus. The study examined the appropriateness of the content and the interface guidelines for web construction, which had been developed in the Australian context.

Theoretical Background

In recent years researchers of technology-supported learning environments have embraced constructivism by providing educators with sets of design guidelines and instructional design goals (Cunningham, Duffy and Knuth, 1993; Savery and Duffy, 1995; Duffy and Cunningham, 1996). At the same time researchers in the area of visualisation and interface design have developed and proposed design guidelines for computer interface (Laurel, 1990; Tognazzini, 1992; Misanchuk, Schwier & Boling, 2000).

Accepting the tenet that learning is the process of constructing knowledge, Duffy and Cunningham (1996) suggested, through a social constructivist framework, knowledge is context dependent and that learners are participants in the socio-cultural process. Therefore, taking into account the interactive nature and ability for knowledge construction of the Web, then this type of learning should also be context dependent with learners participating in a socio-cultural process

This investigation firstly, examined the nature of the learning process from a cultural perspective to determine the extent that context plays, and secondly evaluated the applicability of the components or principles of computer interface design when they are applied in differing cultural settings, in particular, in contexts different from their North American original viewpoints. The questions that guided the study were:

1. Do cultural differences exist in guiding instructional designers as they undertaken webpage design and construction?
2. Can a set of web design principles developed in one cultural context be applied successfully in another cultural context?
3. What cultural differences or context issues should be considered when developing on-line courses for multi-cultural cohorts?
4. Is culture a discernible variable in interface design?

Methodology

The study has been implemented in 2000-2001 within the Cognition and Interface Design postgraduate subject. The first cohort has completed a preliminary pilot study in 2000 and the second implementation occurred in December-February 2000. Fifteen students from Hong Kong developed an evaluation tool, in the form of a rubric, which has been be applied to a number of WWW sites that were deemed exemplary. These sites were chosen with Chinese and English language origins. Sets of four design principles have been formulated based on current research and have formed the framework for this evaluation. A large number of design principles exist in the area of visual and interface design, such as, colour, layout, backgrounds, etc. For the purpose of this study only four design principles or premises were extracted from the work of Williams and Tollett (2001). They were alignment, contrast, proximity and repetition.

In summary, Williams and Tollett describe the four principles as:

> **Alignment** simply means that items on the page are lined up with each, when aligned the page is cleaner and more organised therefore they communicate better;
>
> **Contrast** is what draws your eye into a page, if two elements (such as type, rules, graphics, colour, texture) are not the same, make them very different, contrasting elements create a hierarchy of information allowing the user to skim the information;
>
> **Proximity**: the principle of proximity refers to the relationship that items develop when they are close together, i.e. in close proximity, when two items are close they appear to have a relationship, to belong together, group items together that have some relationship, items that are not close in proximity appear as separate elements, spacing arrangements provide visual clues as to the meaning and importance of different information, the visual spaces create a hierarchy of information;

Repetition: the concept of repetition is that throughout the site you repeat certain elements that tie all the disparate parts together, items such as navigation buttons, colours, style, illustrations, format, layout, typography are all elements that can unify a site.

Fifteen students were asked to identify four Chinese WWW sites each that they considered exemplary in their visual design. The students all had prior experience in web design evaluation through previous coursework. Criteria for evaluation included items such as Content and Strategy, Visual Style, Navigation and Graphic Design. The study was conducted in two phases. Firstly, students were asked to identify four exemplary Chinese WWW sites and second they were given the four Williams and Tollett design principles and asked to apply them to the first four web sites that they had chosen. They were then asked to identify any cultural differences evident.

Results

The results are discussed following the four design principles or premises proposed by Williams and Tollett (2001).

Alignment

It appears that alignment is a principle that may vary according to cultural context. In this study the alignment of text on the screen design used on the Chinese sites was an important factor. According to one student 'owing to the cultural style and characters of Chinese, the left edge is not necessarily the beginning of the text'. While Williams and Tollet contend that indentation and left aligned text is preferable, traditionally Chinese characters for formal writing is presented in a vertical format with writing from right to left (although the Western influence has allowed in some instances for writing characters to be read from the left as well). Therefore, in this context the text would be generally centre aligned and indentation is not a requirement in Chinese writing. From the small sample of Chinese WWW sites chosen for evaluation, centre alignment was the preferred principle. Many sites also used a frame format where the screen was divided into either two or three segments with centre or left alignment within each cell. As another student responded 'Chinese designers always centered the topic and the content for most Chinese thinks [sic]

Contrast

Generally, the sites chosen used bold contrasting elements with many animated effects. Many sites used a variety of font sizes, some headings quite large in relation text size. Colour was used in many of the sites to differentiate particular elements. Many students commented on the 'bolding of topic headings and the significantly bigger font size to bring attention'. Within blocks of texts comments were added that 'important information was appropriately bolded or coloured for focal points'.

Proximity

On the whole, the students commented that proximity in the web sites chosen followed the principle outlined by Williams and Tollett. Text was aligned closely to graphics and images that provided understanding. The centre alignment of the text did allow for space between the concepts but generally this was used in a vertical format and generally for headings only. A number of students commented on the 'clumsy' nature of the sites and the 'crowding' of the sites. As one student stated 'the spacing arrangement is not strong enough to provide a visual clue to the meaning and importance of different information'.

Repetition

Generally, according to the student evaluations, the Chinese sites used repetition as described by Williams and Tollett. On the whole, a consistent and predictable set of navigation tools, graphics, colour and style was carried throughout the sites chosen allowing for ease of navigation. As one student stated of the sites chosen 'the repeated approach simplified navigation and ensured that they were built with a consistent rhythm and unity across the sites'.

Conclusion

This study has resulted in a number of interesting findings that would be significant to on-line course developers, instructional designers and researchers of computer interface design.

Firstly, it appears from this study that there are cross-cultural differences existing between Western designed WWW sites and Chinese developed sites. This is significant for a number of reasons in relation to on-line learning and the content provided for off-shore students. Content is being presented to students from base educational institutions with vastly different cultural contexts. In this case, Western instructional designers using Western design principles being delivered to Chinese students

Secondly, it is important to note that students were asked to choose the exemplary sites first, before being given to the principles by Williams and Tollett. This ensured that students did not purposefully seek sites that demonstrated the principles proposed. In fact, generally the students accepted the principles as 'gospel' and then commented that some of the sites chosen were not exemplary after all because they did not demonstrate the principles. For example one student stated ' the page looks not so neat and not so clear to communicate by the users' [sic] although this site was chosen by the student as exemplary. This is significant for two reasons. First, the reason the students may not have readily found agreement with the principles was because culturally the visual design was different and second, the Western-based principles proposed were being adopted without question because they were part of the course content delivered. The fact that the students noted discrepancies should indicate the tensions and difficulties in matching the visual design and navigation of the sites to the four principles.

Many students commented on the crowded nature of the screen design. Many elements, including animated graphics were added to the pages, generally for embellishment, as one student commented 'flashing graphics caused distracting of users eyes'. Perhaps some parallel could be drawn between the visual impact of the often-cluttered neon explosion of the street signage and decorations experienced by first time visitors to Hong Kong. From experience with other web sites, this perception of more interesting visual appeal being equated with a number of "cute" visual effects appears to be culturally-based. In addition, the use of written Chinese on several sites has additional impact by virtue of the nature of the written language and how it is parsed into grammatical structures. As grammar is derived from the context in Chinese writing this also means that context is used to construct meaning as the text is read. This has immediate implications for how the text is laid out and designed for quick recognition and selection. In particular, web sites are designed to attract and focus attention rather than being "read" the visual representation of ideas through characters can be working in several ways and further studies are required to identify which factors are operating under which circumstances.

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Collaborative Learning Environments: Integrating Informal Learning Experiences in the Home with Learning at School

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Abstract: This paper describes an array of research projects that explore the use of ICT within the home and other informal settings to enhance pupil motivation and learning outcomes and contribute to the attainment of children in school.

It is important for teachers; researches and policy makers to be more aware of the ways children are using computers in the home. More importantly early indications from longitudinal research projects suggest that effective integration of ICT within the school environment is constrained by: -

- a narrow conception of knowledge and its construction
- a lack of appreciation of the power of collaborative environmental environments made possible by ICT
- an underestimate of Children's experience and facility with ICT
- lack of time and opportunity for teachers to explore the Internet and engage in purposeful but playful activities that contribute to confidence and vision.

Little evidence is currently available about the impact of informal learning on pupil attainment at school. Two major projects are underway with research teams from four UK Universities to develop a framework for measuring the ICT environment.

The learning environment in the digital age

Teams of researchers have found that the ways children learn to use computers at home are markedly different from the ways they use them at school. Alongside a huge investment of UK government funding in the National Grid for Learning (NGfL), new technologies are being adopted very rapidly in a majority of homes. Schools are currently coping with children who have an increasingly broad range of computer skills and very high expectations of ICT.

There are some important differences emerging in the ways in which adults and children experience this new technology. When children and young people use the computer for pleasure they learn by playful discovery and experimentation. They ask family, friends and use electronic help frequently such as chat rooms and web sites. Their use of computers at home tends not to include educational software but they do choose to write, design and play games (often in group situations on or offline).

It is of concern that many children and young people are positive about using computers in the home, but disillusioned with school ICT. Often they find the restrictions on Internet Access frustrating and the speed of individual PCs or networks are less efficient than they experience in the home.

Some exciting untapped potential exists in greater home-school linkage and collaboration. This is the wider learning environment in which children can flourish and which need to be understood more fully. Research projects are currently exploring the possibilities of raising pupil attainment through new forms of home school collaboration. It recognises the undervalued knowledge and skills of parents, peers, extended family and global www communities. In this context Music web sites and software user groups can be very motivating and a rich source of learning.

Although it is recognised that important forms of learning takes place both in homes and classrooms, teachers and parents and children rarely have the opportunity to share, discuss and use their experiences and skills.

Teachers are increasingly being asked to develop innovative ways of teaching with ICT. In particular they are asked to use the Web to develop new ways of communicating with parents, children and colleagues.
There is a growing concern that teachers have little time to integrate ICT meaningfully into the school curriculum and ironically they feel that pressure of work prevents them for 'surfing' and exploring the www. Their experience of learning via the web is thus very different from that of children who tend to find serendipitous links and spend a lot of time discovering interesting resources and passing on links to friends.

There is a growing challenge for teachers who are then asked to mark computer produced homework. They are also facing the consequences of differential access in the home which can make it difficult to know how best to compensate for the digital divide within the school environment

Previous research has strongly indicated the potential outcomes of using ICT in education. Factors such as learner engagement, enhanced enjoyment, increased commitment to the task; increased autonomy and self-esteem are frequently mentioned (Cox 1997, Someck 1996, Bonnet et al 1999, Davies & Somekh 1997 and Cole 2000). However there is a complex web of social, cultural and economic factors impacting on educational standards and attainment. This makes it very difficult to isolate or extrapolate the direct effects of ICT on teaching and learning.

ImpacT2 a major longitudinal study sponsored by the DfEE and managed by Becta. The study makes the assumption that there are new empirical and conceptual challenges involved in attempting to identify a causal relationship between children's use of ICT and improvements in their attainment.

The researchers indicate in their early finding that exposure to networked technologies may impact on learning in ways that are not reflected in Standardized Attainment Tests at the end of Key Stages 2 & 3. Nevertheless the skills and attitudes acquired in informal settings may well be essential to developing effective learning strategies.

Exciting possibilities for learning includes the development of higher level conceptualization, better problem solving, more complex small-group talk. However as yet there are no reliable measures for identifying and documenting these in relation to attainment in school.

A Concept Mapping Task has been developed as a research instrument, which could potentially be used as both a baseline measure and an outcome measure. The ImpacT2 research project (1999-2002) provides a fantastic opportunity to 'get inside' the child's experience of ICT.

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Hotel Simulation - a 2nd year student project

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We will present the experience from a 2nd year programming project for 60 electronic design students. Our conclusions from a number of case studies in software industry:

* Ability to learn new things rather than to memorize and repeat static knowledge
* Ability to communicate and to co-operate rather than individual brilliance
* Ability to understand totality rather than having a narrow deep knowledge
* Ability to act and ask questions rather than ability to follow detailed instructions.

We have designed this course to train the new capabilities. The content is computer networking and object oriented architectures. There is a requirement on a graphical user interface with animation and sound. The task this year was to implement a client-server based game-like hotel simulation system. The system implemented will be presented by two of the students. They are happy to discuss the course layout and the general experience from it.

Computer-Enhanced or Computer-Enchanted?
The Magic and Mischief of Learning With Computers

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Abstract: What is it about computers that makes them so hypnotic? How can we educators take advantage of the computer's power to attract and hold our students' attention? How can we ensure that our students are creatively engaged in learning, not merely mesmerized by swirling images and button-pushing? Is the computer wasting our students' time more than it is enriching them? This paper will report on recent research in human-computer interactions, give examples of some of the most promising uses of educational technology, and categorize the effective and ineffective applications. With a focus on the elements of audience, interactivity, and creative integration, we will discuss the educational possibilities offered uniquely by the computer, arguing that we are neglecting the computer's greatest potential that is, its ability to draw out our students' creativity.

Introduction

A Mother's View

My son Jonathan got a 3-dimensional puzzle for Christmas a few years ago. It was a 12 X 14 X 4 inch wooden box with a maze inside. The maze was built on a moveable platform, and you could tilt the box back and forth in an effort to get a little silver ball to roll through until it dropped out some hole. Holes closer to the end were worth more points. My son played with the gadget for about an hour, off and on. He has hardly touched it since.

I think that was the same year my son was introduced to PacMan on the computer. You all remember PacMan. A circle with a triangle mouth cut out on the side moved through a 2-dimensional maze, eating colored pellets while being chased by "ghosts." The more pellets your PacMan ate, the more points you got. Jonathan played PacMan for hours, day after day.

What was the difference? Why was one of these activities so absorbing, and the other of such limited interest? Admittedly, my son is just one case, and perhaps his puzzling preferences don't apply to your child or your students. But it represents a trend that's all around us the proclivity of young people for electronic activities, their willingness to sit mesmerized for hours in front of a computer or video screen, when equal time concentrating on almost anything else would be unimaginable. If we could just get at this, if we could figure out exactly what it is that draws so many of them in so magnetically, educators and parents would have a powerful force within their grasp.

The Purpose of this Paper

The purpose of this paper is to provoke discussion about the problems and the potential benefits of computer use among young people. We begin our discussion in section two ("The Bad News") by acknowledging the down-side to computer-enhanced learning. Our purpose is not to argue for the abandonment of educational technology, but to encourage a more tempered view. To this end, we attempt to analyze what makes computers so attractive and absorbing with an eye to harnessing them for better purposes. Section three ("The Good News") continues by proposing types of computer activities that may be particularly valuable for college level students. We give examples of promising applications of educational technology and describe some original material developed by the authors and their collaborators. We conclude with some personal reflections from a parent's perspective.

The Bad News

Far more has been written about the wonders of computer-enhanced learning than about the time wasted in front of the computer screen. The reasons are pretty clear. Those who don't care to use computers in their teaching may grumble in the halls about all the money and attention thrown at technology, but they generally don't write about it. On the other hand, the defenders of educational technology often have a vested interest that makes them reluctant to speak out in ways that seem contrary to their own professional commitments – for example, large investments in educational technology at their institutions, or publications in computer-enhanced learning that would be devalued if the field were repudiated. Nevertheless, it is important that those who believe in the potential of educational technology speak out clearly about its disadvantages as well. With a growing number of schools requiring that their students have computers, we have a responsibility to consider carefully how young people are spending time with the companion we have assigned to them.

In the face of the great enthusiasm for computer-enhanced learning, a backlash against the hype was inevitable, and in the past few years some notable books and articles have begun arguing for a more balanced view. Clifford Stoll in *Silicon Snake Oil* was one of the first to proclaim that the emperor had no clothes (Stoll 1995). Focusing primarily on our fascination with the Internet, Stoll warns, "You're viewing a world that doesn't exist. During that week you spend online, you could have planted a tomato garden, volunteered at a hospital, spoken with your child's teacher, and taught the kid down the block how to shag fly balls." His equation speaks the simple, disturbing truth. "Every hour that you're behind the keyboard is sixty minutes that

In a 1999 report, the Kaiser Family Foundation added up the hours and gave us the facts with regard to our children (Kaiser Family Foundation 1999). Surveying 3155 young people between the ages of 2 and 18, they found that on the average 5 ½ hours of a child's day is spent using media (including TV, video games, music, and computers). Nearly 70% of children have a computer in their home, and 45% percent have Internet access. On a typical day, 42% percent of these children will use their computer. When asked to choose the companion they would most like to have if they were stranded on a desert island, children generally prefer computers over TVs, CDs, tapes, radios, video movies, and video games.

Many parents would consider this good news. Computers are viewed as educational -- less passive and more enriching than television. But what are our young people doing during those hours at the computer? The Kaiser study reports that 60% of their time on the computer is devoted to games, email, Web browsing, and chat rooms, while only 22% percent is spent on schoolwork. For boys, shoot-em-up games like Doom or Duke Nukem are much preferred over educational programs.

Our greatest care should be toward the young children, who are being deeply influenced by electronic media at early stages in their development. In 1999, a group of concerned educators, physicians, psychologists, scientists, and philosophers founded the Alliance for Childhood, pooling their expertise in a study of the effects of computers on children (Alliance for Childhood 2000). Their results are well-researched and compellingly conveyed. They describe what many parents and educators have themselves observed – that "young students often seem to be mesmerized by, and some even addicted to, the action on their [computer] screens, rather than motivated to learn." Educational psychologist Jane Healy notes that today's children nurtured on swirling, colorful, quickly-changing, and instantly accessible electronic images -- often find it hard to exercise their own imaginations. (See also Healy 1998.) The report warns that computer use can undermine the sense of wonder and reverence that children typically bring to their encounters with the real world of pebbles, streams, mud, insects, and stars. "What happens to the capacity for quiet wonder," they ask, "when children are regularly bombarded with cartoonish graphics that are far louder and flashier than the real thing, or sanitized, edited versions of reality that don't give them a chance to get their hands dirty?" Nature needs to be approached by young people not as some virtual reality, but as its "raw, untidy self."

The report arrives at the same conclusion drawn by Todd Oppenheimer in his 1997 *Atlantic Monthly* article, "The Computer Delusion" (Oppenheimer 1997): We are spending too much money in our public schools on computer technology without questioning carefully enough the premise that computers serve our children's educational needs. Convincingly, they call for a restriction of the computer's influence and more time with hands-on learning, nature, language, the arts, imaginative play, and most importantly, direct contact with caring adults.

What about college levels students? Are their educational needs being compromised as well? A growing number of universities are insisting that students be equipped with computers as they enter their freshman year. College students have passed through the crucial early developmental stages of their education, and we expect that they now have the maturity to benefit from the computer as an educational tool. But how are they really spending their time on the computer, and how can educators guide them to toward enriching rather than time-wasting activities? Our own experience with university students indicates that they are spending long hours exchanging email and instant messages, browsing the Web, playing games, and – perhaps the biggest time consumer -- downloading games and music files. Much less time is spent on educational computer activities. Clearly, computers continue to have their hypnotic effect on many college age students. Perhaps if we understood better what attracts them so intensely, we might put that power to better use.

As a point of discussion and a call to further research, we offer our own analysis of the reasons behind the computer's mesmerizing hold on young people. This list emerges only from personal observation, but it may help us to separate what enriches young computer users from what merely panders to them, and guide us more clearly to our educational goals.

Picture a young student focused for hours on a computer screen playing a game. What is it that holds the student's attention so tightly? We see eight factors:

- a feeling of power and control at the push of a button
- competition
- frequent and quick feedback
- incremental successes and rewards
- instant gratification
- visual and auditory stimulation
- little physical exertion
- simple problem-solving, requiring relatively undemanding intellectual exertion

Web browsing shares many of the same attractions, but with the added element of readily accessible information, and without the element of competition. In the case of email and instant messaging, we see the following enticements:

- easy accessibility of friends
- the novelty and mystery of communication with strangers
- the comfort of anonymous or faceless communication
- the ease of informal communication, often in a fun, shorthand slang peculiar to young computer users
- the ease of capricious communication, less restricted by timing and convention (i.e., one can initiate, respond, or not respond to a message at whim)

As for the hours spent downloading games and music files, there is the natural attraction of young people for the popular music and games themselves, the delight of acquiring things free of charge, and the feeling of power and control at the touch of a button.

These attractions are enough to keep many young people tied to a computer for hours a day. But if this list matches your own observations, you would have to agree that computers are not speaking to our students' deepest intellectual selves. How can we tap into these enticements and help guide them toward greater challenges and richer human experiences?

The Good News

This entanglement with educational technology is a Faustian bargain, warns Neil Postman in *The End of Education* (Postman 1995). And yes, we agree that our relationship with computers comes at a high price, but we need not sell our souls in the bargain.

In spite of the acknowledged pitfalls of computer use among young people, we believe that college educators are *not* selling out by requiring that every student have one of these infernal devices. There is enough essential utility in computers to justify them even if their use goes no further than email exchanges with professors, communication among classmates for collaborative work, word processing, and basic Web research. Ensuring that all students have computers is hardly more unusual than ensuring that they all have telephones.

The challenge of educators is to help students become more aware of their habits; talk with them about the pervasive influence of technology in their lives; frequently point them back to the messy, disorganized real world that won't be changed with the click of a mouse; and focus them on computer activities that may truly develop their problem-solving skills, expand their world view, and foster their creativity.

We must consider both what attracts young people to computers as well as the unique capabilities that computers add to the educational environment, and pull the very best out of this mix. With this purpose in mind, we offer the following classification of promising computer activities.

Rote Learning, Exercises, and Mastery of Information or Procedures

Multimedia presentations and on-line exercises will never be a good substitute for the explanations and guidance of a talented human teacher, but they are an excellent supplement. Subjects such as foreign language, medicine, mathematics, and biology require a great deal of time outside the classroom in drill and exercise. Concepts, facts, and phenomena can be vividly conveyed and well-reinforced through a computer -- building an electrical circuit, exploring visual allusions in the political cartoons of Thomas Nast, examining products of linear transformations, watching a 2D harmonic wave disturbance, experimenting with Fermat's principle, designing a snowflake pattern, witnessing a cytoplasm egg donation, or solving a mystery in French, for example. (Excellent Web sites offering exercises such as these include Learner.org at www.learner.org; Exploratorium at www.exploratorium.edu; ExploreScience.com at www.explorescience.com; 7stones at www.7stones.com, and – as one example among the host of foreign language resources – "Apprendre le francais avec l'inspecteur Duflair" at www.polarfle.ovh.org.)

But what of the warnings against multimedia learning that we hear from both Clifford Stoll and Jane Healy? Stoll cautions against the Sesame Street approach, where students are taught by means of cartoons, gaudy numbers, and weird random noises, all of which are highly entertaining but give children the impression that they can learn "without work and without discipline." Similarly, Healy warns of sugar-coated learning that may "spoil children's appetite for the main course," cheating them out of the joy of mastery that comes from hard work and real challenges.

There is truth to what they say, but perhaps they overstate the case. Audio/visual presentations need not be flashy to be effective, and they take advantage of the interactivity that young people enjoy. It is far more engaging to be able to select activities and see immediate feedback than to watch a non-interactive TV-program-style production. When used as a supplement to rather than a replacement for classroom instruction, multimedia exercises and presentations are clearly beneficial.

Activities That Couldn't Be Done Otherwise, Or That Are Done Better With Computers

Computers are not a good substitute for real-world experience. However, they are valuable tools for activities that couldn't be done otherwise, or for activities that are done better with computers. These include

- *Communication that would otherwise be difficult or impossible, such as long-distance conversations among students of different languages and cultures, or student interactions with artists and scholars.* In April of 2000, Secretary of Education acknowledged "The Growing Importance of International Education" and encouraged educators to use the Internet to foster "classroom-to-classroom exchanges that allow young people to learn about each other from each other." Notable initiatives in this area include The Alliance for Global Learning (www.global-learning.org), ePALS (www.epals.com), iEARN (www.iEARN.com), Intercultural Email Classroom Connections (www.teaching.com/iecc), International School Partnerships in Technology sponsored by UNC's Center for International Understanding (www.ga.unc.edu/NCCIU/ispt/), and The Global Schoolhouse (www.lightspan.com).
- *Experiments and demonstrations that are otherwise too dangerous, expensive, or impractical.* Simulations can rarely capture the random, difficult-to-measure elements of natural phenomena, and thus they are second best to real lab experiments. However, for experiments involving entities not visible to the human eye, or materials that are expensive, inaccessible, or dangerous, simulations

provide learning opportunities previously unavailable to students. With the aid of computers, students can now see astronomical views of the night sky from any location at any time; explore microscopic organisms; manipulate molecular structures; "walk through" architectural designs before they have been built; perform autopsies without cadavers; experiment with radioactive materials; or view graphical representations of mathematical functions.

- *Analysis and presentation of research results closely integrated with the research experiments.* A wide range of data capturing and input devices now exist that can be directly interfaced with computers. For example, sound or light waves, radioactive decay, magnetic fields, or temperature can be measured by hardware connected to a computer. Then the data can be analyzed and the results displayed both graphically and numerically within the same computer environment.
- *Accessibility to information for disabled students or for students at locations distant from learning materials and instructors.* On-line learning can minimize the impact of disabilities by delivering learning material directly to disabled students in an accessible format, and allowing these students to reveal their disabilities only if and when they choose. Access to PIVot (http://ncam.wgbh.org/webaccess/pivot) exemplifies the work being done in making multimedia learning material available to students with disabilities. A cooperative effort of MIT, CPB, the NSF, and Mitsubishi Electric American Foundation, PIVot (which stands for Physics Interactive Video Tutor) provides alternative graphical user interface devices for blind and deaf students. For students whose handicap consists solely in their isolation from educational material, the computer is an equally powerful support. For example, *The Power of the Internet for Learning: Moving from Promise to Practice*, a publication of the Web-Based Education Commission, tells of bringing on-line educational material to isolated native Indian communities behind Arizona canyon walls. These examples represent educational opportunities provided uniquely by computer technology.

Logical Problem Solving with Intelligent Tutoring

Computers are built to be logical, and they are less prone to error than humans. It is no surprise, then, that they make excellent tutors in logical problem solving. Moreover, "intelligent" tutors can give well-targeted feedback based upon the student's current mastery level. Progress in artificial intelligence has augmented the computer's fundamental logic, giving it greater "creativity" in finding its own way to solutions. A single computer program can now be written so that it solves not just a single logical problem, but a whole class of problems – even to the extent of proving theorems in formal logic. To go a step further, the computer, equipped with basic problem solving ability, may "learn" better strategies of problem-solving over time. This opens the intriguing possibility of the human and the computer learning interactively and with each other's help.

We have been exploring human/computer interactive learning in our own research.[1] PLogic Tutor is a tutorial program designed to teach students the fundamentals of prepositional logic, including theorem-proving (http://www.cs.wfu.edu/~burg/).[2] The goal of the project is to test the efficacy of tutorial programs that combine intelligent tutoring in the traditional sense (i.e., a tutor that monitors student activity and gives customized feedback) with intelligence in the machine learning sense (i.e., a tutor that learns better problem solving, and thus better teaching strategies, over repeated tutorial sessions).

The computer's application to logical problem solving is natural and full of potential. Educators are well-advised to consider the existing software for development of problem solving skills, as well as pursue open research questions regarding how humans learn logical thinking and how their learning might be enhanced with their ultimately-logical companion, the computer.

Creative Expression

The greatest untapped potential of computers lies in their ability to foster creativity. We have heard the warnings of educational psychologists who observe decreased imagination in students sated on computer use. But this need not be the case if computer use if both limited and channeled.

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[1] We would like to acknowledge the contributions of John Daniel, Alan Levicki, and Stacy Lukins to the PLogic Tutor research project.

[2] Click on PLogic Tutor link at this site. If a login window appears, type in user name *anonymous* and password *plogic*.

Computers *can* encourage creativity. Perhaps the most powerful stimulant to creativity produced by technology is the world-wide audience that it opens up to anyone with something to share. There are few Emily Dickinson's among us, content to slip our poems quietly into a drawer. Art in any medium is a personal expression meant to be shared and appreciated. The World Wide Web – where students can post their writing, music, and art for international view – can motivate students with the possibility of an audience, and this is a stimulant that educators should drawn upon.

Computers also give us powerful and easy-to-use tools for work in a variety of media. Beginning with word processors for writing, we now have progressed to sound editors, MIDI keyboards, CAD programs, photo-editing software, paint programs, virtual reality authoring tools, and multimedia programming languages.

Computer-generated art integrates various media and senses in a novel way that distinguishes it from traditional art. Combining multimedia and interactivity, computers are more than TV screens at close view. Rather, they give rise to a new art form – one with a unique, still-evolving vocabulary, and calling upon a mindstyle different from those inclined toward fine arts as we have previously known them. Computer-generated multimedia art has an appeal for the mathematically and scientifically inclined, and gives them an outlet for creative expression that they may not experience otherwise. It can be the meeting place of the Gödels, the Eschers, and the Bachs.

In addition to giving students a new mode of creative expression, original computer-generated works can add dimension to a student's experience of traditional art, music, or literature. For example, consider how a student's understanding of a poem might be enriched by an interactive multimedia interpretation, one in which the resonances of a word's interpretations are represented through a vocabulary of hyperlinks, fade in/out, cursor navigation, visual and auditory metaphors, etc. A new form of literary criticism, or a mixture of criticism and creative interpretation through interactive multimedia, opens intriguing possibilities.[3] The enrichment of artistic discovery via computer technology is well worth considering if we hope to tap into the creative reserves of our technologically-inclined students.

A Mother's View, Revisited

My son is 13 now, and he still would like to play at the computer more than I think he should. He has gone on to flashier, more complex games that have him building empires or searching out and destroying superhuman foes. I don't think there's much in these games to challenge his intellect, but nonetheless he can sit absorbed in them for hours. I'm encouraged, however, that there do exist computer-based activities for young people that can engage their interest as well as develop their creativity. Allow me to give an example from my parental perspective.

Last year, Jonathan was required to do an artistic composition for a school project. He chose to do music. His first efforts to compose a song at the piano were simple and child-like – smudged scribblings of alphabetic notes on a dog-eared scrap of paper. From there, he transcribed his song by hand into proper musical notation – still smudged and elementary, but with a few embellishments that came to him as he notated the score. It was then that he learned that he could get a trial version of a musical transcription computer program. Now Jonathan could "type" the musical score into the computer and print it out in perfect form. This basic computer tool made it much easier to note and play back the music. I watched with fascination as my son cut and pasted, made variations, and finally emerged with a piece so complex and interesting that his own fingers could hardly keep up with it any more. This, I thought, was time well-spent on the computer.

Jonathan still prefers empire building and superhuman foes. But I keep hoping that my young technophile – this used-to-be-little boy who always drew people as geometric shapes and lulled himself to sleep murmuring number patterns – will eventually be drawn to deeper intellectual and creative challenges, if I just keep laying them in his path. That's my job as a parent. That our job, as educators.

[3]We will explore the topic of "Creative Multimedia Expression and Interpretation" in the October 2001 issue of *The IMEJ of Computer-Enhanced Learning*, http://imej.wfu.edu, and a First-Year Seminar on "Invention and Interpretation: A Multimedia Approach to Literature " will be offered at Wake Forest University in the spring of 2002.

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Teaching And Learning In A Technological Age: Transforming Learning Through Teacher Training

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Abstract

Two major events require teachers to be knowledgeable about technology influenced learning and how to create learning environments leading to higher levels of student achievement. These events, the 21st century information technology explosion and increasing demands for accountability for teaching results, are changing the way 1) schools are responding to learners and 2) preservice teachers and school leaders are being prepared for the classroom. New millennium teachers and school leaders must have sufficient technology expertise to integrate technology into meaningful learning paradigms. The impact of technology on teaching, instructional delivery and school reform will require knowledge of technology as a cognitive tool which when used skillfully can bring diverse learners to higher levels of academic achievement and significantly change the way learning communities are developed. This paper will 1) discuss the impact of technology learning on teachers and school leaders, 2) highlight basic qualitative research from a group of graduate students in Educational Leadership, and 3) delineate technology readiness skills all teachers and school leaders should possess.

I. Impact on Teaching

Teachers report little or no use of computers for instruction. Despite the growing numbers of computers in the classroom and the increase in available training, teachers are still finding it difficult to use computers as part of daily classroom delivery of content. This results from a lack of development time along with a limited quantity of instructional materials.

According to a March 30, 2001, Atlanta Constitution news report, 84 percent of teachers in a national poll said computers and Internet access improve the quality of education, 78 percent said they are too busy to take full advantage of those technological tools, ninety-seven percent said they have Internet access school, and 78 percent feel comfortable using the Internet. Yet, two-thirds said the Internet hasn't been well integrated into their classroom activities, and 60 percent said they were online for less than 30 minutes a day (Mollison, 2001).

Technology has the capacity to positively impact teaching by: **1) being a resource for instruction..** Technology as a resource can help teachers cope with a growing paperwork load. Teachers can become more productive as they are trained in the use of technology and can gain quick access to information to help them and their students by meeting individual needs. ***2) changing the way teachers teach.*** Technology enables teachers to help students with the construction and integration of knowledge. The process of construction is not an easy one. The students need mentors with whom they can have effective dialogue. ***3) facilitating increased communications.*** On-line communication between teacher and student, teacher and parent, teacher and teacher, and teacher and information expands the dialog necessary to be effective. It is through this human interaction that ideas become creative thought and creative thought becomes a new product or service for humanity. ***4) helping teachers use technology effectively.*** Instructional Technology is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication and employing a combination of human and nonhuman resources to bring about more effective instruction. ***5) improving Learning.*** The application of educational technologies to instruction has progressed beyond the use of basic drill and practice software, and now includes the use of complex multimedia products and advanced networking technologies. Today, students use multimedia to learn interactively and work on class projects. They use the Internet to do research, engage in projects, and to communicate. The new technologies allow students to have more control over their own learning, to think analytically and critically, and to work collaboratively. This "constructivist" approach is one effort at educational reform made easier by technology, and perhaps even driven by it. Since this type of instructional approach, and the technologies involved with it, are recent developments, it is hard to gauge their educational effects. Still, an increasing body of evidence as presented by Bialo and Sivin-Kachala (1996) for example, suggests positive results.

Another effort called the Buddy Project (Indiana's Fourth Grade, 1990) supplied students with home computers and modem access to school. Positive effects included: an increase in writing skills, better understanding and broader view of math, ability to teach others, and greater problem solving and critical thinking skills.

Effects of Technology on Students' Attitudes. Numerous studies over the years, summarized by Bialo and Sivin-Kachala (1996), report other benefits enjoyed by students who use technology. These benefits involve attitudes toward self and toward learning. The studies reveal that students feel more successful in school, are more motivated to learn and have increased self-confidence and self-esteem when using technology-supported instruction. This is particularly true when the technology allows the students to control their own learning. It's also true across a variety of subject areas, and is especially noteworthy when students are in at-risk groups (special education, students from inner-city or rural schools). Also, students reported significantly increased use of computers in four different areas, gathering information, organizing and presenting information, doing multimedia projects, and obtaining help with basic skills.

II. Qualitative Research – A group of 20 graduate students at Albany State University in Educational Administration, many of them teachers, were given question "How will using technology improve teaching and learning in the classroom?" Eighteen of the twenty students returned results. The papers were then reviewed to identify several common threads including the students' responses to the impact technology would have on teaching and learning. To make a difference in education, 94% of the students said that technology training must be provided for teachers. Technology training has been developed in Georgia as a staff development program. Nearly 27% of the state's teachers have completed the program to date. Technologies influence of the classroom is further identified in the table 1. The largest influence identified by this group of teachers is that student motivation increases. Faculty needs to be aware of technologies influence in these areas as a minimum to ensure success.

Table 1 – Elements that influence classroom success

	Graduate Students (N=18)
Student motivation increases	78%
Independent study programs increases	50%
Use of technology in schools prepares students for real life/work experiences	50%
Time on tasks improves	33%
Different learning styles are supported	28%

III. Technology Readiness Skills – The International Society Technology in Education (ISTE) under the National Educational Technology Standards project has identified core skills that new and experienced teachers are expected to know and be able to pass along to their students. Below is a sampling of skills teacher will be required to demonstrate. A full list is available at : **http://cnets.iste.org/**

- demonstrate a sound understanding of the nature an operation of technology systems, - use technology tools and information resources to increase productivity, promote creativity, and facilitate academic learning, - use content-specific tools (e.g., software, simulation, environmental robes, graphing calculators, exploratory environments, Web tools) to support learning and research, - use technology resources to facilitate higher order and complex thinking skills, including problem solving, critical thinking, informed decision making, knowledge construction, and creativity, collaborate in other creative works using productivity tools, use technology to locate, evaluate, and collect information from a variety of sources. - use technology tools to process data and report results.

In order for teachers to create the most effective learning environments they must transform traditional approaches and new approaches in a way that makes learning relevant while addressing individual student needs. "The resulting learning environments should prepare students to:

- Communicate using a variety of media and formats
- Access and exchange information in a variety of ways
- Compile, organize, analyze, and synthesize information
- Draw conclusions and make generalizations based on information gathered
- Know content and be able to locate additional information as needed
- Become self-directed learners
- Collaborate and cooperate in team efforts
- Interact with others in ethical and appropriate ways (ISTE, 2001)."

IV. Conclusion - The U.S. Department of Education and Educational Testing Service (ETS) (Baker, 1998) report that new methods of evaluation that look at technology in context are being investigated. These methods will focus ideally not on the question "Does technology work?" but rather on how it impacts the various components of the educational process. One factor is that *instruction can be more standardized*. One section or one class taught by several teachers can have the same thread of knowledge by using technology. Because of the various elements of color and motion, learning can be *more interesting*. We can go places with video that would be too costly or too dangerous for our students. Yet, they can have the same vicarious experience as being there. Through the use of computers *learning becomes interactive*. Students can make choices and respond to those choices. *Learning time* can be reduced. Much research has been done in this area. Although there still remains some questions as to specifically why time is reduced, student learn faster when using technology...and perhaps as a result the over all *quality of learning improves*. We find, for example, that teachers take care to develop high quality overhead transparencies and other materials for student use that has been fully integrated into the learning process.

The *role of the instructor changes* from the possessor of knowledge to the facilitator of the learning environment. Teachers are free to develop instruction and to spend time with students in small groups, helping the ones who need help and enriching the ones who can absorb more. Technology has been shown to have positive effects on the instructional process, on basic and advanced skills. Technology is also changing the instructional process itself. To be effective, technology cannot exist in isolation. Technology is an essential part of the pedagogical skills and strategies that all teachers must possess. Technology must be made an integral part of the entire instructional process for schools to succeed.

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X-Quest: An Open Tool to Support Evaluation in Distance Learning

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Abstract: In proprietary distance learning environments it often results difficult to exchange educational resources among different systems. In this paper, we introduce X-Quest, an open tool to create and maintain IMS-compatible questionnaires. Two main modules compose the tool: the first one is a user-friendly graphical interface that deals with the questionnaire creation phase and produces a XML output, compatible with the Question & Test Interoperability specifications; the second module takes advantage of XML features to make a presentation of the questionnaire in the more suitable way. This work is part of a more challenging project that intends to apply the same approach in the development of an educational framework for authoring and publishing didactic resources.

The growth of the World Wide Web is transforming teaching and learning at all levels of education, in particular, at the Universities. In this context, a lot of educational environments have been developed all over the world. From a pedagogical point of view, a fundamental topic in any distance learning system design is to include an effective way to evaluate the student progress. In most cases, the student has to answer several questions at the end of every course section in order to assess his knowledge.

Frequently, the distance learning environments we find in the context of education technologies include its own authoring tool to create and use questionnaires. Nevertheless, a common problem in most of these proprietary environments is the difficulty to allow systems to exchange the educational resources, particularly the questionnaires. Because of this situation, several international institutions have created groups to research and elaborate standards, which allow the interchange of educational resources among different learning systems, developed for heterogeneous purposes and in different software platforms. In the field of evaluation resources, one of the most relevant is the one proposed by IMS Global Learning Consortium "Question & Test Interoperability" (QTI) specification (IMS, 2000) which describes a basic structure for the representation of question (item) and test (assessment) data. In this paper, we introduce the X-Quest, an open tool to create and maintain IMS-compatible questionnaires.

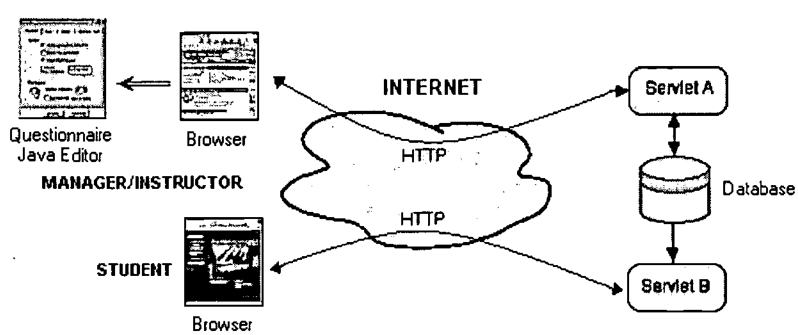

Fig. 1: Simplified System Architecture

Two main modules compose the tool, as shown in Fig. 1. The first one is a user-friendly graphical interface that deals with questionnaire creation phase. This module produces a XML output compatible with the aforementioned QTI specifications and stores all the necessary data elements required to compose, render, score and provide feedback from questions. The second module takes advantage of XML features to make a presentation of the questionnaire in the more suitable way. For example, as HTML pages that can be displayed by any commercial browser; as a PDF file that could be easily printed out or as any other format able to be processed automatically. The current XML galaxy provides us with an enormous set of possibilities to carry out all these transformations.

The X-Quest tool has been completely developed in Java 2 (Gosling et al. 2000) in order to achieve the platform independence concept. The tool offers the next features:

- Typical types of questionnaires: true/false, multiple choice, multiple response, fill in black, as well as heterogeneous combinations of these basic types.
- Questions may contain multimedia resources: text, images, audio, video, etc.
- It is possible to define different feedback messages for each question/response.
- It includes support to be easily portable to different natural languages.
- Displays an intuitive and user-friendly graphical interface (see Fig. 2).

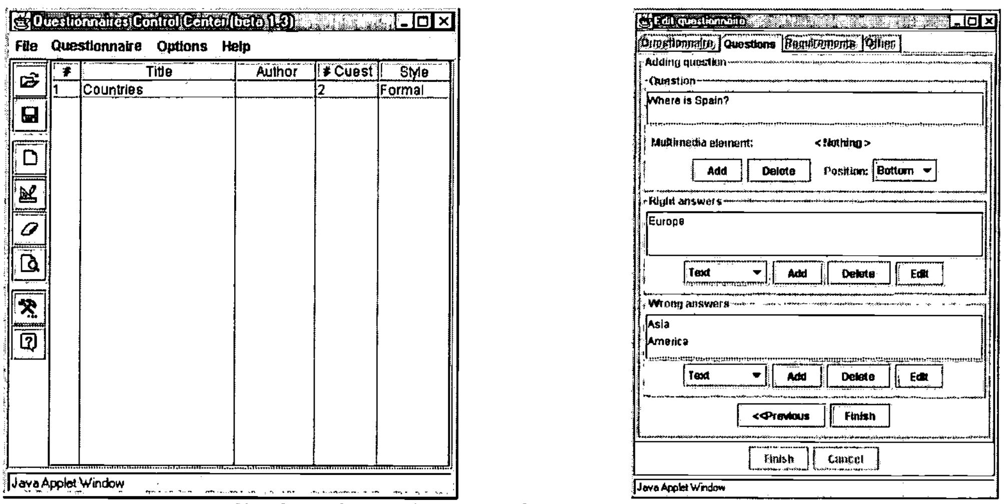

Fig. 2: Main graphical interface and questionnaire editing

The X-Quest tool has already been developed and incorporated into a web site in order to test the functionality offered. The tool has been linked with a database, where several questionnaires are stored. Clients may access these resources through any commercial web browser.

This work is part of a more challenging project that intends to apply the same approach in the development of an educational framework for authoring and publishing didactic resources as tutorials, slide presentations, exercises, simulators, glossaries and, of course, questionnaires. One of the key ideas of this proposal is to represent and organise them and their multiple relationships using a hypermedia model like Labyrinth (Diaz et al. 1997). One of the advantages of that kind of models is the explicit support of structure and navigation. On the other hand, XML is an adequate notation to represent different contents and publish them in a Web environment. Linking both aspects is one of the main purposes of the project.

In the near future it is foreseen to include the questionnaire tool into the global framework and what it is more important, to get complex didactic resources as simulators to dynamically generate related questions and their corresponding responses.

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Visualization of fundamental definitions in calculus[1)]

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Abstract: Some concepts in elementary calculus make students distressed because of abstraction of definitions. For examples, limit of sequences, continuity of functions and partial derivatives are difficult concepts for learners that consider mathematical process as only arithmetic one. Understanding mathematical definitions is the first step to learn mathematics. Most mathematical terminologies are not easy, but learners must understand them to study more advanced mathematics and to apply to many areas related to mathematics. For those reasons, many instructors of mathematics anguish to find the method that they make learners understand mathematical concepts easily and fast as soon as possible. Hence it is efficient to use visual tools in order to make common learners be familiar with mathematical definitions. By tools, some multimedia materials of instruction are prepared and we present some important topics that can be explained easily by using them.

Introduction

Calculus is one of mathematical subjects that are learned in the undergraduate course first of all. Though some concepts contained in this subject have been mastered in high school, many students feel difficult in learning calculus because of the difference of approaching method for every concepts and the strictness of logical process. For examples, limit of sequences, limit of functions and continuity of functions were learned in the previous step but most of learners fall in distress meeting with epsilon-delta argument that is expanded topologically. Hence we need to consider new method of instructing calculus and to prepare learning materials for learners' understanding.

This paper reports an instance of development of some multimedia materials and application of them in calculus instruction. Our materials are related to the following sections: limit of sequences, limit and continuity of functions, partial derivatives and differentials. They are made by use of *Java applet* and *3D Webmaster*.

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Contents and stressing parts

Limit of sequence

Concept of limit is introduced intuitively in high school mathematics. Though such an introducing method is understood easily it is not appropriate for students that want to study more advanced mathematics. Hence, for stable base, we must approach the definition of limit faithfully. The sequence $\{a_n\}$ converges to a if and only if for any positive number ε there exits a natural number N such that $|a_n - a| < \varepsilon$ for all $n > N$. We adopt a statement equivalent with the definition mentioned above: *every neighborhood of a contains a_n excluding at most finite terms.* Visualization of this concept is realized by Java and the following topics must be stressed and observed during our instruction.

- existence of successor of each term
- existence of maximum value in finite set of real numbers

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1)

•meaning of "at most finite"
•uniqueness of limit of convergent sequences
•• oundedness of convergent sequences

Limit and continuity of function

Let $f(x)$ be defined for all values of x near x_0 with the possible exception of $x = x_0$ itself. We say that the number l is the limit of $f(x)$ as x approaches x_0 if for any positive number ε we can find some positive number δ such that $|f(x)-l| < \varepsilon$ whenever $0 < |x - x_0| < \delta$. In word this means essentially that we can make the absolute value of the difference between $f(x)$ and l as small as we wish by choosing x sufficiently close to x_0, i.e. by choosing the difference in absolute value between x and x_0 sufficiently small. Continuity of f at $x = x_0$ satisfies well-definition of $f(x_0)$, $l = f(x)$ and convergence of f at $x = x_0$. Our instruction materials are also made by Java program, and we must use them so as to make learners understand very important concepts:
•difference between definition of function and existence of limit
•existence of right limit and left limit and coincidence of them
•uniqueness of limit

Function of two variables

Instructing functions of several variables need different method from one variable function because of difficulty of drawing their graphs. Computer enables us to visualize the graph of function of two variables, and accumulating experience make us extend understand functions of more variables. Hence we must actively use computer graphics in instruction of function of several variables. Our materials are made by using *3D Webmaster* that is one of authoring tools of 3D graphics. We focus on the followings.
•limit of sequence composed of points in plane
•limit and continuity of function of two variables
•definition of partial derivatives
•existence of functions that are partially differentiable but not continuous
•definition of differentials

Expecting effect

Mathematics is essentially a process of thinking that involves building and applying abstract, logically connected networks of ideas. These ideas often arise from the need to solve problems in science, technology, and every life. Specially, calculus has the widest applicable area, and learning this subject is necessary for students interesting in science and technology. Hence, our multimedia materials will help learners of calculus to understand some fundamental concepts more rapidly and more deeply. Also, this subject will be considered as an interesting one and they will be able to use calculus as more skillful tool for their works.

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Computer Based Lab Methods in the Instruction of Probability and Statistics

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We describe the use of studio labs in the teaching of courses in probability and statistics. These labs augment material presented in lectures, providing students with an experiential context in which difficult ideas can become more tangible. Students generate small data sets from simple experiments involving beads, cards, ping-pong balls, poker chips, etc. The real-life context is given in which these experiments are applicable, thus providing the student with an understanding of the experiment as a simulation. Since the total number of replications of such experiments is too small for illustrating the connection between the model probabilities and the experimentally observed relative frequencies, the student is instructed to use the computer to conduct larger simulations. Thus the connection is made between the just completed small scale experiment and the computer simulation which represents it. We report the reactions of students who have taken these labs over the last few years.

Technology as Facilitator of Quality Education: A Model

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Note: The authors would like to thank the following graduate students for their work on the project: Alex Spatariu; Corina Cimpoeru; Simona Boroianu; Madalina Tincu; Marius Boboc; Michelle Matz; and Nadia Solukhina.

Abstract: Few people would argue with the idea that information technologies have a major impact on how we view schooling, teaching, and learning at this point in time. If technology is indeed a facilitator of quality education, how will it be used? How can developments in information technology facilitate an education appropriate for the 21st century while enhancing student achievement in core areas deemed important to our democratic society? This chapter describes the Technology as Facilitator of Quality Education (TFQE) model currently being developed at the University of Northern Iowa. Technology as Facilitator of Quality Education: A Model. This model includes seven major dimensions: students at the center of their own learning; principles of good learning; aspects of information processing; standards from content disciplines; tenets of effective citizenship in a democratic society; teacher knowledge and behavior; and technology.

Few people would argue with the idea that information technologies have a major impact on how we view schooling, teaching, and learning. They may, however, argue about the *kind* of impact that we currently feel from the use of technology in our classrooms. Opinions range from those who see technology as the driving force for all that will be good about education in the future, to those who see information technology as a force that will destroy education as we now know it, driving us toward all of the negative aspects of consumerism.

Like most complicated technological developments and their associated social changes, the potential impact of information technology on education is somewhere between these two extreme positions. Decision-making is, of course, still the key to the impact that technology will have on education. One would hope that informed human beings would find a way to capitalize on the best of what information technology has to offer, while preserving the core components of our educational system. This blending of the new with the old is most likely to serve us well in the future and provide us with a foundation for effective citizenship in a democratic society.

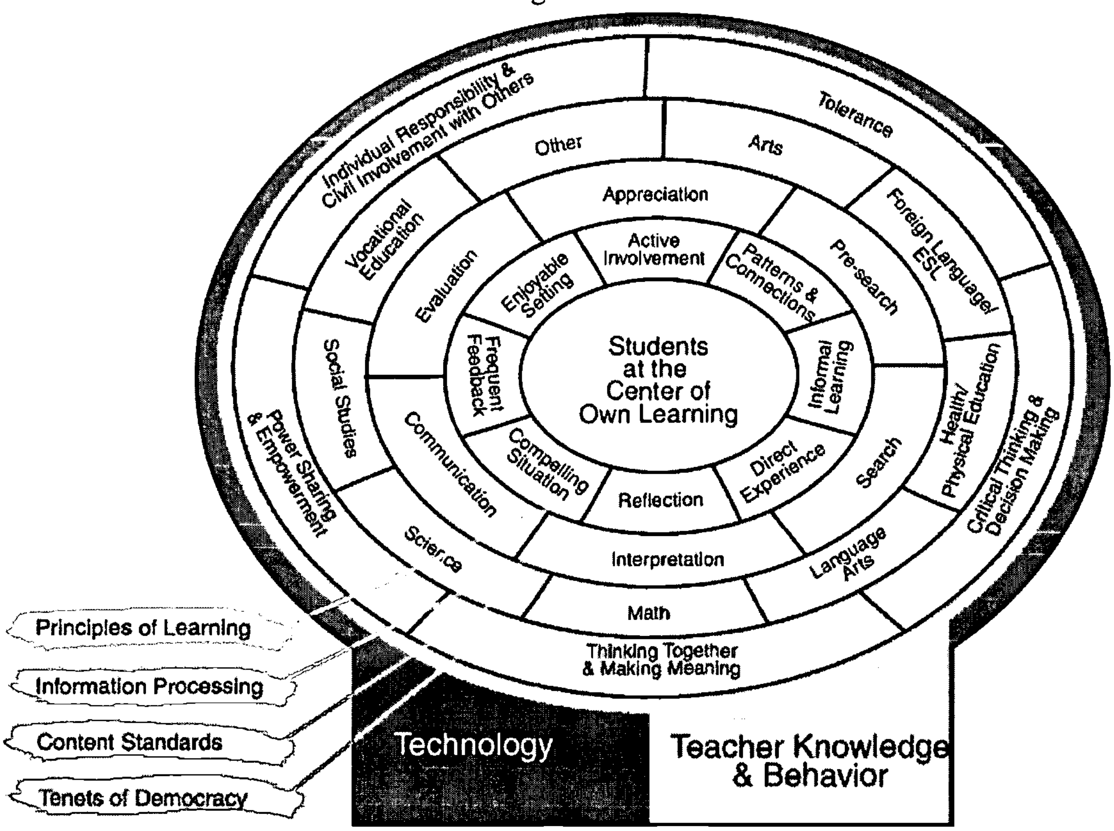
People who fear the consequences of developments in information technology frequently do so not out of ignorance, but from the realization that these technologies present the possibility of a fundamental shift in how we think about the nature of schooling, teaching, and learning. They question the consequences of such a shift. Unfortunately, those who advocate this shift have not developed a persuasive rationale for their position. In their rush to support technology, they have failed to show how the shift can actually promote the core values of education in a democratic society.

If technology is indeed a facilitator of quality education, how will it be used? How can developments in information technology facilitate an education appropriate for the 21st century, while enhancing student achievement in core areas deemed important to our democratic society? Technology as Facilitator of Quality Education (TFQE) is a model currently being developed at the University of Northern Iowa. It includes seven major dimensions:

1. Students at the center of their own learning
2. Principles of good learning
3. Aspects of information processing
4. Standards from content disciplines
5. Tenets of effective citizenship in a democratic society
6. Teacher knowledge and behavior
7. Technology

The seven dimensions of the model provide a way for educators to view the integration of technology-related tools into a robust educational environment and thus answer the hard questions regarding support for the shift in our educational activities toward technology. The model sets up a framework for this robust educational environment and identifies key points at which technology should be implemented and evaluated to determine its impact. It simultaneously allows for the integration of new research findings, while maintaining the structure to evaluate the impact of technology tools on these new findings as part of an ongoing evaluation process. In so doing, the model allows a variety of stakeholders to see the complex process that is education and how technology is affecting that process.

Figure 1



The TFQE model allows us to view the integration of technology as an essential set of tools being used appropriately in a robust educational environment, a democratic setting in which students are at the center of their own learning. Addressing deficiencies in the use of technology in K-12 education using the TFQE model, a consortium of schools have developed the InTime project (Integrating New Technologies Into the Methods of Education, http://www.intime.uni.edu/), funded by a Catalyst grant from the U.S. Department of Education.

Drawing on the TFQE model, this project is intended to produce change in teacher education programs in three ways. First, new learning resources on the Web will be generated to support new teaching and learning processes in education methods courses. These resources will include development of video scenarios of preK-12 teachers effectively integrating technology, along with components of quality education, in a variety of grade levels and content areas. The videos will be stored on a video server already in place at the University of Northern Iowa and made accessible on-line nation wide.

Second, methods faculty will revise their courses to model technology integration using the video scenarios and on-line discussion forum, require students to apply technology, and implement the Preservice Teacher Technology Competencies as exit criteria for their courses. Finally, methods faculty will share strategies for integrating technology and course revisions with other faculty involved in the grant through a variety of activities. Each participating university will ensure that faculty members have access to adequate resources that support the integration of technology into methods courses, providing one-on-one technical support to those faculty members who are revising their courses to integrate technology. Methods faculty members will also participate in faculty development programs to revise their methods courses to incorporate new learning resources and new standards. A professional evaluation team will assess the overall effects of the project on teaching and learning, as new learning resources are developed and implemented, along with new standards, into methods courses.

The Technology as Facilitator of Quality Education model within the context of the InTime project is intended to provide teachers and instructors of teaching methods classes with a rich resource for integrating technology throughout the school curriculum. It is only through full integration and use throughout the curriculum that the full potential of technology will be realized.

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Thomas Switzer is a Professor of Curriculum and Instruction and Dean of the College of Education at the University of Northern Iowa. As Dean of the College of Education at UNI, Switzer has served on the Board of Directors for the American Association of Colleges for Teacher Education [AACTE], as President of the Teacher Education Council of State Colleges and Universities [TECSCU], as Chair of the Technology Committee for AACTE, and on numerous state boards and commissions.

Evolution of an Intelligent Web Tutor

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As distance learning courses proliferate on the internet, there is a problem in providing human tutors to manage students' learning and carry out the marking of their work, and also a problem of providing structured tuition for students. WITS, a Whole-course Intelligent Teaching System, addresses these problems.

WITS is essentially an Expert System shell which simulates the expertise of the teacher. The original system was written in Prolog and used an original form of assessment based on probabilities. It taught Solid State Electronics from a commercially produced videodisc, but a new prototype version uses digital materials on CD-ROM and has been built to run in a web browser. It will be used as the basis of an intelligent, multimedia internet system.

Research funding is currently being sought to validate the probability assessment technique and to develop WITS further, and evaluate its effectiveness as a distance learning tool.

Who Uses the Internet for Educational Purposes? A National Demographic Study in the United States

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Abstract
The purpose of this study was to determine the demographic and socioeconomic characteristics of adults, ages 19-60, that use the Internet to take educational courses or to do research at home for traditional classroom courses. Results suggest that the Internet is not expanding the education market but simply segmenting the traditional market.

Background

Among the various types of educational media, the Internet is perhaps the most often touted. The ability to take educational courses "on line" or use the web to conduct research for formal education is alleged to be altering the way degree programs are delivered and instruction is conducted. Importantly, many institutions of higher education are now investing significant resources in the development of "world campuses" in hopes of tapping new markets of non-traditional students thus expanding enrollments.

While the Internet has made it technically possible to take courses and do research at home, it does not automatically follow that it will attract a new group of non-traditional students. The Price Waterhouse Coopers' 1999 Consumer Technology survey found, for example, that 48 percent of US users polled said they went online for email but only 28 percent said they went online to do research of any kind. Importantly in 1998, those figures were the exact opposite suggesting that perhaps that the demand for Internet based formal education may be overstated or not growing as anticipated.

The purpose of this study was first to investigate the degree of Internet use to take educational courses or to do research at home for traditional classroom courses and second to determine the demographic and socioeconomic characteristics of these users.

Methodology

The data for this study was extracted from The Current Population Survey (CPS), a US government funded monthly survey of about 50,000 households conducted by the Bureau of the Census for the Bureau of Labor Statistics. The sample is scientifically selected to represent the civilian non-institutional population. Data collection involves face to face interviews. The data for this study came from the December 1998 Current Population Survey (CPS) in which interviewers asked supplementary questions regarding

Computer and Internet use. A dichotomous logistic regression model was used to determine characteristics that differentiate those who use the Internet for educational purposes from Internet users in general.

Findings and Conclusions

There were 18,003 adults (age 16-60) Internet users in the final data set of which 3,620 or 20% reported that they used the Internet for educational purposes. This data suggests that among all those who reported using the Internet at home, about one in five use it for academic course taking.

Being unmarried, younger, having some higher education, income lower relative to other Internet users, employed in managerial professional occupations, and working part-time, were all associated with using the Internet for education purposes. Race, gender, citizenship, and geographic region of the respondents had no practical significant relationship to using the Internet for education purposes at home. The characteristics of these users mirror traditional college students. Specifically they tend to be young, single adults, who - if employed - are in professional occupations, and who are either college graduates or trying to finish a college degree.

These findings suggest that the use of Internet based education is significant among traditional college students but not widespread among other segments of the population. While the data used in this study is now two years old, findings suggest it is valid to suspect that the Internet might be only segmenting the traditional higher education market and not making inroads in expanding the market to non-traditional students as hoped or prophesized.

Methodologies of distance invigilation to support distance education*

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Abstract: In this paper, we present four methodologies for distance invigilation; i.e. tutor-based, surveillance-based, software-based, and network-based invigilation. These methodologies form a new invigilation framework to support distance examination. Based on the four methodologies, we have developed a distance invigilation system in which three apparatus-based methodologies are implemented by separate subsystems. Our system has been successfully applied to a nationwide professional examination on a wide area network. As a result, the system performs quite well.

I. Introduction

Invigilation is a necessary way to prevent dishonesty for a fair examination. Along with the development of modern education, especially for distance education, distance examination becomes a sort of new method to evaluate students' performance through network, which demands new invigilation methodologies for such an examination. Unlike the traditional examination forms (i.e. examination on paper), distance examination, especially on a wide area network (WAN), could face several problems that do not exist in traditional invigilation, which leads to some new research topics in distance education.

In this paper, we present four methodologies for distance invigilation; i.e. tutor-based, surveillance-based, software-based, and network-based invigilation. Based on the four methodologies, we develop a distance invigilation system that has been applied to a nationwide examination. In the sequel, we describe our distance invigilation framework and present our implementation in details.

II. Methodologies

II.1. Tutor-based invigilation

Tutor-based invigilation is a typical way used for preventing dishonesty in traditional examinations. In this way, one or more tutors are needed to monitor students' behaviors on site during examination in order to spot any behaviors violating examination rules. This method provides an immediate and direct way to recognize those apparent cheating behaviors, e.g. the use of teacher's book and sneaking other people' answers. Although the environment of distance examination is different from the traditional one, this method is still effective to be taken in distance examination if possible. Here, we suggest that it should also be one of the basic methodologies in distance invigilation.

II.2. Surveillance-based invigilation

Surveillance-based invigilation is a complement to the tutor-based invigilation since one or more cameras can objectively record the real situation that happens in an examination site. Furthermore, a video taken on site can be used as substantial evidence to charge those students violating the examination rules, which also leads to an off-line way for invigilation. Thus, it provides a method to remedy the shortage of the tutor-based invigilation. On the other hand, the video taken by a surveillance system can be transmitted to a remote place through network, which provides an off-site way for invigilation. This salient feature makes the surveillance-based invigilation be one of choices in distance invigilation.

II.3. Software-based invigilation

For modern education, especially distance education, computer plays a critical role in the process of education. In particular, computer has been used as a tool for diversified forms of examinations. Therefore, there appear new dishonest behaviors by means of computers themselves. In order to prevent such a sort of dishonest behaviors, an electronic invigilation method is demanded. Basically, an invigilation software package is designed to record the subject operations on computers and alarm for those illegal operations. In contrast to the above two methodologies, the software-based invigilation provides a more effective way to prevent possible cheating behaviors by means of computer.

II.4. Network-based invigilation

As a basis of distance education, network provides infrastructure for diversified distance education activities. However, it is of potential weakness that can be utilized by hacker-like people for their own purpose. Such a problem is unavoidable yet in distance invigilation. Thus, the network-related equipment should be managed in order to avoid illegally accessing the resources on local or remote computers, including those servers located in the examination center, through network. The technical support for this methodology lies in the use of network administration functions and its related security technology, which needs to develop a special management package based on system functions. In contrast to the software-based invigilation, the network-based invigilation provides a more global way to preventing the dishonest behaviors through the use of network.

III. System overview

We have developed an invigilation system for distance examination based on a Microsoft Windows NT platform under a WAN environment. The aforementioned four methodologies are applied to our distance invigilation. Except the tutor-based invigilation, other apparatus-based methodologies are carried out by three separate subsystems.

In our surveillance-based invigilation subsystem, some multimedia data sampling instruments are installed in the testing rooms located in different areas. The instruments include video camera, microphone, platform, and multimedia data compression apparatuses, e.g. encoder and decoder. Considering students' distribution in a testing room, we adopt two different ways to spot the situation of testing rooms, i.e. capturing pictures from designate areas and taking pictures for a whole testing room, which may enable us to monitor situation of both an individual and the whole testing room. In our subsystem, all the multimedia data collected are first compressed and then transmitted to an examination monitor center through the WAN with an IP-based transmission technology. For efficient transmission, our subsystem can adjust transmission rate to maintain smoothness and fidelity of visual signals to adapt to different channel bandwidths and qualities. At an examination monitor center, all the multimedia data acquired are used for invigilation.

In our software-based invigilation subsystem, a monitor procedure is running to monitor every student's operations on his/her computer during examination. As a result, those data are buffered and transmitted to a server through a WAN. In the client side, our software-based invigilation subsystem is able to capture the following students' operations during examination: a) resident application programs opened by an individual, b) files opened, c) an operating interface, d) data in clipboard, e) keyboard operations, f) mouse operations. In the server side, our software-based invigilation subsystem can provide data for system administrators to identify whether an operation is illegal or not. For implementing our subsystem, we adopt the client/server technology where the UDP (user datagram protocol) network communication protocol is used. The client package spots the related operation of candidate computers and delivers the information to a server, while the server package receives the data coming from suspect's computers on the corresponding UDP ports and displays those operations on screen after processing.

In our network-based subsystem, we take advantage of the technology of virtual private network for network security. Binding IP address and the MAC address of candidate computer together in CISCO routers prevents from the access to the WAN by anyone without authority. In addition, a network management system is employed to monitor the whole network in order to detect and prevent from any illegal apparatus linked to the network. During examination, every student's name, password, and IP address are recorded and checked by a server located in the examination center such that only a legal student can commit to examination.

IV. Conclusion

We have presented four methodologies of invigilation to support distance examination, and three apparatus-based methodologies are implemented by separate subsystems. Our system has been successfully applied to a nationwide WAN-based professional examination covering over ten provinces and cities (around 1/4 areas) in China. As a result, it has effectively prevented miscellaneous dishonest behaviors during this examination.

An Educational Evaluation of WebCT; a Case Study using the Conversational Framework

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Abstract: This paper details a study into the development of a WebCT based learning resource, which was used to augment the delivery of a second year degree level module. The development of the learning resource was informed by the educational theories expounded in the conversational framework, Laurillard (1993). Subsequently the resource was evaluated using criteria extracted from the conversational framework as a set of guidelines. It was found that all of the criteria could be supported to some extent, although in some areas the support was marginal. The learning resource was then evaluated by students who were asked to give details about which of the individual facilities were used, and beyond this which were useful. The results of this student centered evaluation showed that the students did not consider several key facilities 'useful'. It is suggested that further work be done on developing a method for determining criteria, implementing a resource and evaluating the facilities for successfulness, as determined by students.

Introduction

The process of defining educational criteria with which to inform the development of a computer based learning resource is well known. There are a wide range of criteria, informed for the most part by the theoretical assertions of a variety of pedagogic traditions and paradigms. Most of us involved in developing computer based learning resources will be familiar to some extent with one or more of these traditions. The process of choosing criteria, developing the resource and analysing the extent to which the attributes in the learning resource support the criteria is also well known. In addition to this, many of us are familiar with evaluative measures that seek to shed light on the successfulness of the resultant learning resource in general terms. Often these take the form of questionnaires seeking to elicit student attitudes to the learning resource as a whole. Thus we have on the one hand pedagogic objectives, and on the other hand student evaluation as to the success overall of the learning resource. However these two elements are not necessarily directly connected. It is possible to have met a set of criteria in creating a successfully learning resource, without those criteria having had significant bearing upon the outcome.

This paper is based upon a case study learning resource, constructed using WebCT.
The design of the learning resources was informed making use of criteria taken from the conversational Framework devised by Laurillard (1993). The case study is described in the next section, followed by an explanation of the criteria taken from the conversational framework.

The case study

The case study module under consideration is IC240 module, 'IT in business', a second year module provided by the division of Information and Communication Technologies, which is part of the University of Abertay Dundee. The students of IC240 are studying for degrees in accountancy, tourism, business, management and a range of other courses. This diverse mixture of student backgrounds means that there is a wide range in levels of previous experience in IT. In practical terms this diversity of student experience suggests that a flexible learning resource would be beneficial to students. For this reason a learning resource making use of the Virtual Learning Environment (VLE) WebCT was developed.

WebCT is an integrated web based learning environment. It was devised at the university of British Columbia, www.webct.com. The software is based upon web technology, offering a number of facilities running as Java scripts or applets. In this study the vast majority of WebCT facilities available were deployed, Table 1 outlines the facilities and how they were used.

Table 1 WebCT facilities/use

Navigation model	**Discussion Forum**	**Compile**
Home page with	Course questions	Sections of module material
icons/hyperlinks to resources.	**My progress**	**Calendar**
Content	Charting access	Module information and
Module Material	**Chat**	deadlines
Quiz	Questions to tutor and other	**References**
Formative and summative	students participation	Links to external resources
assessments	**Whiteboard**	**Student Web Pages &**
Survey	Student interaction **Student**	**presentations**
Evaluative feedback	**tracking**	Student created content
Goals	Register	**Glossary**
Learning objectives		Defined terms

The case study learning resource was the subject of a two-fold evaluation. Firstly the learning resource was evaluated heuristically against the criteria extracted from the conversational framework. Subsequently the individual facilities comprising the learning resource were tested by means of a survey of student opinion.

The Conversational Framework

The heuristic evaluation made use of the Conversational Framework developed by Laurillard (1993) as an evaluation tool for WebCT. This framework was chosen as the work encapsulated in the framework has pioneered the evaluation of hypermedia based learning resources. Authors such as Brittain (1999) have argued that whether the VLE is being used for distance learning or to enhance learning within institutions, their most important role is as a medium for supporting constructivist and conversational approaches to learning (Brittain 1999). Therefore Laurillard's conversational model offers itself as an interesting candidate for providing the basis of a heuristic pedagogical evaluation framework for WebCT.

The roots of the framework lie in the Conversation Theory developed by Gordon Pask (1976), although Laurillard traces the need for dialogue in the learning process back to the Socratic method of philosophical enquiry. The centrality of dialogue in the model comes from the need for the teacher to unearth the student's mental constructs about a topic before negotiating the path to the target conception that is the goal of learning from the teacher's perspective.

The teaching strategy advocated in the model is based on interaction between lecturer and student and not solely on the actions required of the student. The model advocates that action on the part of the student is constructed around the dialogue and should be supplemented by constructive and meaningful feedback from the teacher. There are a number of key characteristics of the conversational model as applied to academic learning. These are drawn from Laurillard, (1993, pp.94-95).

1. T(eacher) can describe conception
2. S(tudent) can describe conception
3. T can redescribe in the light of S's conception or action
4. S can redescribe in light of T's redescription or action
5. T can adapt task goal in light of S's description or action.
6. T can set task goal
7. S can act to achieve task goal
8. T can set up world to give intrinsic feedback on actions
9. S can modify in light of feedback on action
10. S can adapt actions in light of T's description
11. S can reflect on interaction to modify redescription
12. T can reflect on S's action to modify redescription

It is important to note that these criteria are not necessarily sequential, but it is suggested that they should be supported by WebCT if it is to be judged compliant with this educational model. In the next section we will explore the extent to which the case study module is successful in delivering the criteria, but before this we will examine an important new revision of the conversational framework.

Conversational Framework revision 1999

The first version of the conversational framework (Laurillard, 1993) described the learning process and was used as an analytic tool for information technology media and methods. However, the original framework did not indicate a process whereby the student internalised their learning, rather it focuses entirely upon a dialogue between student and teacher. This omission has been dealt with in an article 'A conversational framework for individual learning applied to the 'learning organisation' and the learning society.' (Laurillard, 1999). Clearly this revision addresses a crucial part of learning, and as such it is suggested that the evaluative criteria be expanded to encompass this element. Therefore for the purposes of this evaluation the full set of criteria will be numbers 1-12 as indicated above and in addition;

13. S can internalise articulation/action.

The Heuristic Evaluation

A suitable evaluation framework for WebCT using the conversational model could be constructed in a variety of ways. The way suggested in this study involved constructing a table that describes the tools that are available for each of the stages of interaction described in the model (see Table 2). Table 2 shows the evaluation framework for WebCT using the interactions in the conversational model as criteria against which to identify the tools provided by WebCT. For each element a WebCT tool is identified along with a description of how it was used in the case study module.

This relatively simple approach offers much potential as a methodology for evaluating virtual learning environments (VLE) such as WebCT. A similar proposal has been recently put forward by Crawley, (1999). However, the major emphasis in this study is the way the evaluation by students, given in the next section, is used to validate the findings put forward by the theoretical evaluation.

In order to evaluate WebCT using the conversational framework we need to establish which tools are provided within the software to allow dialogue and action to mutually influence each other to allow modification of both conceptions and actions on the part of the student as described above. Another issue that quickly becomes apparent is that the notion of a 'micro-world', takes on a different meaning in the case of WebCT than more traditional forms of courseware, Britain (1999). In essence, WebCT provides the tools for a lecturer to build a micro-world by allowing the teacher to construct learning activities enriched by the resources.

Table 2 Conversational framework evaluation of WebCT

CHARACTERISTIC	SUPPORTED	IC240 example
1. T can describe conception	Goals, Module content. Ref., Calendar	Database exercise, Theoretical content.
2. S can describe conception	Discussion forum, Chat, Whiteboard, Web pages	Questions, Remote lab
3. T can redescribe in the light of S's conception or action	Discussion forum, Chat, Whiteboard.	Answers, Remote lab
4. S can redescribe in light of T's redescription or action	Discussion forum, Chat, Whiteboard Web pages	Questions, Remote lab
5. T can adapt task goal in light of S's description or action.	Goals, Module content, References.	Discussion
6. T can set task goal	Goals, Module content.	Learning objectives Database exercises, quiz information.
7. S can act to achieve task goal	Quiz, Compile	Build notes

		Review test, Examination.
8. T can set up world to give intrinsic feedback on actions	Quiz, Progress	Review test.
9. S can modify in light of feedback on action	Quiz	Review test.
10. S can adapt actions in light of T's description	Quiz	Review test.
11. S can reflect on interaction to modify redescription	Discussion forum, Chat, Whiteboard.	Discussions
12. T can reflect on S's action to modify redescription.	Discussion forum,Chat, Whiteboard.	Discussions
13. S can internalise articulation/action.	Note editor.	Independent study.

The points described in the table show that WebCT as used for the module in this study has, at least to some extent, the facilities to support all of the features laid out by the conversational model. However it is important to consider how successful the learning resource is at delivering the requirements specified in the conversational framework. It is the results of this evaluation, given in the next section, that will be used to make a judgement as to whether this particular resource is *successfully* compliant with the criteria in this educational evaluation.

Student centered evaluation

In this study the evaluative measures included an 'exit survey'. The rationale for the exit survey was to find out directly what the experience of using WebCT was like for the students. The students were asked about their experience in general, where it was discovered that 13 of the 15 students taking part in the evaluation, found the resource as a whole useful, 2 were neutral, none negative. It is important to note that only fifteen students were involved in the survey, representing around a quarter of the total number of student studying the module. These numbers mean that the findings can only be regarded as indicative, carried out within the context of a pilot study. The next two questions in the survey sought to shed light into which facilities the students used, and beyond this which they found useful. This distinction between used and useful is crucial for this study. It is suggested that it is not sufficient to say that a theory indicates the use of a facility, and consequently its inclusion validates the learning resourcé. If students do not find the facilities useful it throws into doubt the voracity of using the facility to achieve a particular educational objective. The questions and findings where as follows:

- From the list of WebCT facilities which have you USED?
- From the list of WebCT facilities which did you find USEFUL?

Table 3 The results of the student evaluation 'exit survey'

Response	Number of response (used)	Number of responses (useful)	Percentage of total Useful
1. Module content	15	15	100%
2. Discussion Forum	9	7	46%
3. Chat	9	5	33%
4. Calendar	15	12	80%
5. Quiz Review tests	15	15	100%
6. Whiteboard	7	1	7%
7.Check up progress	4	0	0%
8. Compile notes	9	6	40%
9.Targets/goals	4	3	26%
10. References	8	8	53%
11. Web page authoring	9	6	40%
12. Note editor	4	1	7%

These results indicate that some facilities were used but not found to be useful, in particular the note editor, discussion forum, chat, whiteboard, check progress and targets were not useful to all of the students who used them. In addition, some of the students elected to not use some of the facilities. As some of these facilities were key to supporting the conversational framework, this finding poses searching questions about the context for their use. Further analyses of the findings regarding the usefulness of the facilities are shown in table 4 on the next page. Table 4 shows the numbered items from the educational criteria along the top (listed in table 5), whilst the WebCT facilities are listed down the left hand side. This form of analysis i.e. the conversational framework analysed against the facilities in a VLE was used by Conole (1998). It is suggested however, that this analysis goes a step further, in so far as it makes use of student evaluation to inform the rate of successfulness. The table highlights the points discussed earlier, for example some of the requirements are not being *successfully* met.

Table 4, on the next page, shows that as the module content display was useful to 100% of students, therefore criteria 1, 5 and 6 of the conversational framework were successfully implemented. On the other hand, the note editor facility was useful to only 7% of students, therefore criteria 13 can not be said to be successfully implemented. Reading the table starting from the criteria, we can see criteria 6 Teacher set task goal, is successfully implemented by the module content facility if not entirely by the goal setting facility. Perhaps most significantly for the conversational framework the facilities being used to support interaction between Student and Teacher, for example criteria 2,3 and 4, are not being entirely successfully implemented by facilities such as the discussion forum.

Table 5 Conversational framework Criteria

1. T(eacher) can describe conception
2. S(tudent) can describe conception
3. T can re-describe in the light of S's conception or action
4. S can re-describe in light of T's re-description or action
5. T can adapt task goal in light of S's description or action.
6. T can set task goal
7. S can act to achieve task goal
8. T can set up world to give intrinsic feedback on actions
9. S can modify in light of feedback on action
10. S can adapt actions in light of T's description
11. S can reflect on interaction to modify re-description
12. T can reflect on S's action to modify re-description
13. S can internalize articulation/action

Conclusion

In conclusion it is suggested that whilst the WebCT software supports the design and development of a learning resource that can be compliant with an educational evaluation based upon the conversational framework. It can not, however, be taken for granted that any individual learning resource is entirely successful in delivering the aims of the conversational framework. The results of this study indicates that success maybe illusive, even in terms of the fundamental requirements. In respect of the IC240 module, it is suggested that the learning resource be redeveloped, in order to leverage more successfully key facilities in the learning resources. In more general terms, it is suggested that the process of developing pedagogically informed learning resources, going from criteria, to facilities and then to evaluation, should be refined into a methodology that focuses upon the student as the main arbiter of successfulness.

Table 4 Successfulness! Conversational framework criteria vs student evaluation.

WebCT Facility	1	2	3	4	5	6	7	8	9	10	11	12	13
Module content	100%				100%	100%							
Calendar	80%												
References i.e. URLs	53%				53%								
Goals/targets	20%				20%	20%							
Discussion group		46%	46%	46%							46%	46%	
Chat		33%	33%	33%							33%	33%	
Whiteboard		7%	7%	7%							7%	7%	
Compile notes							40%						
Quiz Review test								100%	100%	100%			
Progress chart								0%					
Web page authoring		40%		40%									
Note editor													7%

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COORDINATION ROLE IN EVOLUTION SYSTEMS

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For the evolution the knowledge also changes: One of the changes is the denial of one of the agents for doing a task belonging to a role, the coordinator is in charge of choosing a new one among the other free agents and teaching him if no other agent is found, that has done a similar or related task before. In the case of a new task that is to be carried out, the coordinator shows the coordinated agent how to execute the tasks belonging to his role, going first through a teaching and understanding of the new functions stage. For example, when the process coordinator receives new information that affects him, he must analyze it and check what tasks and functions must evolve, teaching his own to execute the new tasks to his coordinates so they can also teach their auxiliaries (if they have any) or to train in such functions. After the teaching process, the coordinated agents change their role, because they are now able to do a set of tasks that the coordinator may assign him later.

Behind the MASK Project

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The Media Appraisal/Selection Kit (MASK) Project is about identifying and organising the various 'tools' we use in the process of developing educational media. We may not think of them as tools but over the years we have used our experience and training in educational design, programming, graphic design, video and print production to guide clients through the development process using these various mechanisms.

A 'toolkit' would aid this process of educational materials development by:
* identifying possible media types and answering some typical questions about them;
* highlighting features of the alignment of technology and educational purpose through annotated case studies; and
* providing checklists to aid project specification.

The MASK project is not about determining whether or not to use interactive multimedia instruction but is about informing the client of possibilities. It is recognised that this can be heavily influenced by the learning problem being presented but MASK does not take this responsibility.

A Survey of Academic Use of Information Technology

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Abstract: Wollongong is recognized as a top performing regional university in Australia. Its leading edge approach in introducing its students into the '*e*-world', acknowledged in the accolade of joint 2000-2001 Australian University of the Year award, underlines the significance of information technology in our educational environment and the activities we perform within it.

A cross-disciplinary working party was given the task of developing a framework to inform future planning and policy on information technology at the University of Wollongong. Information gathered by the working party was used to develop a survey. This paper presents some results of this survey of Wollongong academics.

To maintain an edge in information technology (IT) in our current educational environment, requires effective: IT infrastructure; Management of IT; Implementation plan for IT; and Methods for monitoring progress and adaptability. From an academic perspective, we need all this in place to optimise our use of IT in support of our primary functions in research, teaching and professional activities. We need significant input to these – and to facilitate these processes, we need effective administrative systems.

A cross-disciplinary, academic working party was given the task of developing a framework to inform future planning and policy on information technology for academics at the University of Wollongong. Information gathered by the working party, in particular, from focused user groups, interviews with key stakeholders and appraisal of available information technology policies, was used to develop a survey. A sample survey was trialed with a number of faculties and the feedback received used to modify survey questions.

The final survey incorporated and examined. Academic and personal profile; IT proficiency; Use of IT in the work of academics; Structural information, such as types and age of computers; Rating of IT support; Areas of IT need; Communication on matters of IT and a call for independent opinion – both positive and negative on IT at the University of Wollongong.

Over one third of the academics in the University completed the Survey - even though by necessity conducted at that time of year when marking, administration, looming summer conference papers, planning days, and student appeals converge. Overall this was a phenomenal response. It was as if the academic community was grateful for an opportunity to have their needs heard - and this represented a vehicle to get that message through . A testament to the importance and the preparedness of academics at the University to be involved, was that when asked "If they would be willing to serve on a University-wide IT committee?", approximately 50% said 'Yes'.

Preliminary results

At this stage, only a preliminary analysis has been made of the substantial data collected. Some results are presented here.

An analysis of a survey question relating to type and age of computers, showed an even split between Macintosh and IBM-compatible (PC) personal computers. However, on average, desktop PC's on campus were reported as younger at 1.75 years and for Macintoshes older, at 2.4 years. Interestingly the survey pointed to lots of overtime going on – 75% of academics reported that more than half of their home computer use was for work purposes.

In overall computer use, academics rated their IT proficiency at a high level, with 52% feeling very comfortable to virtual experts and 28% comfortable. Macintosh users rated their IT comfort at higher proficiency levels with 52% in the very comfortable to expert regions compared to 46% of PC users. This may explain why Macintosh users may be reticent to change to another platform with the vision of having to rebuild their IT proficiency.

When asked their chances of getting release time to develop subject teaching material involving IT, the answer was less than a 10% chance. The same level of response was given to getting release time to develop any other area that involves IT. Respondents indicated there was a better chance, about 20%, of gaining release time to undertake technical training. This may account for the previously reported high degree of comfort with IT proficiency.

On the last page of the survey was an opportunity to write about any issues that academics felt impeded or facilitated their use of information technology at the University. These responses were categorised and in the 15 positive categories, the top response was for Faculty IT support. This comment was listed by 25% of academic staff and therefore rated as the most commonly unsolicited comment in the area of a feature that facilitated IT. It should also be noted that this response was dichotomous, as the same comment was made by 6% of academics in the negative.

Conclusion

There are many issues which deserve deeper consideration. It was a surprise to the researchers that the overall rating of information technology satisfaction across the university was skewed to the right, with a peak response between 60 - 90% approval. Also we saw that 90% of academics saw themselves as having at least satisfactory competency in IT - but the most significant impediment to IT was a strongly felt lack of time for familiarisation and training in new systems and/or processes. Such seeming paradoxes deserve closer attention.

The purpose of the working party was to provide insights into the most important IT requirements of academics at the University of Wollongong. This information would be used to *inform future information technology planning and policy* at the University of Wollongong so that academic work would be even better facilitated.

The survey has provided a rich source of data, which may provide insights into the most important information technology requirements of academics both at Wollongong and similar institutions. From a more detailed analysis we should be able to more clearly define the aspects of information technology which will facilitate rather than impede our academic effort. Can we identify core values which are central, and articulate them with Faculty and academic imperatives? Can we evaluate how this can be matched to other policy needs - like all good policies we must ensure information technology policy is congruent with other University of Wollongong policies?

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Computer Mediated Communication Applications in Vocational English in Hong Kong

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Abstract: This paper reports on the applications of Computer-mediated Communication (CMC) tool, eGroups.com (currently known as groups.yahoo.com) in English as a second language learning in a vocational education setting in Hong Kong. CMC is playing an important role in creating a learning environment that encourages interaction and communication which are crucial in language learning. The purpose of this investigation is to ascertain the usefulness of CMC in supporting third year computing majors in the VTC in the learning of the English module.

Introduction

CMC refers to "computer applications for direct human-to-human communication. This includes electronic mail, group conferencing systems, and interactive 'chat' systems." Santoro (1995). Hart's (1999) definition is that nteraction between people, using computer or computer networks as the medium of communication. This communication can be synchronous or asynchronous." December (1997) -Mediated Communication is a process of human communication via computers, involving people, situated in particular contexts, engaging in processes to shape media for a variety of purposes." Regardless of the definition, communication is the key issue of CMC.

Lane (1994) collected and summarized the advantages of CMC in education. Some of them are: "enhances flow of information; sharing ideas; provides the capabilities to store, process and transmit messages; breaks down barriers to communication; fosters more participation and contribution; convenient; flexible." Codde (1996) believed that "The biggest advantage of CMC is that it encourages student to be active in the creation of knowledge rather than passive reactors to instruction." Warschauer (1997) suggested that the potential contribution of CMC is that it results in "more equal participation among learners" and "communication is time-and place-independent".

The Study

The CMC tool used in this experiment was an egroup, 2000CM3, at eGroups.com. A group '2000CM3' was founded on 26 September 2000 in eGroups.com. Students started to sign in and subscribe to the group in early October. The actual duration for students using the egroup was about 10 weeks. eGroups.com (http://www.egroups.com/info/features.html) provides a web based communication environment for users. Its major instructional features are: teacher to students asynchronous communication, teacher to students synchronous communication. Other features include: Message Archive, Files, Calendar, Chat and Polls.

The goals of the integration of the egroup into the English language module are to support students' English and Communication learning by providing links to resources, giving supplementary information of assignments, announcing news about the course, sending reminders of deadlines or events. Above all it is a channel of communication between teacher and students and among students themselves. The integration of CMC tool aligns with constructivist perspective of learning, communicative language teaching methodology as well as the circumstances of the students. According to constructivism, learners take an initiative role in knowledge building through negotiation and collaboration in their learning process. (Jonassen, Peck and Wilson, 1999). CMC supports active learning (Shield, Weininger and Davies, 1999). The communicative language teaching approach emphasises active interaction in meaningful use of the target language (Littlewood, 1981). CMC "can provide authentic communication and can foster awareness of both the language learner and the languages they are learning." (Singhal, 1998). Holliday (1999) proposed that "CMC is highly motivating as students have a real purpose for communicating, using authentic language and receive peer group support in their language learning endeavours." The duration of the module is short and class time is quite limited. However, CMC tools overcome such distance barrier. (Codde, 1996; Fishman, 1999) "Computer mediated communication (CMC) provides a third platform where L2 students can transcend the spatial and temporal confines of the classroom via the Internet" (Blake, 1999).

Findings and Evaluation

Data was collected by means of pre and post investigation questionnaires, interviews, qualitative comments posted and teacher's reflection. 101 students became members of the egroup. The number of messages recorded was 275. The questionnaire results showed that the use of the egroup did not have much effect on the enhancement of professional speaking abilities, professional writing abilities nor did it result in an increase in students' confidence when communicating in English. Positive comments were posted. Positive feedback was also obtained from interviews with students. Most of the students agreed that the egroup supported their learning in the following ways: link to resources, get supplementary information of assignments, get announcement about the course and get reminders about deadlines.

There is no doubt that the egroup provides a very convenient tool for communication between teacher and students. Students who actively take part have chance to practice the language and students who lurk can gain insight from reading the messages. However, the workload of the teacher increases tremendously as it is time consuming to respond to students' messages. It is difficult to foster changes in students' attitude towards the facilitating role of their teacher. The duration of implementation should be longer in order to help students to get used to the new form of learning. Language enhancement is a long-term process so it would be more appropriate to integrate egroup in a year long module. In this investigation, egroup is mainly used as a support. Therefore some students are not actively using the egroup. If the aim is to enhance the language abilities of the students, the use of the egroup should be incorporated into the curriculum. Modification of the scheme of work of the course may be necessary as one student suggested having some discussion tasks scheduled in class to be conducted through the egroup.

The investigation provides encouraging results to the supporting role of integrating CMC in the English learning of students in a vocational setting. The egroup is a very useful communication channel for both teacher and students. The effect of whether the use of CMC enhances the language abilities of students has not been confirmed. Further investigation and modification of the instruction design are needed. The integration of CMC will be more fruitful if students take a more active role, put more time and effort in their learning, and if students accept the facilitating role of the teacher.

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Building A Virtual Learning Community of Distributed Knowledge on Web for University Students

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Abstract: This paper mainly tries to explore and grapple with some of the key issues of building Web-based learning community. We have completed the construction of knowledge distributed learning community (KnowDisLC). Development tools paving the way for building KnowDisLC are presented. Challenging issues associated with effective system building are discussed. A model involving systematic process of effectively building Web-based learning community is proposed. Lessons learned are subsequently discussed.

Research background

The new wave of Web-based teaching and learning has given rise to various Web-based teaching and learning systems. In Taiwan, some emphasize hypermedia and distance collaborative learning such as the CORAL (Cooperative Remotely Accessible Learning) (Chiao Tung University, 1996). Some emphasize constructive learning and peer assessments such as the Albatross system (Chiao Tung University, 1999); and still others emphasize active and social learning such as the LISA (Learning is Active) system, which is comprised of both the intelligent educational agent and the virtual learning buddy. The Earth Science Learning Environment was founded on project-based learning (Central University, 1999); the Pathfinder system on the integrated functions (Tainan Teacher College, 1999); the DALE (Distance-assisted Learning Environment) on the will to overcome learning barriers for teachers, parents and students (Hsinchu Teacher College, 1999). A few even focus on creative learning like the Taiwan University's Management Forum, in which students will not need to go to school (Taiwan University, 1999).

Some are designated for student teachers to enrich their knowledge in academics and counseling practice, such as the distance counseling and instructional resource systems developed by the normal universities and teacher colleges. The target user groups of these systems include students of colleges, high schools, middle schools, elementary schools and teachers of middle and elementary schools. There is a large variety, and each one has its own characteristics. They are vivid and interactive. However, it is a fact that there are many other Web-based learning systems that only provide static Web page material and lack any interaction to motivate students. Some of these are also very seldom visited. The widespread application of the WWW and learning technology has raised the awareness of WBL/WBI developers to the potential of virtual learning community on the Web. Though some domestic research in Taiwan on the Web-based learning environment and knowledge guidance systems for in-service teacher has noted the concepts of a learning community, none of them have developed any system based on the complete idea of a learning community. Actually, there are a lot of related documents and research overseas.

Founded on the concept of community of practice, CoVis (Learning through Collaborative Visualization) aims at research related to science learning (climatology and geology) (Pea, 1993). It provides online discussion, e-mail, teleconferencing and other WWW tools to link experts, teachers, students and field workers to form a collaborative learning community. CSILE is a kind of collaborative database style of learning community which aims at providing students with strategic tools that can stimulate thinking. Therefore, it is designed for a wide variety of knowledge (Scardamalia, Bereiter & Lamon, 1994). A student can access the thoughts of the present or former students and can leave his own for other students. As a kind of asynchronous data sharing, CSILE emphasizes that the context of the learning community, and its knowledge building should be more effective than knowledge telling. During the building of knowledge, a student will continue to confirm what he does not know and to expand his own knowledge system through the sharing of thoughts and assistance from the others.

We have built a Web-based knowledge distributed learning community (KnowDisLC) based on the concepts of knowledge distribution and sharing. The system has been experimented on subjects of the university to evaluate its functions and effectiveness. The purpose of this paper is mainly to explore and grapple with some of the key issues of building Web-based learning community (WBLC). Meanwhile we are also intend to explore the design considerations paving the way for building WBLC, as well as challenging issues associated with effective construction and implementation of WBLC. Finally, a feasible model involving systematic process of effectively building WBLC is expected to propose for helping guiding further modeling efforts.

Construction of System functions

The KnowDisLC provides access to utilities that include news bulletin board, discussion board, curriculum center, learning activity bulletin, learning resources sharing and provision, user profile center, expert consultation, website resource search, opinion bulletin board, point accumulation system, web-based learning record, system management. KnowDisLC enables synchronous and asynchronous interactivity. KnowDisLC includes students, instructors, field experts, and practitioners among its memberships. It supports tele-discussing, tele-mentoring, teleconferencing, tele-sharing, tele-instruction, and access to communal resource bases and information bases for learning enhancement and enrichment.

News bulletin board provides dynamic up-to-date information, including a 'system bulletin', 'school bulletin', 'class bulletin', and 'information bulletin'. Bulletins that have been posted for over one week will be automatically moved to the 'old bulletin box'; users can browse old news or information there. Dynamic HTML flexible menu has been adopted in the system to avoid a problem of long screen resulting from too many sub-menus. *Discussion board* provides 'synchronous online conferencing', 'host conferencing', 'asynchronous discussion', 'online calling' and 'host list' functions. Users may partake in distance conferencing, or they may publish and discuss articles through asynchronous discussion board. In addition, the discussion board provides a conference/discussion host, system manager, online assistant and teacher with management functions. For instance, a host may use the conference-record function button for the host conference to take down all the contents of the discussion as a reference for teachers and students. A host can also announce or remove the time and topic of a web conference. The host may also modify or remove from the academic discussion all articles of an improper issue or content which have been put online.

*Curriculum cente*r provides online curricular outlines and multimedia presentation materials for users to online browse or download for offline reading, which can be used for preparation before class and revision after school. *Learning activity bulletin allows* teachers to announce the newest learning activities, such as personal assignment, project-based assignment, collaborative learning, group list, examination information. The bulletin includes 'bulletin announcement' and 'bulletin browse'. The 'bulletin announcement' function is only assigned to the system manager, teacher, and online assistant); while the 'bulletin browse' function is assigned to students. *Learning resources share and provision* is designed in stays true to the spirit of 'knowledge share and provision and distributed knowled provide 'website-resources share', 'website-resources provision', 'files-resources download' and 'files-resources upload' functions. Users may enter information and URL address of related websites or link to related websites and upload or download related materials for knowledge sharing, resource sharing and information exchange.

User profile center provides 'personal data inquiry', 'personal data edit', 'user inquiry' and 'user data list' functions to enable a user to query and modify his own data, view the data of other users, browse the learning status of his own or other users and accumulated point record. The 'user data list' contains information such as user ID, Chinese name, nickname, log-in frequency, last-log-in date, last-log-in time, total accumulated points. This enables users to know the log-in status of other users. *Expert consultation provides* three functional modules including 'expert list', 'expert registration', and 'management' module. The term 'Expert' refers to both 'experts' (students); users may ask them questions through e-mail. A user may become an expert or little teacher by using the expert registration function provided by the system once his log-in accumulated points have reached a certain standard and he is interested in becoming one to help other students. Users who are given system management authority (teachers, system manager, and online assistant) can remove data provided by unqualified experts.

Website resource search including search engines are provided to enable users to run a remote search by inputting key words. In addition, the function enables users to link to websites not directly related to curricula (such as libraries, related organizations and institutions, net bookstores, and other websites), so that a user may use other resources from within the system. *Opinion bulletin board* enables users to state their own opinions and to browse the opinions of others in order to establish a humanistic virtual community. A user may choose from within a set of 16 emotional patterns provided by the system to express his feelings. The system will automatically display a week's worth of contents on the bulletin board when a user logs in.

*Point accumulation system is used t*o encourage user involvement in learning activities. When a user participates in any of the community activities, he will be given a set number of points. Furthermore, the point accumulation system will provide a reference for teachers to evaluate student involvement and to open advanced functions. *Web-based learning record* provides information about a user's learning status on web, including 'learning record statistics', 'browse conferencing record', 'assignment upload statistics', and 'host performance' to enable students to understand their own progress, learning status, and performance by viewing other users' learning activity records and summaries. This will stimulate the visit of log-in and revision of learning. The current problem, however, is that the system is unable to detect what students are doing when they are actually on the site, including what and when they are browsing. This is what we are trying to improve the KnowDisLC at the moment. *System management* provides online system management to teachers, online assistants and system managers, and includes 'news announcements', 'user log analysis', 'user data maintenance', 'upload data reviews', 'mail delivery center', and 'web conferencing record' functions. The system can automatically identify a user's account authority level according to his user ID, and no additional password is needed.

System development

Development tools

The KnowDisLC system is constructed on the MS Windows NT Server 4.0 Chinese version platform, and uses MS IIS (Internet Information Server) 4.0 as the site server. On the server side, site database tables are created with the MS Access 97 database management system, using the ASP (Active Server Page) which is used in application programming. On the client side, applications are programmed using HTML, Dynamic HTML, VB Script, and Java Script. In Web page editing, MS FrontPage 98 is used to create the basic architecture and static data of the site, and the dynamic Web pages and applications are edited and programmed using MS Visual InterDev 6.0, which is a very handy and visualized tool for dynamic Web page and application development, including built-in HTML and script editors, database development tools, ODBC (Open Data Base Connectivity) support, and Website management tools. It also allows developers to integrate other programming components (ActiveX controls, VB Script, Java Script) with the developing system.

Other system development supporting tools include SA-FileUp software for ActiveX-based active server components by Software Artisans; without its programmable object module, the Web-based FTP module would not have been developed for timesaving and laborsaving goals. In image processing, Ulead PhotoImpact 4.2 was used for special text effects, the Web page image, GIF animator, button, and object production. On the client side, the commonly used MS IE 4.0 was chosen to be the target browser.

Prototype

The prototype of the KnowDisLC system first used the MS FrontPage 98 to create the format for the system, including its page layout, screen background, Web page hyperlink of main functional buttons, form/table design, and Web teaching material (PowerPoint presentation). However, since the prototype is an HTML-based model with some sections designed with Dynamic HTML, VB Script and Java Script, which are all client script languages, (i.e., program commands are embedded in the HTML files and are interpreted by the browser after it is transferred to the client. It is unable to output different Web page contents or results according to different environments and data requirements.) therefore, having static Web pages is still the major concern of the prototype, and the majority of the system functions are not covered.

Model of Building WBLC

The process of our building KnowDisLC follows the ISD and ADDIE frameworks that are consisted of analysis, design, development, implementation, and evaluation components. The construction of KnowDisLC is focused on finding out how to incorporate the increasingly powerful Web application and multimedia technologies and content development tools into developing and producing a feasible online learning environment, as well as enhancing the system functionalities and performance so as to improve its applicability. In order to establish basal theory of Web-based learning, a commonly accepted construction model of Web-based learning community is imperative to explore. A feasible model of building Web-based learning community is proposed as Figure 1. The proposed model is based upon our experiences of design and development as well as the evaluation results of the KnowDisLC. This model involves systematic process and tasks of building Web-based learning community. It is observed that effective design and construction of a Web-based learning community can be facilitated through systematic process and prototyping approach. Moreover, integration of ISD and prototyping approach may be employed to find opportunities for establishing a derivative framework for enhancing Web-based learning. Internet and multimedia technology may be applied within the framework of ISD and ADDIE as a systematic approach for building Web-based learning community. In this manner, effective integration of an adaptable ISD approach along with Internet technology may contribute to learning experiences in the current instructional framework.

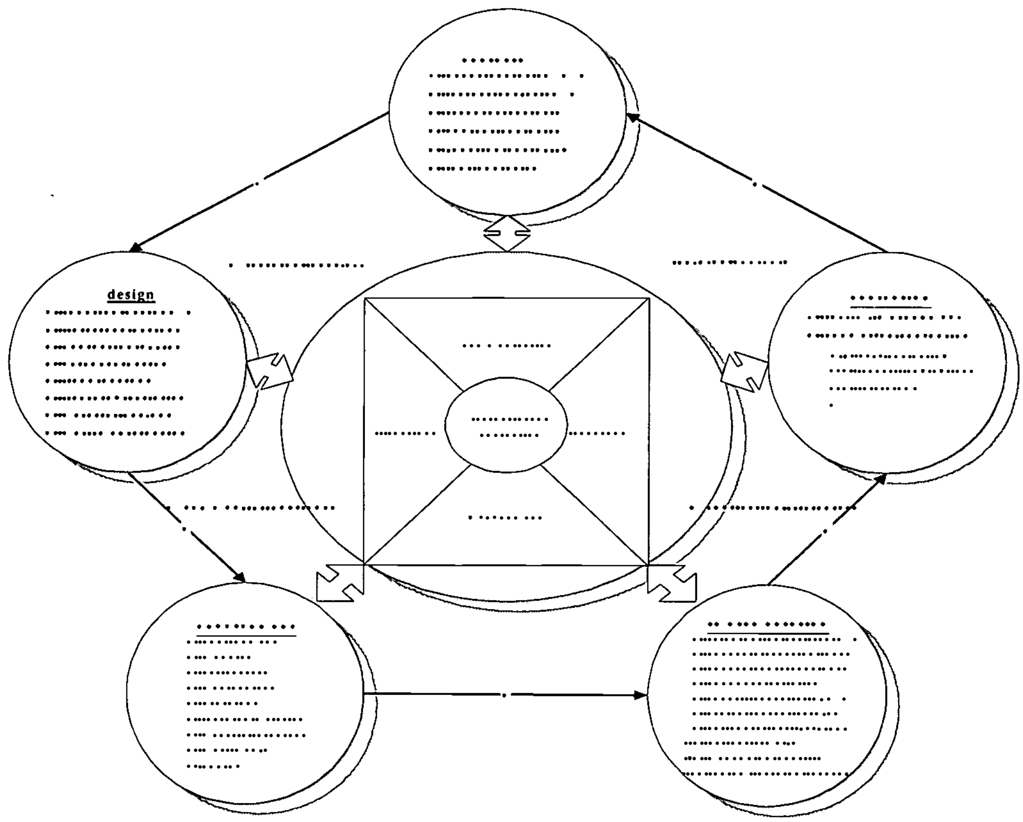

Figure 1: The model of building Web-based learning community

Issues of Building WBLC

Building a learning community network on the Web is accomplished by installing, executing and maintaining a Web server. Support of standard network protocols is needed for providing server with high access performance. Construction of learning community generally involves funding, resources, and time as well as is associated with budgetary, technical, design, production, testing, operational, and implementation issues. There are numberous challenges in building KnowDisLC that include the following:

1. What are the common goals, objectives, missions, and visions of the learning community for incorporating members together to form a tight-knit community consortium.
2. What is the main intent of the learning community?
3. What types of memberships will compose the learning community? What are the target groups of the learning community?
4. What are the technical requirements for developing and producing the learning community system?
5. What are hardware and software requirements for accessing and executing the learning community?
6. What software tools will be used for developing and producing the learning community?
7. What are the tools for creating Web pages and HTML documents?
8. How to enable the learning community to be multi-courses platform?

9. What are the contents of database for supporting the learning community? What types of data will be made available?
10. How will the information in the learning community be presented? Will the information be in textual or graphical format?
11. How will the course materials be presented and delivered? Will the course materials be supported by multimedia such as audio and video?
12. What are the tasks and responsibilities for building the learning community?
13. Who are the team members for building the learning community? Who will be responsible for the instructional design, system design, programming, multimedia production, course design, Web-page design, database design, evaluation and so forth?
14. How will operations of the learning community be sustained over the long time?
15. Are there sufficient funds available for building the learning community?
16. What types of learning resources will be appropriate to support learning? How will the learning resources be presented? How to gather and manage learning resources such as Websites related to courses?
17. How to create portfolios for monitoring students' learning processes?
18. What amount of time is needed to setup and run the learning community?
19. How will rapid prototype be created for correctly developing final system?
20. Hot to compartmentalize, build, and integrate programming modules that constitute the codes of learning community?

Lessons Learned of Building WBLC

The context of telecommunication offers validation, encouragement, interaction which researchers have found absent in tradition learning experiences. Consequently, this may facilitate design and construction of Web-based learning community. Reliable communication performance, rapid response time, favorable operations, and ease of maintenance are key factors of effective implementation for Web-based learning community. Participants in Web community may find themselves sharing knowledge and exchanging experiences in an online discussion/forum. As Goodyear (1995) observes, this is so called information, expertise, knowledge and intelligence distribution. Participants in the Web community share common goals and visions as well as show the diversity of memberships. Participants may vary in gender, age, education, interest, experience, and occupation background and can comprise students, teachers, field experts, and practitioners.

Students used a great deal of discussion to clarify their understanding of not only the contents of course materials, but also interactions among peers. Discussion in the forum of the learning community opened up students' views on the depth of the interesting issues. Students indicated that they had sensed participating in and penetrating the very constructing of new knowledge. The virtual community was created to captivate events, in turn leading to learning experiences gleaned in participation. Bandwidth of telecommunications and access to acceptably reliable Internet technologies continue to distract from Web-based virtual community. Nevertheless, limitations of effective learning may be minimized through adaptable instructional design of course materials and congruous applications of communication mechanisms. Just like Palloff and Pratt (1999) state, distance learning will not replace traditional face-to-face learning. Whereas, it sustains to enwrap nontraditional learners for the main reasons that the structure and confinements of the traditional classroom simply do not work.

Regardless of adequate support of technologies, effective Web-based learning requires appropriate design, sufficient interaction, good course materials, and meaningful communication. As HerrNeckar (1999) observe, availability of course content, interactivity of telecommunication, and alleviation of time and place constraints provide basal implications for access to virtual community. It is necessary for successful implementation of a learning community to include training for its online assistant, forum moderator, and instructor in the process of online learning. Online assistant and instructor training involve an introduction to the hardware and software being used to deliver course materials. Forum moderator training involves skills of presiding over online conference or discussion. What we have learned from our experiences of building and executing KnowDisLC is that regardless of the environment, the establishment of learning community aplenty promotes the quality of learning experiences.

Conclusions and Future Works

Based on building the KnowDisLC supported by the Web, this paper covers experiences regarding design considerations and issues of building system, deemed crucial to electronic community building. It is an examination of systematic processes uses through which the KnowDisLC was created, constructed, and evaluated. Recent advances in Internet technology have afforded flexibility in building Web-based learning environment. Network technologies and services and Internet popularity contribute to the Web-based learning whereas, there are still many obstacles to the integration of technology and Web-based learning into curriculum. Worldwide acceptance of the Web as a medium for knowledge share, experience exchange, information distribution, and resource access contributes to the development of the KnowDisLC. Nonetheless, merits and liabilities of Internet technology in Web community domain are not yet fully documented (Littman, 1999). Despite the obstacles, establishment of KnowDisLC, a virtual learning community on the Web, can happen.

KnowDisLC involves virtual reflections of activities taking place in real life. It provides a common cyberspace for the interaction, exchange, and retrieval of information and enables participants to access, share, and update information from variety of resources.. Its socially oriented activities transcend tradition learning; heighten interactions among participants; serve as forum for discussing common issues; promote collaborative capabilities; and increase knowledge creations. As Herrmann (1998) observes, Web community is one such social structure and that this structure has a strong affective dimension. Participants in the learning community gain more attention from instructors and online assistants. Additionally, they may spend more time thinking about, responding to, and exploring on, whatever question peers or instructors give. We discussed a number of issues as we found them based upon the experiences of building KnowDisLC. Whereas, we are attempting to create points for further discussion rather than offering solutions. The question of wider applicability and effects of the KnowDisLC may be left open to corroboration and further investigation in varying contexts.

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Discover Sequential Patterns of Learning Concepts for Behavioral Diagnosis by Interpreting Web Page Contents

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Abstract: As Web-based course become popular, the Web system accumulates a large amount of log data. Because the log data was generated by learners' behavior on the Web-based course, many researchers agree that analyzing the Web logs will bring benefits for learners, instructors, and the Web site manager. In general, one record of Web logs can specify "the filename of the Web page that was accessed", "who access that Web page", and "when the Web page was accessed". Although many interesting results can be derived merely depending on the general Web logs, some important meanings of the Web logs were not considered in previous researches. In our opinions, the content, represented by the Web page format, is not included in the general Web logs. For instance, a Web page may present a project work, a discussion article, a section of curriculum, or a grade report. However, previous researches did not consider the represented content of a Web page in the Web logs, in which only the file name of the accessed Web page is generally identified. This paper proposes system architecture to analyze learners' online behaviors for mining learner's patterns by transforming general Web logs to a content perspective. Hence, the methods of previous research still can be used to find the more meaningful results. Most important of all, this methodology finds patterns based on learning behaviors instead of browsing behaviors.

Introduction

As Web-based course becomes popular, various learning activities can be running on the Web (Herrington, Sparrow, and Herrington, 2000; Chang and Chen, 1997). The asynchronous discussion activity, homework assignment and submission, announcement, grade reports, and almost anything students expecting to do can be executed on the Web. Because all the learning activities are represented as Web pages, the Web server will accumulate a large amount of log data for every Web page. One record of the Web logs can indicate which page was access by someone in sometime. Hence, many researches analyzed the Web server logs to figure out users' motivation, users' response, browsing pattern, and the network traffic (Sullivan, 1997; Sun and Ching, 1995). Furthermore, analyzing students' on-line learning behaviors and on-line problem solving activities can also discovery meaningful results (Jehng, 1999).

There are many products of Web log analysis for commercial web sites. The technologies used for analyzing Web server logs evolve from traffic-based or time-based assessment to user access pattern analysis. For example, Perkowitz uses access patterns to construct an adaptive Web site (Perkowitz and Etzioni, 1997). Hence, the interested Web pages will be linked and organized as a proper view for every user according his/her access patterns. The *path* concept, users' sequential Web page access records, is important for constructing user access pattern for Web logs. For instance, Stuart Schechter (Schechter, Krishnan, and Smith, 1998) create users' path profile to predicate users' browsing behavior. Consequently, the field of Web log analysis is growing for the purpose of custom services.

Recently, applications of Web log analysis integrate data mining techniques to focus on the customer behavior patterns. It is because the predictive modeling and link analysis operations in data mining techniques can be used to answer questions such as "Which of my customs will prove to be good, long-term valuable customers and which will not?", "How can I sell more to my existing customers?", "Is there a recognizable pattern in which my customers acquire products or use services so I can market to them just-in-time?", and so on. Although there is no universal approval definition of data mining, it generally indicates the process of extracting previously unknown information from a huge amount of data. Then, the discovered information can support users make decisions, develop a predictive model, or do something benefit from it. Consequently, we intuitively apply data mining and 'from where the learner come', but also should know 'what the Web page contains'. However, it is difficult to represent the content of a Web page with symbols. The reason is that the content of a Web page may contain many concepts. Consequently, the first step for understanding the pedagogical meaning is reconstructing the Web pages in the site of a Web-based course by endowing only one topic or concept for each Web page. While breaking a Web page into single concept Web pages, one would find that some concepts are not *atomic* concepts. That is because a major concept will contain many sub concepts. Hence, the second step for understanding the pedagogical meaning of a Web page is to identify its location within a concept hierarchy, which is a special case of a concept map, instead of its location within the hypertext hierarchy.

Concept mapping is a technique widely used to represent knowledge in graph (Johannessen, Beissner, Yacci, 1993; Roberts, 1999). Some researches demonstrate that teaching materials are more easily assimilated if a concept map of teaching materials can be consulted (McAleese, 1998; Wang, 2000). Although concept mapping could be used for diagnose misconceptions or assess understandings, current applications of concept mapping technique on the WWW do not focus on that purpose. After Web pages interpretation, the following issue is what a concept hierarchy can support for assessing learners' understandings. Therefore, the second requirement, referred as *mining concept patterns*, for discovering learners' learning pattern is to mining sequential access paths on previous aforementioned concept hierarchy. Learners' navigating tours on a course web, also called hypertext paths, are an important issue in hypertext. Generally, hypertext paths are related to two major problems: user disorientation and cognitive overhead (Conklin, 1987). However, the users' access (navigate) pattern can only help Web site manager improving Web site schema because a Web instructor still can not figure out learners' intention. The proposed concept hierarchy presents a feasible style for supports of interpreting the Web page content. After learners' navigating paths on a Web site are transforming to navigating paths on the concept hierarchy, a Web instructor can comprehensive how learners learn from the information of what learners read.

The third requirement, coming from the founded concept patterns, is to infer students' internal concept states for explaining students' behavior. This requirement is referred as *behavioral diagnosis*. Inferences, interpretation, and classification are three types of behavioral diagnostic activities in literature (Wenger, 1987). The classification type of behavioral diagnosis is used to characterize or evaluate observations of learners' behaviors. The interpretation type of behavioral diagnosis will explain observations of learners' behaviors. In this paper, the requirement of behavioral diagnosis is inferences types because the goal of our data mining effort is to provide the instructor with results that are interesting or unusual. For example, the assertion can be made that a novice of a programming language is likely to visit the synopsis of language syntax often. In other words, a learner's internal states, that are concept patterns, produce his/her behaviors in determinism. If a concept pattern of a learner is "surprising" to an instructor, it means that the instructor's expectancy of the learner differs from real learning state. Consequently, an instructor can posit learners' concept structures to account for observed learners' behaviors.

This paper proposes a methodology to mining learners' learning pattern by transforming learners' Web page access sequences to sequences of learning a concept in Web logs. Traditional web logs mining algorithms, which is designed for discovering users' access pattern on a Web site, can support the methodology. This methodology is not used to replace traditional web logs mining algorithms nor is arguing that concept hierarchy is a suitable web site schema. Rather, this methodology presents a framework for integrating traditional web logs mining algorithms with pedagogical meanings of web pages to support Web instructor get more feedback from learners' navigation on the Web course site. Broadly speaking, this methodology contribute to apply traditional web logs mining algorithms to a specific domain in the technical aspect and progress assessment skills in the Web-based distance learning aspect.

System Architecture

To apply data mining methods for concept sequential patterns discovery, a distance learning instructor should first construct the concept hierarchy of a learning Web site and link every Web page to a related concept in the concept hierarchy. Then, the system can implement the mechanism for mining concept sequential patterns by general sequential pattern discovery techniques. Finally, an instructor will get a report of interested or unusual concept sequential patterns. Thus, the instructor can refine learning strategies or diagnosis learners' behaviors after assimilating the mined results. Meanwhile, the Web site manager can evolve the schema of learning Web site according a distance learning instructor's pedagogic ideas.

There are three phases for mining sequential concept patterns by general sequential pattern discovery techniques in the system architecture. First, data preparation phase is responsible for constructing a concept hierarchy. This phase also links every Web page to a node in a concept hierarchy and prepares a logging mechanism to record learners' behaviors on a concept hierarchy. Then, the second phase begins to transform Web logs after the learning Web site for a group accumulates many Web logs. Because the only way to access a Web page is through the concept hierarchy, a sequence of accessing Web pages can be transform to a sequence of learning concepts. Third, a general technique for sequential patterns discovery is used for mining both concept sequential patterns and Web page access patterns. Hence, a distance learning instructor can use the mined information to diagnosis whether any special behavior is happening in a group. For instance, learners are debating a topic in a long time. Consequently, a distance learning instructor can intermediate in time. Furthermore, a distance learning instructor can also review the arrangement of Web pages according the reported portions of learning Web site.

Figure 1 illustrates the system framework for mining sequential concept patterns by interpreting the Web page content. The portfolios block denotes a database containing Web logs, discussion articles, and project works so on. First, a distance learning instructor should construct a concept hierarchy and reorganize Web site schema according the concept hierarchy. Then, learners will be asked to use the concept hierarchy to access all pages in the learning For instance, the system will forbid a learner's browsing behaviors if the learner uses an URL to access a Web page directly. Implementation of this part can be easily archived by using the Session object of Microsoft's ASP(Active Server Pages) technique. After learners use the concept hierarchy to access Web pages, the logs of his/her browsing behaviors can be endowed additional meanings. For instance, an instructor can find out the members who have not read summaries of a discussion activity posted by the moderator of a group. Consequently, a distance learning instructor can diagnose learners' behaviors from concept level instead of browsing behavior level.

A distance learning instructor now has a concept hierarchy to support interpreting Web page contents. Interpreting Web page contents can support the system operations in two aspects. For data preparation, every Web page is linked to a symbol that denotes a concept. Then, a filename in Web logs can be transformed to a symbol of a concept. For data mining, only a general method for sequential pattern discovery (the up arrow in Figure 1) is needed to mining concept sequential patterns because a symbol in Web logs represent a 'node' in a concept hierarchy instead of a filename. Hence, the results of mining sequential patterns may reveal a 'path', that is a sequential pattern, in a concept hierarchy. A sequential pattern of learning concepts is more useful for behavior diagnosis than a Web page access pattern. For instance, '80% of learners who accessed page A will thereon access page B' is less clear than '80% of learners who read discussion summaries will thereon access
Furthermore, an instructor is easier to assimilate a sequential pattern of learning concepts than a Web page access pattern.

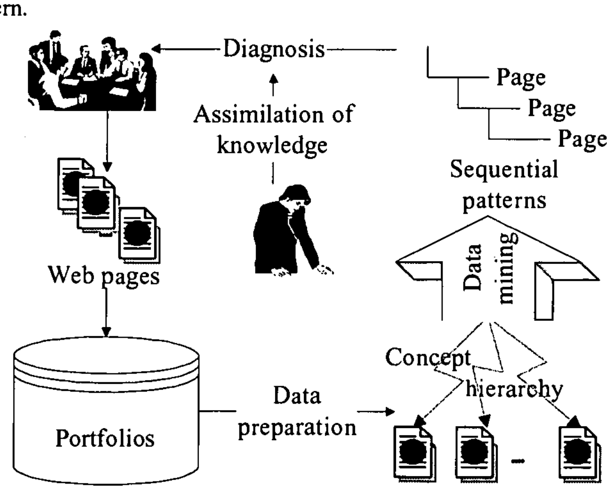

Figure 1: System framework for mining concept sequential patterns.

Illustrative Example

In overview, there are two steps in this illustrative example of detecting learning status. The first step is data preparation. We design a sophisticate structure of a Web site so that we can recognize the content of the accessed Web page. The second steps will find pedagogical meanings from the contents of the preferred Web pages. In this illustrative example, the result of step two will show that learner is not familiar with the learning topic.

Data Preparation

The required data was collected from the students in an undergraduate course of Perl programming. Perl is a high-level programming language written by Larry Wall. Perl is a very popular programming language for system administrators and CGI script authors. After a brief introduction of Perl, students were asked to study the Web pages extracted from Perl manual. There are three topics in the prepared Web pages. First topic of Web pages demonstrates how to execute the Perl interpreter, called *Perlrun* in Perl manual. Second topic of Web pages explains the Perl model for declaring importing, and calling a subroutine, called *Perlsub* in Perl manual. Third topic of Web pages describes associativity and precedence of Perl operators, called *Perlop* in Perl manual. Consequently, learners' behaviors recorded by Web logs can be recognized by the topic of accessing Web page.

Synopsis and description compose each topic of Web pages. Synopsis is a summary of a topic and generally contains no more than one page. Description explains the details of a topic in original Perl manual. For illustration, description for each topic was reorganized into two Web pages. In general, synopsis of a topic is prepared for learners who are familiar with that topic. Learners who are learning a topic will prefer the description of that topic. Hence, we can help a learner just in time if he/she is always looking around the description of a topic.

Aforementioned structure is content structure of learning materials. To present learning materials in a hypertext style, a hyperlink structure is required. We use the full connection style to link all Web pages. Hence, learners can navigate to any destination in any Web page.

Figure 2 shows the concept structure of the learning materials on the Web site. The notation P_i indicates the Web pages. Although the overview structure is composed of concept hierarchy and contents of learning materials without hyperlink information, the tree structure above the P_i can be used to interpret the content in the page. For instance, the P_1 belongs to concept synopsis, which is the partial content of the Perlrun topic.

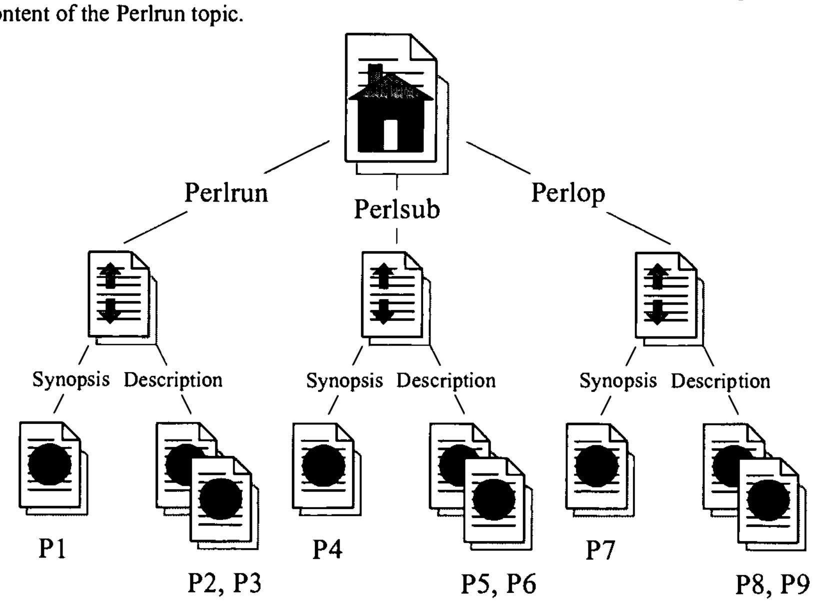

Figure 2: The concept hierarchy of a Web site.

Mining Processes

There are three learning topics in the Web site, denoted as Perlrun, Perlsub, and Perlop. Each learning topic has two sub concepts, denoted as synopsis and description. The word "synopsis" is used to indicate the Web page for summarizing a topic and the word "description" represents the Web pages that explain a topic in detail. There is an index Web page linking every Web pages to serve as communicating interface with learners. Hence, learners can study any topic in any order through the index Web page. Assume that there is a learner who prefers the "description" Web pages of any topic. In other word, that learner is not familiar with all topics. Hence, the logs of that learner's browsing behavior on the Web site may be like the sequence:

p2, p3...p2, p8, p9...p5, p8...p5, p1...p2, p5, p6

Because learning can happen in any time, only time nearly browsing behaviors will be related in a learning pattern. Hence, the transaction idea, used in database theory, is involved to cluster learners' browsing behavior. The T*i* means a transaction of the learner's browsing behavior. The content of every Web page can be interpreted as a pair of topic and representation style. For instance, p2 belongs to topic Perlrun and is a description of the topic. Hence, p2 is interpreted as (Perlrun, description). After interpreting the transaction data of learner's behavior, the results are follows.

T1: (Perlrun, description), (Perlrun, description)
T2: (Perlrun, description), (Perlop, description), (Perlop, description)
T3: (Perlsub, description), (Perlop, description)
T4: (Perlsub, synopsis), (Perlrun, synopsis)
T5: (Perlrun, description), (Perlsub, description), (Perlsub, description)

Most of algorithms for mining pattern are derived from aprior (Agrawal, et al., 1996). A general description of aprior is presented as following four phases.

1. Find the items with minimum support (threshold) by a length.
2. Increase the length by one.
3. Recalculate the items with minimum support.
4. Repeat step two and step three until no new item is found.

Finally, the maximal phase will find the most meaningful pattern from large-2 itemsset and large-3 itemset. Initially, the union of large-2 itemset and large-3 itemset is used as the result. Then, some items will be eliminated because they are the subsets of some larger items. For instance, the meaning of {5, 4, 4} is more than its subset {5, 4} and {4, 4}. Hence, the large-2 items, {5, 4} and {4, 4}, will not be deleted from the initial result. Finally, some items will be eliminated because they are less meaningful then items in the result. For instance, the {4, 3} will be deleted because {4, 7} implies {4, 3}. Similarly, the {2, 4} will be deleted because {6, 4} implies {2, 4}. The following table illustrates the result.

Maximal itemset	Real patterns	Support
{6, 4}	{(Perlsub, description), ('*',description)}	2
{4, 7}	{('*', description), (Perlop, description)}	2
{5, 4, 4}	{(Perlrun, description), ('*',description), ('*', description)}	2

Table 1. Maximal itemset.

Assimilation of Knowledge

The goal aforementioned data mining efforts is to provide the instructor with results that are interesting or unusual. In other words, an instructor may be interested to understand a concept pattern that contradicts to general beliefs. *Beliefs of domain knowledge* and *beliefs of instruction knowledge* are two important types of beliefs for behavior diagnosis. Consequently, the pedagogical meanings of mined concept patterns can be depicted from two different aspects. First, if the mined concept patterns contradict to general beliefs of domain knowledge, those mined concept patterns may imply the learner's misconception. For instance, a learner's browsing behaviors will generate a pattern of irrelative concepts when applying wrong concepts to solve exercises in problem solving activities. Second, if the mined concept patterns contradict to general beliefs of instruction knowledge, those mined concept patterns may imply the learner's disorientation. For instance, the "array" concept should be learned before the "pointer" concept in C programming language. If a learner is studying the "array" concept, any "pointer" related concept pattern would contradict to beliefs of instruction knowledge.

Conclusion

The Web-based learning environment offers opportunities to precisely observe learning processes.

However, it is tedious for a Web instructor to discovery useful information from the huge amount of Web logs. Traditionally, a Web instructor uses the Web log analysis products to realize the unusual parts of a Web site. From the pedagogical standpoint, the results of the Web log mining algorithms are not very useful for figure out learners' learning process because the contents of Web pages are not considered. This paper proposes a methodology to mining learners' learning pattern, which is related with the Web page contents, from Web logs. The methodology uses Web log mining algorithms, which is used in Web log analysis products, and the concept structure embedded in Web pages to mining patterns with learning and pedagogical meanings, so called concept patterns. In our opinions, this methodology presents a framework for integrating traditional Web log mining algorithms with pedagogical meanings of web pages to support Web instructor figure out learners' navigation on the Web course site from the concept hierarchy perspective. Consequently, the approach presented here may be not only a feasible application of traditional Web log mining algorithms, but also a possible direction of Web-based learning assessment research.

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Applying Navigation Mechanism to Virtual Experiment Environment on WWW with XML-style Teaching Materials

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Abstract: With the navigation mechanism designed in this paper, an intelligent agent then can learn how to solve a specific experiment in a virtual experiment environment such as IVC (Internet Virtual Community), through reading those XML-style experiment teaching materials alone. After storing the mind of experiment agents with knowledge, an agent can capture users' actions and send corresponding commands to Virtual Lab to help learners completed their tasks. Besides, this mechanism could also be used in solving problems, for example, learners can ask for instructions from agents.
Keywords: Virtual Experiment Environment, XML, Agent, Teaching Materials, Interactive Protocols

1. Introduction

A Virtual Experiment Environment (V.E.E) in distance learning systems provides a visualized social learning environment by creating experiment situation on Internet. [Tung95][JCCH96] A set of simulated virtual equipment for doing experiment is also included in V.E.E.. [HSCX98][HHCH99] Recently, V.E.E. on WWW (World-Wide Web) categorized as three major types, Real Lab, Virtual Lab and Visual Lab,

1. Real Lab: needs a set of external experiment devices and software kit. [JJYH97]
2. Virtual Lab: simulated experiment through software. [CCJH96]
3. Visual Lab: using video-media and some manipulation toolboxes. [WCHH00]

Although V.E.E. offers an environment for learners doing lab on Internet, there is difficult for learners to ask question/demonstration or find out what is going wrong when they are doing exercise inside V.E.E. Hence, many researchers proposed some interactive intelligent tutors or environment solutions. [GSCX92][FuL92] In this paper, not only the model of interactive intelligent experiment agent is implemented, but also the mechanism of reading and understanding teaching materials is well analyzed and designed.

2. Analysis of Interactive V.E.E.

Architecture of Interactive V.E.E.

According to V.E.E. mentioned in previous Section, an interactive virtual experiment environment consists of four major components, including teaching materials, user interfaces - UI (visual lab, in this paper), interactive protocols and knowledge base. As Figure 1 shown below, those four components operate cooperatively.

Learners do any scientific experiments as they like with appropriate visual lab interface (UI) and teaching materials, of course, these materials and UI should obey some basic educational concepts such as the seven problem solving stages and science process skills. An experiment agent (or agent, in shortly) might be able to read the teaching materials directly without supervising, and store some well-organized knowledge (or information) into their artificial brains, which is so-called knowledge base. After understanding specific experiment, an agent owns capability to be a navigator as learners processing a lab exercise, agents can provide instructions for next step, demonstrate the whole experiment process through UI and even predict whether a learner's doing will go wrong or not.

User interfaces provide some interactive methodologies to learners for studying materials and doing experiments; Although teaching materials seem easily to develop, how agents can understand it is a big issue;

Interactive protocols include learner-UI (experiment), agent-UI (experiment), agent-material and learner-agent; knowledge base can be divided into two parts, knowledge structure and inference engine.

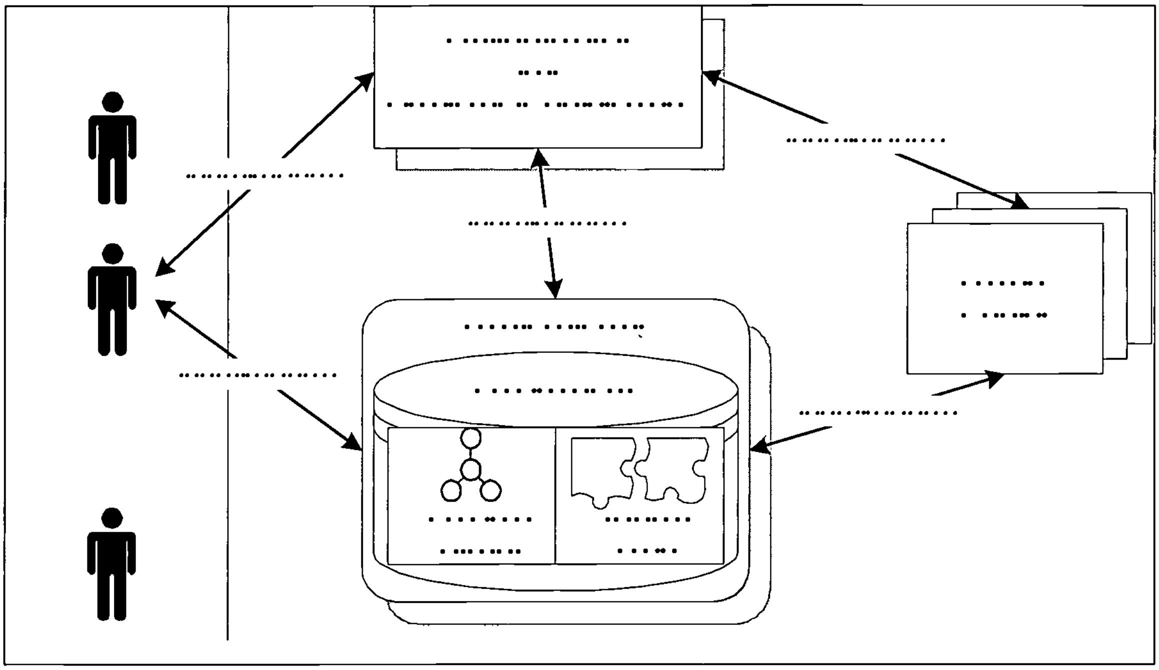

Figure 1. Four components in V.E.E.

The user interfaces, including study interface and experiment interface (visual lab, we called) are well built on WWW during these several years. [HCHH99][WCHH00] Therefore, this paper focuses on the XML-style teaching materials analyzing for reading by experiment agents, and the design of the four interactive protocols described above. Based on the CLIPS and JESS a simple version of knowledge base is also applied to the experiment system implementing in the paper.

Next on this Section we will analyze the protocols between agents and teaching material, agent and user interface (visual lab) at first. Secondly, a flow diagram for the interactions among agents, UI and teaching materials in the instructional system can be designed. About those interactions between learners-UIs and learners-agents are quite simple, and we had done a lots in past, hence, there will not discuss too much in this paper but you can still get some ideas in the experiment system constructed by this paper.

Interactive Protocols and Knowledge Base

Since the agent-material protocol requires the understanding of experiment agents in teaching materials, the W3C standard, XML, is taken into consideration of constructing the experiment teaching material on WWW. XML has capability to form a HTML style document within the concept of object oriented. It is so important to have some properties in the specific learning concept and experiment, take a free-falling experiment for example. We will need both a ruler and a timer when doing this experiment, a ruler should have length property and timer should be able to let us get current time. Following is an XML-style example for the free-falling experiment.

```
<VLaction act="adjust" obj="Ruler">Adjust
        <Obj id="VRuler">Vertical Ruler</Obj>'s as
        <length l="13">13</length>
</VLaction>
<VLaction act="getvalue" obj="Timer">Get
        <Obj id="Timer1">Timer</Obj>'s current time
</VLaction>
```

List 1. XML-style teaching material

Where the "<VLaction>" tag indicates an action in the visual lab, "<Obj>" and "</Obj>" create a timer or a ruler object with a special id. We may have some actions, such like adjust and get value, using these actions the properties belong to object can be obtain and modify simply. Besides, agents can read and understand this sort of standard XML-style teaching material by parsing those tags in the document.

After understanding the teaching materials, agent might need to interact with UIs such as visual lab. Through operates equipment and observe data, an agent can demonstrate the whole process of doing an experiment for learners. Hence, to design a communication language for the interaction between agent-UI is necessary. Here we try to design a lisp-like language to simulate what teaching materials tell as List 1 show above.

```
(adjust VRuler 13)
(getvalue Timer1)
```

List 2. Communication language between agents and UIs

Now, flows between these four components in V.E.E. can be drawing down as Figure 2 below.

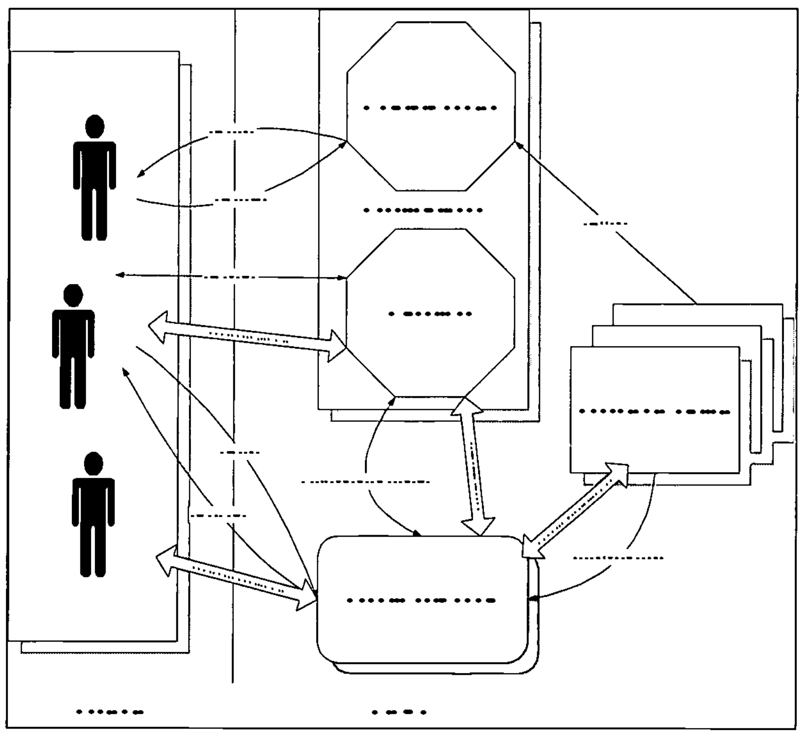

Figure 2. Interactive protocols among four components in V.E.E.

In Figure 2, a learner should acquire and read teaching materials at first through the material reading UI, and doing experiment with the visual lab UI. Similar to learners, an agent also can use its agent-material interactive protocol to read teaching material, and then with agent-UI protocol to manipulate lab equipment and obtain experiment data from visual lab. Besides, depends on the learner-agent protocol a learner can ask an experiment agent for help, and agent can also provide either instruction or demonstration to learner through this protocol.

3. Visual Lab within Navigation Agent

Navigation Agents

Although everything seems going fine as Figure 2 shown above, there is still important issue needed to design. The very important issue is, how to let agents can understand what they read from XML-style teaching materials, remember it and even inference. As we talk about previously, some exist systems and languages, JESS and CLIPS, are used to achieve this final goal.

Java Expert System Shell (JESS) is a system provides an expert environment in which rules or knowledge can be stored/inferred in CLIPS form. Therefore, a java agent constructed with JESS/CLIPS can direct store/recall/inference relative knowledge/rules from those teaching materials it read. The knowledge structure and inference methodology of agents for navigation in the instruction systems such as V.E.E. is illustrated in Figure 3.

In Figure 3, an experiment agent first use Microsoft Browser Helper Objects (BHO), which can be found in almost Windows operating systems (Windows 95 or above), to get the specific XML-style teaching material. Then the experiment agent can parse the XML-style documents and store some information and rules into knowledge base. When either it needs for demonstrating or learner asks for instructions, JESS can recall these rules/information for inferring and producing results to agent.

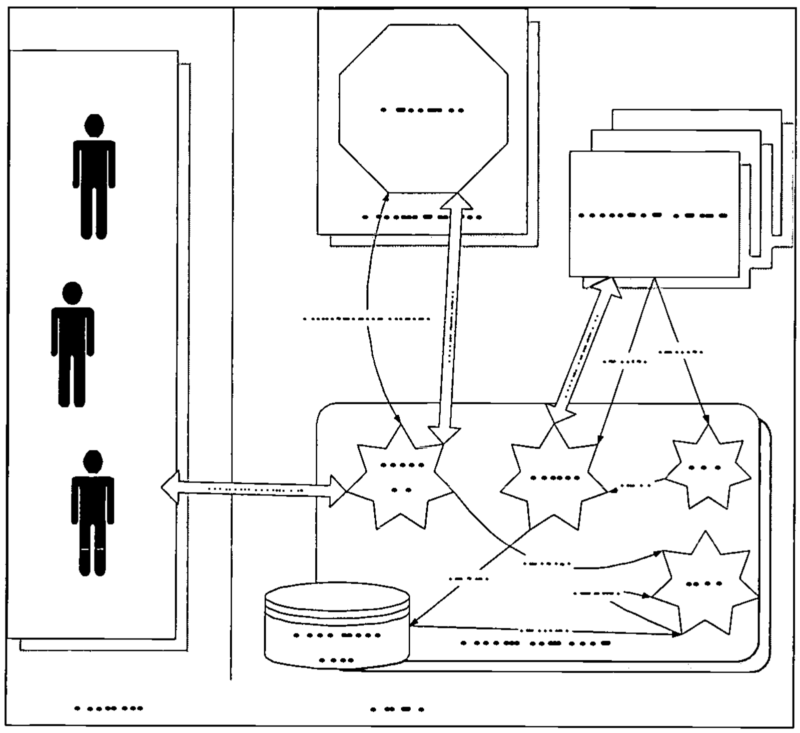

Figure 3. Knowledge structure in the JESS based agent

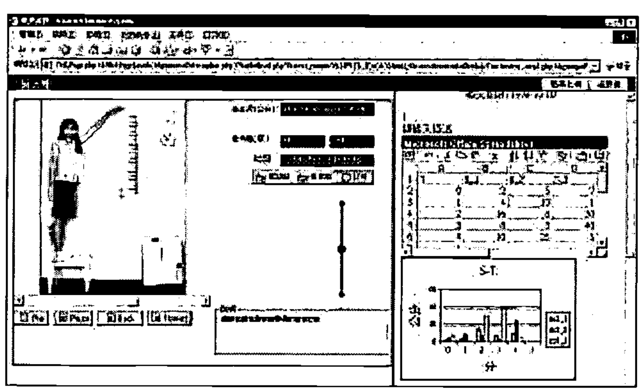

Figure 4. Visual lab without experiment agent

Visual Lab

To extend our past researches, the visual lab in IVC has been modified with those four interactive protocols, knowledge base and navigation mechanism we analyzed and designed in previous Section.[LCH00][CCH00] Figure 4 demonstrates the visual lab in Internet Virtual Classroom, and there is no experiment agent in it but only some equipment as visual lab UI provided for learners. An experiment agent with navigation capability looks like Figure 5. When a learner ask agent for help through the learner-agent UI (protocol), the experiment agent can either demonstrate, tell or explain instructions for learner as Figure 6 shown following.

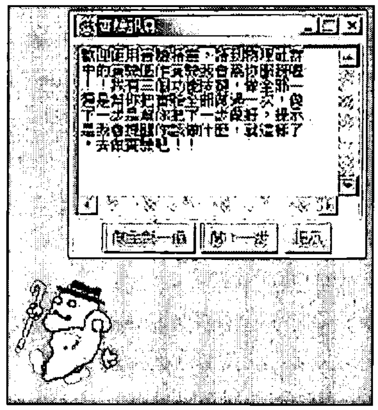

Figure 5. Experiment agent for navigation

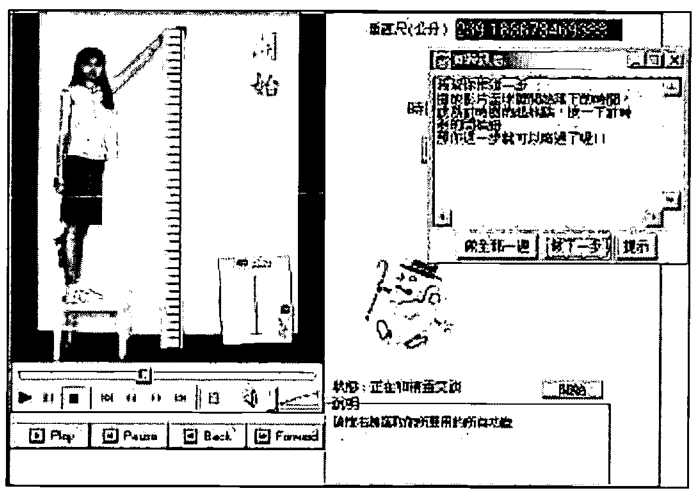

Figure 6. Experiment agent explains for learners in visual lab

4. Summary and Future Works

In this paper we have done the following things,

1. Analyze four components in a V.E.E., including learners, user interfaces, experiment agents and teaching materials.
2. Four interactive protocols, including learner-UI, learner-agent, agent-material and agent-UI.
3. Design specific XML tags for XML-style physical teaching materials.
4. Design Lisp-like communication language for agent-UI communication (protocol).
5. Integrate both JESS/CLIPS and Database.
6. Implement an experiment agent in V.E.E. for demonstrating experiment process, diagnosing errors and making suggestion for next step to learners.

Beside those contributions summarized above, there are still several issues can be taken into consideration,

1. More general XML tags for courses in other fields should be analyzed.

2. Can the knowledge structure inside knowledge base be concept map?
3. Operations for acquiring knowledge base.
4. Knowledge exchange among learning systems.

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Considerations of Spatial Ability in Learning from Animation

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Abstract: The study explored the use of animation in facilitating descriptive and procedural learning in a scientific instruction. Spatial ability was used as a variable to observe students' learning of different knowledge. Both quantitative and qualitative data were analyzed. It was found that the effects of animation were different among students with different spatial ability. Compared with the control group, students with high-spatial ability leaned better with animation in descriptive learning tasks, whereas, students with low-spatial ability learned better with still graphics in procedural learning tasks.

Introduction

When designing interactive multimedia applications, animation is often seen as an important component in presenting information. Animation provides potential visual interest for presenting computer-based materials, which makes scientific learning more interesting and enjoyable to learners. Learning under multimedia instruction requires students to integrate various types of information, which involves complex processes constrained by properties of the learner's cognitive operation, and especially by the capacity of working memory (Gyselinck, Ehrlich, Cornoldi, de Beni & Dubois, 2000). The most effective arrangement of animated visual aids may vary with the differing spatial abilities of students. Literature suggests that students scoring high in spatial abilities should be able to conceptualize the processes of diffusion in animation more completely or to a deeper elaboration (Hay, 1996). Individual differences in the use of their perception and visual strategies have become an indicator for analyzing students' learning patterns, especially in hypermedia learning environments. It therefore seems useful to determine whether the use of visual strategies produces different effects on different learner groups. The ultimate aim is to design learning materials optimized for the preferred modes of presentation among groups with differing characteristics to improve their performance. How users employ an appropriate strategy during the process of learning is also highlighted in the study.

Static and Dynamic Graphics

In design of scientific multimedia lesson, graphics and animation are often used to present instructional information. The terms, "static visual display" and "dynamic visual display" are used to differentiate between graphics and animation (Park and Hopkins, 1993). By definition, "graphics" refers to representations that do not rely solely on the use of text or numbers to provide informational content, while animation is the combination of a series of graphics and motions to form a visual scenario to represent information. Rieber & Hannafin (1988) define animation as a series of rapidly changing computer screen displays that represent the illusion of movement. In recent years, the increased availability of design tools has also permitted the design of instructional materials that incorporate unlimited variations and forms of verbal and visual information to fulfill our visual need (Parkash & Mathur, 2001; Rieber, 1995). The representation of motion provides potential learning interest and stimulates viewer's attention.

One note of caution should be sounded when using animation to present information. A number of researchers have identified individual differences among learners as influencing the effectiveness of animation. For example, Mayer & Sims (1994) concluded that learners with either high- or low- spatial abilities used different cognitive activities in processing visual information. Discrepancy in individual differences might influence the way given visual information is processed, and the degree to which related concepts and information are triggered and connected (ChanLin, 1999). Further study on individual differences in perceiving visual information is required before any firm conclusions can be drawn.

Spatial Ability

In mathematics and science learning, "spatial ability", is one of the most important indicators used for differentiate students' individual differences.Animation is also often used in current instructional materi
visual skills (Holliday-Darr, Blasko, & Dwyer, 2001).The term "spatial ability" identifies what has also been labeled as the spatial sense, spatial perception, visual imagery, spatial visualization, visual skills, spatial reasoning, mental rotations, and visual processes (Davey & Holliday, 1992; Dixon, 1995).Spatial ability also refers to the ability to rotate or fold objects in two or three dimensions and to imagine the changing configurations or objects that would result from such manipulation (Mayer & Sims, 1994).In a study investigating the relation between the factors of gender,spatialvisualization,mathematicalconfidence,basicability,andclassroomgraphingutilizationtoconceptual mathematicalperformancewithgraphingcalculatorsincollegealgebra,Cassity(1997)foundthatspatialvisualization is related to conceptual mathematical performance.

Although from a design aspect, visualization is a fundamental component of presenting information on the computer screen, different presentation formats (non-graphics, still graphics, and animated graphics) may facilitate learner encoding of information differently for students with different levels of spatial reasoning ability.For example, Mayer and Sims (1994) explored high- and low-spatial ability students learning from computer-based instruction.They concluded that spatial ability allowed high spatial learners to devote more cognitive resources to building referential connections between visual (graphical) and verbal representations of the presented material, whereas low-spatial ability learners had to devote more cognitive resources to building representational connections between visually presented materials and its internal representation (Mayer & Sims, 1994).Large et al. (1996) found that primary school students with higher spatial ability gained more benefit from the presence of animation with text than students with lower spatial ability.Supporting evidence also comes from Hegarty and Sims (1994).They found that visual representations appeared to help those subjects who already had good visualization skills more than those subjects whohadmoredifficultyinvisualizing.Althoughtheuseofvisualtreatmentaimstofacilitateeffectivementalprocessing, individual differences in processing spatial information may be a fundamental factor requiring consideration.

Specifically, the purposes of this research were to: (a) study the effects of visual treatment and differences in spatial ability in learning from scientific multimedia instruction; (b) observe how individuals differ in navigating and processingvisualinformationinahypermediaenvironment,and(c)examinehowdifferingvisualtreatmentsinfluence learning in students with different degrees of spatial ability.

Methods and Procedures

Subjects and Instructional Materials

•

The study consisted of three hundred and fifty seven students. There were nine classes of eighth-grade and ninth-grade students, randomly assigned to different visual treatments on a class basis. The material used for teaching physics was a computer-based learning program, covering problem about force. Students studied the instructional materials individually. After a period of study, a criterion reference test was conducted to assess students' learning performance.

With an emphasis on using meaningful representations, which would encourage thinking, the lesson was designed with various scenarios for interaction. Several physics problems were embedded in the scenarios, which had adventures to draw students into becoming actively involved in finding the solutions. The lesson covered descriptive and procedural knowledge. Descriptive knowledge referred to knowledge that could be communicated through a recital of facts or the description of objects or events. In the learning and application of scientific concepts, it is essential for providing the basic information to be remembered. For example, the definition of "resultant" and "force vector" provided in the lesson was considered descriptive knowledge. As opposed to descriptive knowledge, procedural knowledge referred to learning and construction of the problem-solving procedures related to physics concepts. Learners needed to relate rules and facts to formulate a problem solving procedure. For example, the step-by-step problem-solving procedures were provided to help students construct a problem-solving concept.

The lesson was designed in three versions. The following is a description of the three different treatments:

(1) Treatment 1. Text (Control group): In this version, only textual information was presented to explain scientific concepts.

(2) Treatment 2. Graphics with Text: In this version, static graphics with textual information were presented to explain scientific concepts.

(3) Treatment 3. Animation with Text: In this version, the instructional materials contain textual instructions and animated graphics.

Instruments

Classification of students as to their spatial ability was determined by a spatial ability test. This test had several sub-test which were part of the educational testing services package, "Multiple Factor Test" (Lu, et. al, 1994).The spatial test involves several visualizing tasks that require students identify the specific three-dimensional shapes that result after an object rotates to a certain angle.This kit of spatial tests was selected for a variety of reasons.The first was because the visualizing tasks involved in the test were related to learning the spatial concepts in the lesson.Also, through official assessment, the test has been determined to be a reliable indicator of spatial ability.

To assess students' performance, a criterion reference test was created based on the content provided.The criterion reference test contained 25 testing items.Twelve of them were to assess students' learning of descriptive knowledge, and thirteen were to assess students' learning of procedural knowledge.Kuder-Richardson Reliability (KR21) for the criterion test items used in this study was 0.76.

Results

Among the 357 subjects, 182 were classified as being high in spatial abilities, and 175 were classified as low in spatial abilities based on the spatial ability test.To determine the effects of visual treatments and students' spatial ability in descriptive and procedural learning, a 3 (Text/Graphics/Animation) X 2 (High/Low Spatial Ability) ANCOVA was employed to examine the effects of these two factors.Separate ANCOVAs were also used to describe the effects of visual treatments on different spatial groups.Since in the Pearson correlation analysis, students' grade levels, prior physics, and mathematics scores were significantly correlated with post-test scores for both descriptive and procedural knowledge ($p<0.05$), all of these factors were used as covariates for controlling the initial differences among groups.

Descriptive Learning

In descriptive learning, the 3 X 2 ANCOVA indicated insignificant effects for both spatial ability [$F(1,348)=0.675$, $p = 0.412$] and visual treatment [$F(2,348) = 2.429$, $p = 0.090$].No interaction was found between the two variables ($p = 0.572$) (= 0.05 level).

In order to see whether animation or still graphics assist learning of descriptive texts, separate analyses were conducted within each spatial level group for treatment-to-treatment comparisons.It was found that among high-spatial ability learners, only the group using animation was better than text group ($p = 0.039$); while among low-spatial ability learners there were no significant differences in any of the tests ($p>0.05$) (= 0.05 level).

Procedural Learning:

For procedural learning, the 3 X 2 ANCONA indicated an insignificant effect for spatial ability [$F(1, 348) = 0.000$, $p = 0.988$] and a significant effect for visual treatment [$F(2,348) = 3.582$, $p = 0.029$] (= 0.05 level).No interaction was found between the two variables($p=0.548$). Overall, Students learning with animation and still graphics performed significantly better than those learning with text did ($p = 0.035$ and $p = 0.013$ respectively).No significant difference was found between the animation and the still graphics group ($p > 0.05$) (■= 0.05 level).

Treatment-to-treatment comparisons within each spatial level group were conducted. It was found that among high-spatial ability learners, there were no significant differences in any of the tests ($p > 0.05$); while among low-spatial ability learners, only the group using still graphics did better than the text group ($p = 0.031$) (■= 0.05 level)

Observation

It was found that when learning spatial concepts, the use of processing strategies can be categorized into three kinds: external visual representation, internal visual representation, and combination of both types of visual representations. Employing external visual representations, students often used their own drawings as well as the graphics and animation provided by the teaching materials in the lesson to construct their own understanding of the meaning. By contrast, with internal representation, students used the images created in their minds with the description or concepts presented in the lesson to construct their own internal meaning. Even when graphics were not provided, they translated the verbal information into internal spatial representations for further processing. Some students shifted their spatial strategies either from external to internal or from internal to external visual representations in order to process and assimilate complex information.

In spite of the differences in the use of external visualization and internal visualization strategies among learners, learning spatial concepts does require internalization of the external representations provided by the graphics or animation. The difference between students' spatial performance is determined by their ability to create, rotate and manipulate objects in their minds, and their knowledge of how to use these abilities to perform the spatial tasks given.

Conclusions

In the study, the main effect of visual treatment was observed significant for procedural learning, but not for descriptive learning, revealing that differences in visual treatment (the use of animation, still graphic, and text) were an important concern in procedural learning. Overall comparisons among different visual treatments indicated still graphics and animation were both better than text for learning procedural knowledge (not for descriptive knowledge).

Although literature reveals that spatial differences might favor students with higher spatial abilities in scientific learning (Cassity, 1997), insignificant effect of spatial ability was observed in the study. The effects of spatial differences might be tempered by the factors within the training and instructional setting. The use and training of various spatial strategies within the classroom setting also served as a function of gaining experiences of solving problems in descriptive and procedural learning.

The analysis of different visual treatments among different spatial-ability learners shows that the use of animation promotes descriptive learning among those with high spatial abilities, while the use of still graphics promotes procedural learning among those with low spatial abilities (compared with control group). Inconsistent with other studies (Hay, 1996; Hegarty and Sims, 1994), which concluded that lower spatial-ability learners benefit more from animation, the study found that those with lower spatial-abilities learned better with still graphics in the procedural tasks. For those with low spatial abilities, the element of motion in animation might require extra effort in constructing the procedural links among rules and steps. Motion might not be suitable for students when the procedural links among rules and concepts can be presented with sufficient clarity in a still graphic form. In addition, the limited capacity of working memory in processing animation among lower spatial-ability learners might be worth noting.

Learning descriptive facts requires deciphering and encoding the rules and verbal information. For students with higher spatial ability, the deciphering process is automatic. Animation might provide some level of elaboration for encoding process. As a result, learning of descriptive tasks was facilitated. With the motion cues embedded in animation, high spatial learners might devote more cognitive resources to building mental connections for elaboration. However, low-spatial ability learners must devote more cognitive resources to deciphering the visual information. They did not benefit from animation in descriptive learning as high spatial-ability learners.

In summary, this research points to the theoretical and practical benefits of visual treatment.Different treatment effects among different learners imply the need for considering the cognitive processes in different learning tasks. Onthetheoreticallevel,thisstudyconcludedthattheuseofanimatedandgraphicrepresentationsfacilitatesassimilation of scientific knowledge.On a practical level, this study raises the issue of differing mental processes for different learning tasks among different learners.From the qualitative assessment, it was concluded that learning requires internalization of the external visualization.Cognitive overload and spatial meta-cognition among learners when performing the spatial tasks was worth noting.Animation should be used with some caution, especially when internalized visual strategies are not an automatic processes employed by most learners.

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The Role Of Exports In Economic Growth With Reference To Ethiopian Country

Faye Ensermu Chemeda

Abstract: This study applies the Cobb-Douglas function model to analyze the effects of exports on economic growth in context of Ethiopian economy. To determine the relationship between export and economic growth, an attempt will be made to use econometrics techniques of analysis (co-integration system) by using the RATES software package for the time series data from 1950 to 1986. The lack of capital stock data is overcome by using the ratio of real investment to real gross domestic product (I/Y), in a place of capital stock while lack of labour force data is overcome by using the real gross domestic product per capita. The results suggest that the real export and (I/Y) are co-integrated with real GDP per capita. These results support the idea that the rate of growth of real exports has a positive effect on the rate of economic growth in context of the Ethiopian economy. Even strong positive relationship exists between real export and real growth domestic product per capita in long run rather than in short run when I compare real exports with that of (I/Y). Thus, the contribution of real exports to economic growth in context of Ethiopian economy is greater in long run than in short run.

Introduction

The are two extreme views which have attempted to assess the relationship between exports and econmic growth, i.e., some have regarded export as it contributed positively to economic growth. Others have regarded export, as it does not have contribution to economic growth. Even some have regarded export as it has contributed negatively to economic growh. For example, H.V.Berg and J.R.Schmidt (1994:p:250-51), O.A.Onafwara (1996,p:346) and D.E.A.Giles, J.A.Giles and E.McCann (1992,p:196) suggest that growth of export stimulates economic growth. In other words, there is a positive association between thegrowth of export and economic growth. The reasons most of them give are:

First, export growth may reflect a rise in the demand for the country's outputs, and this in turn will be realised in economic growth.

Second, by raising the level of exports, additional foreign exchange will be generated, and this facilitates the purchase of productive intermediate goods.

Third, a growth in exports may lead to greater productive efficiency (perhaps through economies of scale or technical improvements as a result fo contract with foreign competitors and enhanced output. Productivity growth is also assumed to be the result of specific policy choices, namely policies that expand exports.

Fourth, there are externalises associated with export sectors; export earnings allow a country to use external capital without running into difficulties servicing foreign debt.

On the other hand, arguments have also been made (see, for example, D.E.A.Giles, J.A.Giles and E.McCann (1992,p:196) in support of the opposite view point; i.e., it has been argued that export hinders the development of country. The reason some authors give for the fallrity of the export as the contribution to economic growth is that the strategy the country may depend crucially on the type of good that is being traded like primary commodities exporting. Moreover, D.E.A.Giles, J.A.Giles and E.McCann (1992,p:196) also stated that there is no effect of export on economic growth. Their hypothesis is rejected the existence of the effect of export on economic growth. As some of them stated, the positive relationship between real gross domestic product and real exports does not exist in developing countries like Ethiopia, which depend on exporting primary commodities.

In general the empirical evidence associated with the effect of export on economic growth is very mixed. Accordingly, the objective of this paper is to test the validity of the hypothesis, i.e., the effects of exports on economic growth in context of Ethiopian economy. In other words, the aim of this study is to investigate the magnitude of the link between exports and economic growth of the country in question.

Thus, this paper uses the data on Ethiopia to investigate the effects of exports on economic growth using the cointegration system. Since Engle and Yoo(1987, p:143) stated that a co-integrated system can be represented in an error correction structure which incorporates both changes and levels of variables such that all the elements are stationary. This error correction structure provides the framework of estimation, forecasting and testing of co-integrated system.

The paper comprises three major parts. The first part examines the methodology and the data used while the second part presents the result from the data. Finally, it is summarised.

Migration, Income and Employment Linkage in Ethiopia With Special Reference to Bahir Dar Town

Faye Ensermu Chemeda

Abstract

In both developed and developing countries, cities have been attractive centers to human settlement. As such, the rate of urbanization has been increasingly higher. In other words, the urban population in general and population of cities in particular are growing substantially faster than the total population. Moreover, this differential is widening in several countries. As a result, urbanization continues at a rapid, and sometimes at an accelerating pace. For example[1], in 1950, there were only two cities, London and New York, with populations of more than 10 million. By 1994, in the world the number of cities which had populations of more than 10 million were 14 of which 10 were in developing countries. It is also anticipated that there will be 27 largest cities in the world with population of 10 million or more two decades from now, of which 23 will be in developing countries, and only 4 in industrialized countries.

This has recreated a situation of incompatibility between urban facilities and the people who need them. This problem though prevalent in both developed and developing countries is more prominent among and within towns of Third World countries like Ethiopia.

This study examines and contributes to an enhancement of understanding of the urban situation in Ethiopia with special references to Baherdar town.

This town, one of the towns, which are found in Ethiopia, has an important role that is changing from time to time. The town was the capital of Bahirdar Province among Gojjam Administrative Divisions, latter it become the capital of West Gojjam Administrative Division.

Now it is a special zone and the capital of Region 3[2] and also serves as the capital of West Gojjam Zone, which is one of the administrative zones within the region. This Region consists of ten zones and one special zone, Bahirdar itself, 106 weredas, and 208 towns[3] (location that had 1000 or more persons whose inhabitants were primarily engaged in non agricultural activities were identified as towns irrespective of whether urban Kebele Administration has been established or not. Similarly capitals of weredas were also identified as town even if urban Kebele Administration has not been established). From these administratively importance, it is assumed that the population growth (as a result of natural and in migration) increased rapidly and leads to face a considerable socio-economic problems.

Among demographic factors, migration stands out as having strong and immediate political, social and economic effects. It is no wonder that many governments around the world rank (put) migration as the most pressing demographic related problem. For example, G. Standing (1984, p:1) stated that, according to the 1978 survey, the overwhelming majority of "developing" country governments saw population distribution as a greater source of development problem than population growth. He also stated that, by the 1980 survey in every part of the world, more governments regarded the special distribution of their population as cause of the development problem than their fertility levels.

But there are two extreme views {see, for example, G.Standing (1984, p:1)} which have attempted to assess the relationship between migration and socio-economic aspects.

[1] UNDP-UNCH(Habitat)(1996,p:6), 'The Urban Age", World Bank Urban Management Program and The World bank,Volume four, Number two, August 1996; HABITAT II -A Retrospective.

[2] Amhara Region is one of the National Regional States form the nine National Regional States of Ethiopia. It is found in the north western part of the country.

[3] CSA, (1995,p:144), The 1994 Population and Housing Census of Ethiopia, Results for Amhara Region,Volume I : Part I Statical Report on Population Size and Characteristics , Addis Ababa

Some have regarded migration as growing at a rapid rate in recent years, contributing to "excessive urbanization" and the growth of huge "mega-cities", to chronic urban open unemployment, worsening income inequality, ecological stress, population maldistribution and a growing threat to the social fabric.

Others have regarded migration {see also G. Standing (1984,p:1)} as a necessary part of economic growth, evidence of equilibrating tendencies, a factor facilitating industrialization, improving income distribution, inducing technical change in agriculture, reducing population growth and easing social tensions, mainly but not only in those areas from which the migrants move.

The approach used is to make the analysis of comparison of socio-economic characteristics of migrants and non-migrants to determine the linkage of employment, income and migration. Thus, based on this approach and relying primarily on secondary data of census survey of 1984 and 1994 and primary data of sample survey, which was carried out by NUPI on Bahirdar town in 1994, this study seeks to investigate the relationships among them.

Through out the study, to determine the relationship among migration, income and employment, an attempt will be made to use statistical techniques of analysis (cross section data and qualitative response model like probit model) by using the SPSS software package.

The facts & figures presented in this study indicate that relationships among migration employment & income are, in most cases, positive. For example the high proportions of the migrants that non-migrants were working age (15-39 years). In addition to this, on the average, more of migrants were better educated than non-migrants. The evidence also shows that, in the town, the migrant's contribution to the labor supply is not strictly proportional to their total number because the age sex proportion of employment rates are higher among migrants than among the non-migrants and the migrants have a higher proportion in the working ages.

What do all these facts add up to for the migrants and for the town affected by migration? Numerous studies (See K.C.Zachariah & J.Conde, (1981, P:12) have shown that migration improves the Well-being of the migrants it is also stated that migrants who stay in the town seem to be better off, on average, than people who remain in the place of origin. The income distribution of the town indicates that relatively more proportion of the migrants was in higher income bracket than non-migrants.

Finally, the result of probit analysis also shows that the linkage of employment, migration and income is in most case positive though there is a few exceptions

Online assessment decision supports in electronic portfolio systems using data mining technologies

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Abstract: A teacher can use student portfolios to evaluate learning performance and promote learning outcomes. The portfolios can also be used as a communication channel among students and teachers as students implement them on the web. However, it is burdensome for teachers to obtain the required information to determine student learning status. This study describes a web portfolio system that enables teachers to use information technologies to guide and evaluate student learning processes. Teachers can utilize this design to analyze the web portfolios online to improve instruction, understand the progress of students, and guide their learning.

Introduction

Educators have increasing interest in authentic and performance-based assessment to actively assess and manage students' learning performance. Authentic or performance assessment are used to describe a series of assessment practices that evaluate students in the process of performing real tasks with relevance to their education (Mcafee&Leong 1994). Portfolio assessment, one of authentic and performance assessment manners. According to Northwest Evaluation Association, portfolio is a purposeful collection of student work that exhibit the student's effort, progress, and achievement. That is, portfolios must contain students' learning products, learning processes, and learning perceptions (Lankes 1995). Such performance-based, realistic, contextualized assessment may be used to be applied to decision making about instruction (Shaklee et al. 1997). Electronic and web portfolios (Niguidula 1997)are increasingly being used in education applications as computer networks become more widespread. Integration of such portfolio with data mining tools enable teachers to not only comprehend student learning processes, but also make decision to assess students' learning performance.

Support of decision making with data mining tools

This work presents a web-based portfolio system to elucidate teachers' role in inducing and using student model and the method used to assess students' learning performance. Teachers desire to comprehend students' learning performances at application, analysis, evaluation levels for enforcing peer support strategy in the web learning system since teachers world prefer to recommend students only with application, analysis, and evaluation abilities to help others with analyzing and providing a solution to a problem. Therefore, the teachers and the learning system require the performance database that records the students' ability in each learning concept at the application, analysis, evaluation assessment levels. Constructing a performance database entails observing students' states by analyzing the quality of portfolios, inferring the ability of application, analysis, evaluation level from observed learning states, and updating student performance in the database. Figure 1 schematically depicts the architecture of constructing a performance database.

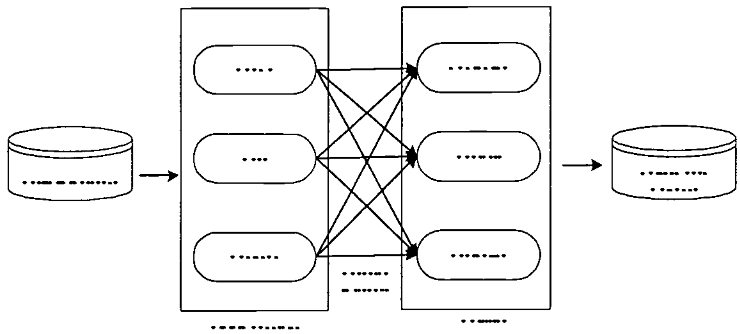

Figure 1. Architecture of constructing a performance database

For a portfolio of a certain concept, teachers assess the quality of the portfolio to assert the learning state that a student has reached after developing the portfolio. The teachers assert the following states from portfolios:

- *Known*: The student knows the definition and basic constructs of a learning concept.
- *Used*: The student has correctly utilized the learned constructs to solve problems.
- *Analyzed*: The student has correctly analyzed the effectiveness and performance of a solution to a problem.

Bayesian network software are applied Bayesian network technology to infer students' abilities from observed states. Table 1 lists the probabilities of inferring the application ability from *Known* and *Used* states in our experiment.

Application				
KNOW	Yes		No	
USED	Yes	No	Yes	No
Yes	0.9	0.6	0.3	0.1
No	0.1	0.4	0.7	0.9

Table 1. Inferring application ability from Known and Used states

Conclusion

Database and data mining technologies enable teachers to assess learning performance and enhance student learning with web portfolios. The web logs can record student portfolio development processes and facilitate teachers to query student learning processes via a clear frame of portfolios. In addition, data mining tools such as Bayesian network tools assist teachers to extract rules to infer student ability level from observable state in portfolios. Thereby, teachers can go online to utilize the valuable information in web portfolios to predict students' performance, and hence regulate proper strategies for promoting performance.

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BKD(Bayesian Knowledge Discoverer) develop by Knowledge Media Institute of The Open University, URL is http://kmi.open.ac.uk/projects/bkd.

A Mentor finder based on student preference and learning status for web-based learning systems

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Abstract: Because students can not interact face to face with each other in an asynchronous learning situation, they are difficult to know who is able to help them. Thus, teachers or teaching assistants should put many efforts in solving students' questions. Besides, students have no chance to learn by teaching others. In this paper, we use existing commercial machine learning tools to construct a mechanism for suggesting peer mentors for students according to their questions and preference. The mechanism will locate peer mentors who not only perform better than the student in the area of the proposed questions but also can possibly provide solutions that can be understood by the student that issues the questions. Experiment data is provided to demonstrate that the mechanism also distributes the mentors equally without putting all the efforts on some particular well perform students..

Introduction

Peer support becomes an important method for students to involve their learning process (Baker & Dillon 1999). Acquiring such an understanding through experiential learning facilitated by student mentors is offered by London Guildhall University Student's Union. When students encounter learning problems in the web-based learning system, finding suitable companion mentors for them to help each other is a good way in both reducing teacher's effort and solving students' learning problems. However, two things need to take into consideration for choosing a mentor. One is that the mentor should be able to solve the problems. The other is that the student should understand the explanation of the helper. Moreover, the student should be willing to accept the helper. In Flower and Hayes (Flower, & Hayes, 1981), they proposed an important writing progress model, which indicates that everyone has a different writing style. Students may have different preference to select article/answers proposed by others. In other words, reader's acceptances on article writing styles depend on individual's preference. Article writing on the same topic is not always suitable for each reader because of different writing preferences. Therefore, finding a mentor whose knowledge is good enough and suitable for learner's preference is the key points to peer support in web-based learning system.Some systems have designed effective mechanisms for finding experts. For instance, Expert Finder (Vivacqua, 1999) helps users to locate expert in Java programming. It determines the expertise of Java language according to the frequency of object classes used in java programs developed by the expert candidates. Although this model could get the student's learning states, but student's preference are not considered in this model. Referral Web (Kautz et al. 1996) utilized personal email to identify users' interest and employed the social network in the email to search the expert for helping users. This method uses the classification methodology to locate the helper with the same interests. However, this method does not immediately detect everyone's status and preference.

Finding companion mentors for students in web learning systems involves detecting learning status and getting students' preference. While using web-based learning systems, there are several difficulties about how to find mentors for students. For instance, the mentor finder system should sustain a list of learners, who master a specific learning topic, before suggesting suitable mentor companions for a learner, who encounter problems in learning the specific learning problem. Moreover, the mentor finder system should know how to rank those qualified mentor companions by prediction of the pupil's progress. Hence, the mentor finder system can suggest a most appropriate mentor companion from whom the pupil will most benefit. To finding a most suitable mentor for a learner, the difficulties that a collaborative learning system will encounter are summarized as the following three problems.

Learning Status Awareness Problem

In order to understand who has the ability to help other classmates, the teachers of learning systems must detect students' learning states immediately. When students encounter learning problems, the mentor finder system can suggest mentors who have the capabilities to solve their question. In other words, the mentor finder system should know how to get every learner's current learning states. However, it is not trivial to immediately detect learning states in an asynchronous, for instance Web-based, collaborative learning environment. A behavior monitoring mechanism is a postulation to solve this problem, but it is not enough. For instance, we do not know that a learner is browsing, reading, or studying a Web page when he/she accesses the Web page. This difficulty is denoted as a *learning status awareness* problem.

Preference Detect Problem

Because of learning through web learning systems, students have less chance to have direct interaction with others. The system is not easy to capture the students' preference among their classmates. Therefore, the mentor finder system needs a mechanism to collect students' predilections from all aspects to know student's preference about other classmates. In order to get all students' preference without adding too many loads for students, a feedback assessment mechanism is needed for students to decide preference level in discussion board. By this way, we can collect each student's preference. A preference detect mechanism is needed to suggest mentors that the students with problems will be highly possible to provide solution or explanation that can be accepted by them. This is a *preference detect* problem.

Preference Classification Problem

In order to find out suitable mentors for students, the mentor finder system needs to consider student's ability and preference about each other. Besides, the mentor finder system also should avoid suggesting mentors from a small pool of students who have good learning performance in all aspects. For instance, a student's test grade within the top 10% of students can help the other 90% of students. However, it is not a reasonable obligation for the top 10% of students to dedicate to teaching others. In other words, the mentor finder program should suggest mentors that not only qualify to answer the questions for the student, but also learn something by teaching others. Consequently, both a pupil and the suggested mentor can benefit from the mentor finder mechanism. To sum up, learners' preferences compounded the difficulties of finding out the most suitable mentors. A *preference classification* problem represents aforementioned difficulties.

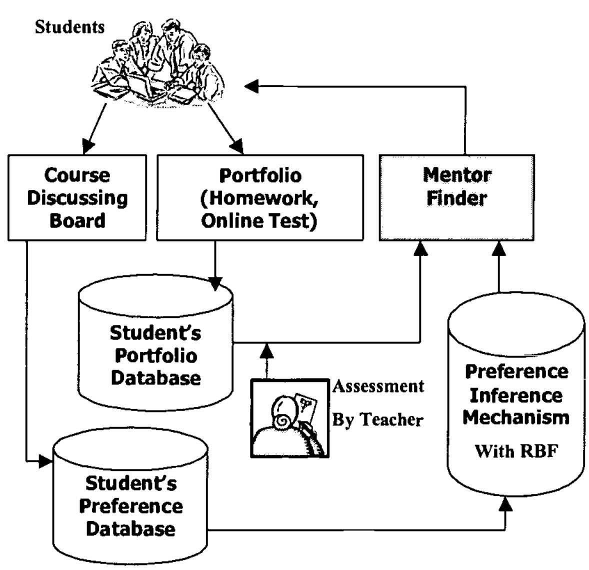

Figure 1. Mentor finder with portfolio assessment and RBF technology.

This paper presents a novel methodology to assist teachers in finding companion mentors for the students requiring help in the web-based learning systems. The methodology utilizes machine-learning technology on web portfolios to solve the problem. To classify students' preferences, the mentor finder system uses one of the tools provided by *"IBM Intelligent Miner for Data"*, which is a famous commercial product of machine-learning technology. RBF(Radial Basis Function) technique in the set of intelligent mining tools is used to classify all students to categories of preferences. After classification, all students can be ranked by two dimensions, the students' preferences and the learning performances of a topic. By using the results, the mentor finder can suggest suitable mentors for who needs help. With the mentor finder system, the processes of collaborative learning is more efficient than traditional heterogeneous grouping strategy for collaborative learning. Furthermore, an innovative method of using learning portfolios on a collaborative learning system is proposed to assess students' learning status by integrating with students' preferences. Consequently, student can support with each other by the mentor finder system, and thus reduce an instructor's efforts of answering students' questions. Figure 1 illustrates how teachers of web-based learning systems utilize portfolio assessment to analyze and observe learning status and preference via a discussion board feedback and RBF technologies

Reasons for using portfolio assessment and RBF technology

Teachers require automatic mechanism to detect student's learning progress to know who is excellent to teach other students. Expert Finder (Vivacqua, 1999) helps users to locate expert of Java programming. It helps teachers to find out lists of learners who are excellent in a learning topic of Java programming. In other words, the key of finding suitable mentors for a student is their degrees of mastering a learning topic. However, few students with good learning performances will be burdened with answering questions if results of learning assessment are the only referable factor for finding mentors. Consequently, students' preferences about authors of discussion articles can disperse the opportunity of playing the mentor role to most students.

The web learning system allows multiple students to learn and interact with peers on the Internet. In order to let students help with each other, when students encounter learning problem, teachers of the web learning system need to know which student is good enough to consult. For not to concentrate on few excellent students, every student will have a chance to be the mentor by using RBF technology to take into account students' preferences about other classmates. Therefore, in addition to using domain knowledge to assess student's portfolio, RBF technology provides an inference mechanism for the instructor to find mentor who is suitable for a learner's preferences. Integrating portfolio assessment and RBF technology can help teachers to locate suitable mentors for a student from two perspectives.

Portfolio assessment for detecting students' learning progress

In order to get students' learning status of every learning topic, the first task is to determine what learning topics should be included in the C programming course. The contents of a C programming textbook are reorganized to a style of learning topic oriented, called a *topic map*. It is worthy to be noticed that a learning topic may contain many concepts. Hence, it is not proper to refer the topic map as a concept hierarchy because every node of a topic map represents a learning topic, which may be composed by many sections, in textbook. Fig 3 illustrates the topic map of a student's learning status that is denoted by skill levels.

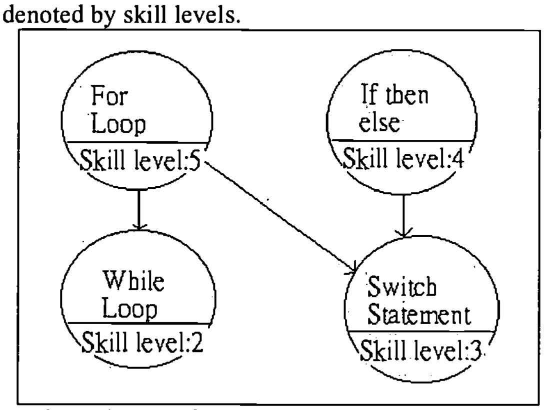

Figure 2. A student's topic map with skill level.

We build a topic map for each student to record his/her skill level about each topic in textbook. In order to detect student's skill level about each topic, there is homework or online test next to each node in topic map represented in Fig 2. The system will ask student to do homework or online test on web learning system to detect student's learning status. After students have finished homework or online test on time, teachers then assess students' homework or the system will grade students' answer of an online test immediately. Consequently, the portfolio assessment mechanism can completely record every student's grades of every learning topic (node) in his/her topic map. Furthermore, an instructor can shortly know a student's learning status of every learning topic by maintaining every student's topic map.

Collecting students' preference feedback from discussion board

Because of less contact with classmates during distance learning environment, we build a feedback mechanism in discussion board. In our system, we have logged the author who post articles in discussion board. When student browsed each article on the same page, we set a questionnaire for student to express his preference. Through questionnaire in discussion board, our system logged all attributes as follow table.

Student Name	Reading Time	Article requested	Article Author	Preference Grade
Linms	11/Oct/1999/11:02:41	/cgi/vc/Read.exe? article=990242	Robert	3
Linms	11/Oct/1999/11:03:05	/cgi/vc/Read.exe? article=990231	Christia	4

Table 1. Example of preference log about students from discussion board questionnaire

We log student's name, each article's reading time, each article's ID, article's author and the grade of preference that indicate reader's preference. We set five degree 1~5 in preference grade for student to express their preference about other classmates' article. For example, in second row of table 2 represented that student Linms read an article, which ID is 990242 and the article author is Robert. The reader's preference about this article is at level 3. In table 1, we can see that Linms likes Christia's article more Because of each article has an author, we can know student's preference after he read the article and give us the preference feedback. By this way, we can help teachers to know student's preference about some classmates after he uses discussing board.

Inference all students' preferences about other classmates

Because of less contact with classmates and most learning behavior is performing in web site, student has less chance to read every classmates' article and portfolio. Therefore, teachers of learning system feel hard to know students' preference on all other classmates without using inference mechanism. Here we use a machine learning skill RBF(Radial Basis Function) which is a conditional probability inference method. Radial Basis Function is used to find nearest students who have the common preference. Because RBF just has one layer inference function in his network, it infers rapidly to help student to find out who are the suitable mentors for him.

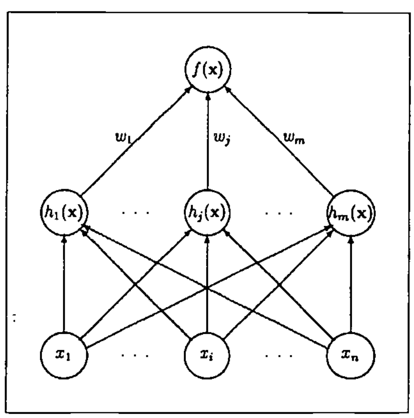

Figure 3. RBF inference network example

Figure 3 is a RBF influence network example. RBF, which looks like a neural network, influence each node from one to one through direct arrows. In figure 4, f(x) is the result function that RBF can find out from students' preferences. The final f(x) is the summation, formally called a linear combination, of all $w_j h_j(x)$ where j ranges from 1 to m. If the f(x) function is calculated, it can be used to rank classmates for a student by preference perspective. In other words, the f(x) function will score a candidate from preference perspective. For instance, the priority of student S_1 is higher than student S_2 if the value of $f(S_1)$ is greater than the value of $f(S_2)$. Hence, the mentor finder system can use RBF as an indicator of a student's preferences about his/her classmates to suggest learning companions, who are qualified by portfolio assessments.

Each x_i in Figure 3 represents a student and each $h_j(x)$, formally called radial function, represents the feedback mechanism attached to a discussion article. The mentor finder system sets up a RBF inference network for every student to represent the preference. For example, every student, who is illustrated by x_1, x_i, and x_n, in Figure 4 has read three articles in discussion board. The feedback parameters coming from those three students' preferences compose the vector $\langle h_j(x_1), h_j(x_i), h_j(x_n)\rangle$ where using a typical style of radial function to represent $h_j(x)$, that is Gauss Function. The other two vectors are $\langle h_1(x_1), h_1(x_i), h_1(x_n)\rangle$ and $\langle h_m(x_1), h_m(x_i), h_m(x_n)\rangle$. The goal is to find a f(x) and its "distance" to the three vector is as close as possible. In other words, the problem is theoretically like determining the least squares function, which has been proven to have at least one solution, in linear algebra.

$\langle w_1, \ldots, w_j, \ldots, w_m\rangle$ in Figure 3 is an optimal weight vector used to linearly combine all radial functions to get the experience function f(x). After the optimal weight vector is founded, the experience function can be used to help students find favorite classmate. When a student encounters learning problems, we input all classmates' preferences with three qualified students in experiment function like figure 4 to derive how much does the learner prefer about each mentor. The basic inference rule is that if a C-student likes A-student's articles and B-student likes A-student's articles then the C-student have more probability to like B-student's articles.

Evaluation Result

An experiment is conducted herein to evaluate the mentor finding system. The experiment engages 54 undergraduate students electing the one-semester course, *Introduction to Computer Science,* in National Central University. After learn in the conventional classrooms, students are required to discuss in the learning system. The collaborative learning environment for programming results about 2993 discussion articles in four months. A native approach of finding peer mentors is to recommend the top ten students in the learning program to students who need help. However, one issue of recommendation is that a student should not assign to solve others' learning questions too frequently. Therefore, the recommendation experts should not converge on a certain group students who have expertise in the learning program. The recommendation expert should distribute on any students who are able to answer the question. An evaluation is made to clarify the effect of the learning system to distribute loads of excellent students in the learning program. The system recommended experts in terms of only the required knowledge level and students' preference, rather than the expertise in the whole learning program. Therefore, any student who is master of the proposed learning questions, even he/she is not the top ten students, may be recommended.

Figure 4 lists the loads of every student. A vertical bar indicates the frequency of suggesting a student as a mentor. There are 54 vertical bar in Figure 4 because there are 54 students involved in the experiment. When a student plays the mentor role to support a pupil, the pupil will be inquired about whether the mentor is suitable for him/her. The frequency of pupils' agreements about a student is shown by the white part of a vertical bar. Regardless of students' rank in the whole learning program, each student is possibly to be recommended to solve others' questions. The experiment result in fig. 4 shows that the recommendation times for each student as well as the times students regard him/her as an expert for a learning topic. The result indicates that although the top ten students are generally considered as experts to solve others' problems, other students are possible to be capable of solving peers' learning problems. A sophisticated mentor finder system is required to distribute the workloads of excellent student and accurately locate experts not only in excellent students.

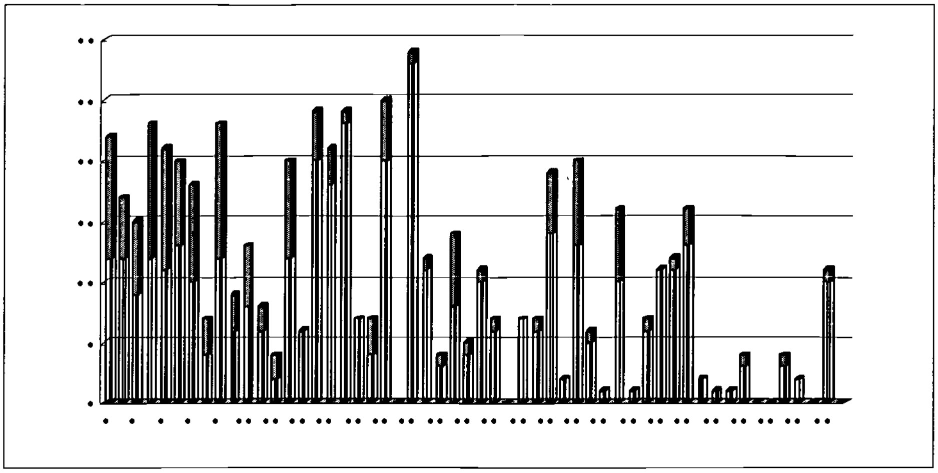

Figure 4. Distributing workloads over learning companions.

Conclusion

To experiment with the idea of suggesting mentor, a Web-based collaborative learning environment was constructed. Then, a novel sub system, called mentor finder system, was designed and implemented to support students find suitable mentors among learning companions. To properly suggest mentors for a student, the mentor finder system uses a discussion board to collect students' preferences and use portfolio assessment to get students' learning status. The topic map is introduced as a repository for every student's learning status of every learning topic. Moreover, a feedback mechanism for collecting preferences can automatically attach to every discussion article when a student reads it. Besides, the mentor finder system successfully integrates a machine-learning tool, RBF (Radial Basis Function) technique coming from IBM Intelligent Miner for Data, to classify students by similar preferences. The operation of calculated RBF functions as an indicator in view of a student's preferences before the mentor finder system suggests learning companions. Most important of all, the experimental results show that using students' preferences as a bias to suggest suitable mentor is more acceptable than what without considering students' preferences. Hence, the mentor finder system can let everyone have a chance to be the mentor that makes the best students won't be too busy resolving other students' questions.

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The Development of A Hypermedia Language Learning Environment For Teaching Academic English

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Abstract: Considerable research has shown that academic language is more difficult and takes longer to learn than social language. Comparatively, there are two factors affecting language comprehension: context and cognitive complexity. With these two factors in mind, the paper describes how hypermedia and web-technology can be deployed to support academic English learning. Based on these considerations, we developed an interactive hypermedia language-learning environment, called "AcademicEnglish", based on communicative approach in second language acquisition (SLA), for EFL/ESL academicians to improve their basic communication abilities in academic contexts. To support our hypotheses in building such an environment, we conducted a questionnaire survey of the difficulties in academic language learning. Moreover, we have explored the research findings of SLA from the educators' and learners' points of view. The focus is to present our approach in communicative-oriented courseware development. Based on the new hypotheses that emerged from the preliminary study and the literature, we built an illustrative prototype system, which intends to allow learning goals communication, learning activities negotiation and collaboration between learners.

Introduction

The effectiveness of computer-assisted language learning (CALL) systems has been proven by many previous studies (e.g., Yang, 1997). However, the main weakness of current CALL systems is that most of the video-based multimedia materials treat language as a set of linguistic structures. Thus, language is taught as words and sentences, not as discourses and interactions in context (Duranti &Goodwin, 1992). A communicative focus on the appropriate and meaningful use of language in a variety of contexts is still in its struggle in a computer environment, although hypermedia tools have offered a context for the successful acquisition of communicative competence with the aid of CALL. Another problem in present CALL systems is that there is little courseware for non-native English speakers to learn English for their academic purposes (Jarvis, 1997). Even if some systems provide examples, words, etc., from the academic life, there is no major difference between the support for social language learning and academic language learning in their courseware implementations. Context and cognitive complexity will be the two main factors that affect academic language comprehension. So the current CALL systems cannot meet the academicians' requirements and needs. Therefore, our research goal is to respond to these needs, by building a hypermedia language-learning environment for teaching academic English via the World Wide Web. We intend to find the best ways to organize, present, and index multimedia information to maximize effective academic English learning for academicians.

This paper is organized as follows: in section 2, we start by presenting the research goals of our system; then, in section 3, we show the results of our preliminary tests, and in section 4 the new constructive hypotheses that emerged from it. Section 5 is dedicated to the illustrative prototype system that we have built, based on these new hypotheses. This section presents the general overview of our system, as well as the AcademicEnglish courseware that we built, based on the communicative language teaching approach. Section 6 presents a discussion about our work. Finally, in section 7, we draw some conclusions.

Goals

Our study has four purposes: the first one is that academic language modalities are developed for content area activities, as they are needed, rather than being taught sequentially; the second one is that students should learn academic language and content more effectively with the explicit instruction of the learning strategy and communication skills; another one is that the simplification, comprehension and visualization of the domain content will allow students to focus more on language learning; the last one is that the hypermedia learning environment access methods should be "cognitively relevant" to the learning, reasoning, and information seeking goals of the user.

Pre-experiment

In order to achieve our goals, we have done some preliminary experiment before actually designing our system. In this way, we could determine what kinds of components affect a student's learning process, and how the various elements fit together. This study was conducted by a questionnaire survey of 20 ESL/EFL students majoring in computer science. The test was designed to examine the difficulties influencing the academic contents learning and language acquiring.

We interviewed 20 students by questionnaire. The questionnaire consisted of 20 questions, including close-ended questions and open-ended questions, like "*What are your language problems when you read and listen to academic materials in English?*", "*What type of words cause problems when you read and listen to academic materials in English?*", and others. The subjects questioned were all students at university level. In short, the test results showed that students who learn and use academic English might experience content-related problems and language-related difficulties as well (see table 1 and figure 1 for more details).

Elements	**Difficulties**	**Number of Responses**
Discourse	Expository discourse	18
Non-linguistic factors	Concept formation	16
	Content knowledge	10
	Domain cultural background	7
Vocabulary	Subject-specific vocabulary	17
	Essential vocabulary	7
Grammatical forms and structures	Passive voice	11
	Multiple embeddings	15
	Long noun phrases	10
	If…then constructions	8
	Expressions indicating causalities	11
Academic language skills	Listening skills	16
	Speaking skills	18
	Reading skills	10
	Writing skills	15

Table 1: Difficulties in academic English learning

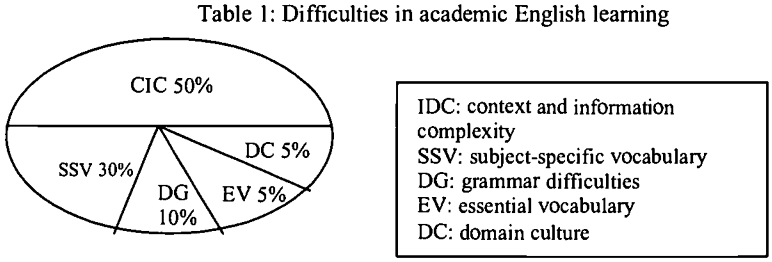

Figure 1: Percentage of factors influencing content comprehension

Resulting Hypotheses

The learning environment and courseware that will be presented in this work is based on the following four hypotheses derived from our preliminary tests (for more detail, see, Chen, 2000) and from various other research studies (e.g., Brett, 1998): 1) interaction and negotiation are important features of communication, and therefore of second language learning; 2) students learn academic language via domain content more effectively with the explicit instruction of learning strategies and communication skills; 3) hypermedia environment with well-defined courseware can play a mediating role between academicians and their context; 4) learning should be communicative, active, and dynamic.

The four hypotheses above are used as the springboard for an examination of the possibilities and pragmatics of developing a communicative-oriented hypermedia-language learning environment for the delivery of academic English learning courses via the web.

AcademicEnglish: an illustrative system

Based on our hypothesis, we have developed a hypermedia language-learning environment called AcademicEnglish, which contains multimedia material targeted at undergraduate artificial intelligence (AI) and knowledge computing students. The environment allows students with some background knowledge structure of artificial intelligence (AI) and education technologies (ET) in their own native language to learn to express and use this knowledge in English in academic context. The subject materials for the environment are topic-based conversations, which came from introductory AI courses, which are delivered via hypermedia language learning environment in accordance with the improvement of students' listening comprehension and furthermore with their academic language competence.

System structure

The architecture of AcademicEnglish consists of three layers (see figure 2): *visualization layer*, *logic layer*, and *data store layer*. The visualization layer presents the actual learning material and interacts with the user or a group of users through the Internet. The logic layer serves for the processing logic and allows the users to access the teaching resources in the data store layer via the *search mechanism* and to check answer and get feedback via the *assessment mechanism* (for more detail, see the next section) as

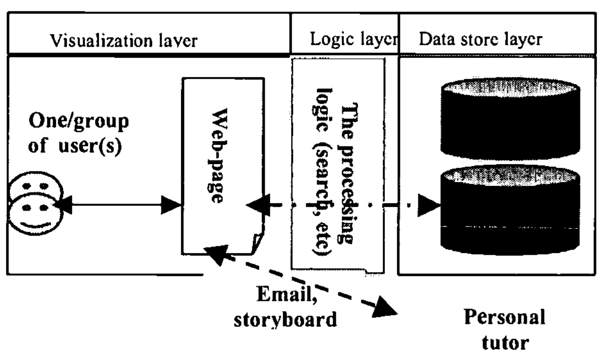

Figure2: System Structure

well. The last layer is the data store layer, consisting of two databases; one is the *teaching resources database* (for more details, see Chen, 2001) and the other one is the *student profiles*, in which students' personal data, learning behaviour, learning and communicative strategies, and actual performance will be stored. Furthermore, during the learning, we provide three types of interactions: interaction between the user and the system, interaction between the user and other users in the same group, and interaction between user and the human teacher.

Assessment mechanism

In analyzing student input, the environment contains additional assessment modules, which get evoked when processing a student's answer. Figure 3 illustrates the modules of the simple natural language processing.

The first module in analyzing student input, the system extracts the base forms of each word. When defining an activity, we anticipate and store possible answers of a given task. The Answer Check module matches the extracted base forms with the anticipated answer. If any of the words in the task are not contained in the student answer, the system will report an error.

The Error Check is the most elaborate of the modules. Here the sentence is analyzed by the semantic parser according to the rules and a corpus of language.

The assessment mechanism is organized in a way that if a module detects an error, further processing is blocked. As a result, only one error at a time will be displayed to the learner. This was implemented mainly to avoid overloading the student with extensive error reports in the case of multiple errors. After correcting the error, the student restarts the checking mechanism by clicked the "Continue" button. Then all of the data will be stored into the student learning history and update student profile

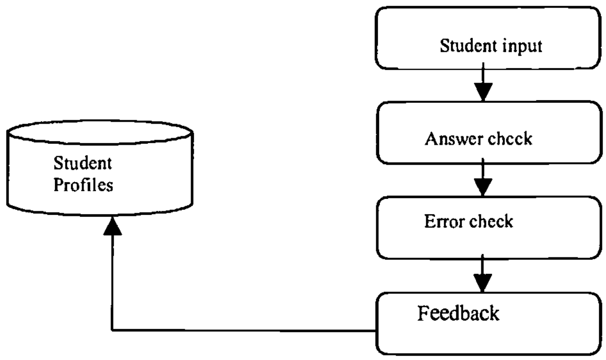

Figure 3. A diagram of the assessment mechanism

Courseware structure

When this environment is used, in the beginning, registration details, such as name, email address, and level of English learning of the user is required. After the registration, the user has two choices: to search the course via the VOD search mechanism (*autonomous study*), and to access the course via a placement-test (*automatic study*). When the user chooses one of them, the activity with VOD corresponding to the user's choice appears on a newly generated page. Each activity session consists of three modules: pre-viewing module, while-viewing module, and follow-up module (for more detail, see activity design section). After each session, the environment will update the relevant attributes of the student profile (e.g., current progress, learning behavior, communicative strategies, etc). Then it generates a plan of remedial actions and presents it to the student in the form of suggestions for further sessions and learning, and the user him-/herself can decide whether to continue the study or end it.

VOD-support dialogue linking

We edited some complicated AI and ET course-book into oral conversations, and then recorded them as video resources. The whole courseware consists of ten topics, and each topic is subdivided into several subtopics, and each subtopic has three levels of dialogues. In total, our present courseware contains one hundred dialogues, and each dialogue corresponds to one video resource. The dialogues in a topic are internally presented in a form of a directed acyclic graph that we call " concept map".

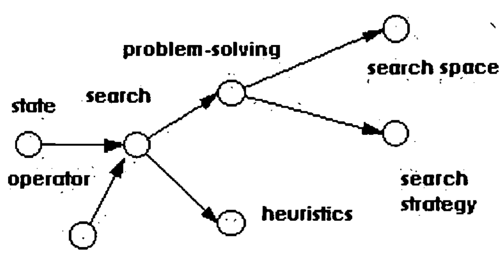

Figure 4: A sample concept map

Each dialogue is presented as a small hypertext document, which represents a node in the graph, and arcs define the prerequisite relations between the dialogues. The prerequisite relations are attributes that are defined as video numbers. The inputs of the nodes are constraints to activate the actual node, thus user can begin with any of the node via Search mechanism. Figure 4 illustrates an example of a simple knowledge graph of a topic and its subtopics, where a student must understand the concepts *state* and operator to understand search (a fundamental technique in AI).

Activity design

The academic language function acquiring, language learning strategies and communicative strategies are naturally embedded in content activities. We defined the activities with three language levels: 1) intermediate, 2) upper-intermediate and 3) advanced, in addition, there is a continuum in the activities in and among each level, which are graded according to the cognitive and performance demands made upon the learner, moving from *comprehension* based activities to controlled *production* activities and finally ones which require the learner to engage in real *communicative interaction*, which are hierarchically organized into three modules: (a) pre-viewing module, (b) while-viewing module, (c) follow-up module. Student's performance in each activity contributes to the student profile.

In the present courseware, we used communicative teaching strategies, like eliciting, personalization, information gap, problem solving, and game playing, etc., to promote opportunities to use language meaningfully. Here we give the information gap activity as an illustration:

Information gap activity

These types of activity are focused on extracting, recording and sharing information in various class groupings. This is exemplified as follows, where we see a unit, which is built around an information gap task. The activity contains the following steps.

The activity goal: Plan a project

The description of the activity: In this activity, you will watch two videos describing various concepts of AI Search technique. Your task is to use the information you heard to produce a project based on the AI Search technique.

Activity contents:

Pre-viewing module:

Instruction1: please write five subject-specific vocabularies about the AI Search technique in two minutes, and click the "Hidden" button to compare yours with the vocabulary list. (The "Hidden" button displays subject-specific vocabularies and academic language functions involved in the conversations.)

While-viewing module:

Instruction2: *Step one*: here are two videos describing some concepts of the AI Search technique. Please listen to one, and then inform your partner to watch the other. And then answer to the questions relating to the conversation you heard individually. You may replay the tape as often as you need in order to find answers to the questions. Then press the "Check" button to check the answer.

Step two: exchange video information with your partner by asking five questions via dialogue box and then fill in the information table. After finishing, press the "Continue" button.

Step three: watch your partner's video, and check the information you got from your partner, and you can reverse it according to your understanding. And then press the "Check" button to check your answer and read the feedback (see the assessment mechanism for more detail). Write an evaluation to your partner via the dialogue box.

Follow-up module:

Instruction 3: *Step one*: below are a diagram and a title for the project. Use the information in the information table to write an abstract of a project based on the AI Search technique within 300 words. The subject-specific vocabularies should be included in the abstract.

Step two: press "Publish" button to publish your essay online, and then select the "View" button to share your partner's abstract; if there are some language problems, please correct it and send it to your partner.

Step three: now reread your own abstract carefully, especially your partner's correction, if you disagree, you can negotiate with your partner who corrected your abstract.

Step four: rewrite your abstract and send your final version to your personal teacher.

Table 2: A scenario of information gap activity

Discussions

In view of our research purpose, the analysis and descriptions we have just offered have attempted to present the full potential of our illustrative system. Our methodologies involve designing CALL systems based on our hypotheses, conducting empirical studies with students, and building an interactive hypermedia language-learning environment.

Related to the system development, we intend to provide the users with a dynamic, flexible and communicative learning environment. The three types of interactions provided allow the user to negotiate the meaning in her or his academic language competence development. The selection and realization are based on our five hypotheses above.

Related to dialogue editing, since academic course text is decontextualized, we put our emphasis on the simplification, comprehension, and visualization of the domain content, which, we believe, results in SLA. Research on comprehension outcomes using written or spoken input texts, which contained large amounts of these features (i.e., a slower speech rate, bimodal input, and elaborative modification of the discourse (Conrad (1989)) in non-interactive input, have consistently showed greater resulting comprehension.

Related to dialogue arrangement, we adopt an approach of using relatively small, linked knowledge elements, which has many advantages. Firstly, it makes it possible to effectively define specific goals for studying. Secondly, student's knowledge of each topic can be estimated separately by enabling automated navigation guidance, and thirdly, the hierarchical structure of information is stated explicitly. In a learning context, students bring to bear a variety of knowledge, goals, and strategies. These can result in a considerable variability in the nature of the activity that arises while interacting with computational artifacts. Our intention is to provide different types of access methods so that individual learners can make appropriate choices.

Related to activity design, following our hypotheses, we put emphasis on the need to relate the new concepts and knowledge with the learners' existing knowledge, comprehensive input, and authenticity of language use. We expect that language learning can become a "communicative practice". The pre-viewing activity follows Schmidt and Forta's (1986) findings that by 'noticing the gap' between the state of one's current language knowledge and output, and then by consciously comparing this with what has been experienced in input, learners will realize language gains. In the while-viewing module, we believe that listening comprehension tasks, coupled with feedback, may help learners to "notice the gap" in their comprehension. Furthermore, the hypermedia environment may provide access to the linguistic phenomena that have caused comprehension breakdown and the resources to facilitate a negotiated understanding of these problematic linguistic items. Finally, the follow-up module provides communicative activities for users to monitor what they have learned and furthermore to intake what they have learned. The selects and realizations are based on the assumptions about SLA of Krashen (1977) and on the hypotheses about communicative competence of Hymes (1972).

Conclusions

In this paper, we proposed a hypermedia language-learning environment based on the communicative approach. Our work is in the analysis and design phase and the actual system is in progress. What we need to do in the next steps is to implement the courseware, including assessment mechanism. We also need to continue to develop the collaborative learning functions. Finally, we plan to do real-life experiments to evaluate the effectiveness of our academic English teaching environment.

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Voice Interpretation On Web

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Intranet is a local group of computers where each terminal can communicate between each other. The main theme of this project is to convert voice message into text format and pass it to all the terminals in Intranet. This system is developed in RMI (Remote Method Invocation). This system deals with the communication in the Company. In this model one system will act as a Server and the other system will be clients. Server should be turned on always. Accounts should be created for all the clients in the Concern. Client has to log into the Server to get response for its request. Database is been maintained by the Server to evaluate the user id. Server will provide the details of the active clients connection and all the members of the concern.

Server spoke the messages and it is converted into text format using the IBM Via Voice Software and placed into the message box of the Server. And the Server can make corrections if required. Finally the Server will pass these messages to all the members of the company through Intranet. During the data transfer if the client is not connected then the message will be stored in the client's inbox. Later when the client log into the system all the messages will be listed in the inbox which can be down loaded like in E-mail.

In Server side, maintenance modules are added. They are New User, Change Password and Disconnect. New User module helps the Server to register the new client. And for each new user a separate inbox (directory) is created. To tight the security Change Password module is used. Server can also disconnect the active client by sending the tokens to the client, using Disconnect module. So the user has to get connection once again.

The Client can also disconnect from the server and Server will receive immediate notice of the client disconnection. Client send acknowledge message to the server about its message receivable. Help is also provided which will guide the user to use the package efficiently.

All the distributed system uses the registry to keep track of the addresses of remote objects that are being exported by their application. In RMI, stub and skeleton are created for the server. The stub is a client side proxy of the remote object. The skeleton is a Server side proxy of the remote object. RMI Registry application should run continuously as the background process. It can add or remove the object to or from the registry.

NetKnowledge Presenter and Content Reuse

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Abstract: Streaming technologies, with the introduction of synchronized media support, are now able to produce a more faithful copy of classroom lectures, and hence, meet better the distance education needs. At the same time, streaming content creation and distribution tools are also widely available. However, many of these tools are not designed to allow users to edit, reuse, and share contents. Without such flexibility, authors' productivity and opportunities for incremental content refinement are greatly constrained. For example, users cannot import parts from an existing web presentation into another one. In this paper, we describe a streaming authoring tool that we have developed to facilitate the editing of the parts of a slideshow presentation and assembly of those parts into future presentations.

Introduction

Recent developments of streaming media technologies have dramatically improved the Internet's capacity to serve as an effective medium for sharing multimedia contents. Nowadays the viewer can start watching a presentation as it downloads and the streaming content can contain different media types that are synchronized in time and space. This is attracting individuals and organizations to make use of the new opportunities for reaching a wider global audience. Education is one of the fields that can benefit directly from this potential.

There are already many lectures available on the Web and many others are published everyday. Probably the most popular format of web lectures is slideshow, where audio/video narrations are correlated in time with slide images. Such lectures are usually generated by recording continuously the live presentation and capturing timing information of the slide transitions. Although there are tools that assist users in creating and publishing their digital presentations, only few of them offer a reasonably practical solution and an even smaller number provide means for flexible editing of content as well as facilitating sharing and reuse. In this paper, we propose NetKnowledge Presenter, a web presentation authoring tool that realizes content reusability by maintaining the parts (i.e., slides and narrations) of a presentation separate. The audio/video part of the presentation is encoded into one single stream and built from assembling the individual audio/video narration files produced for each slide. Slides are static image files that match to each change in the original slide (e.g., animation effects). Our framework, by enforcing the separation of a lecture into independent editable units from the creation stage, allows content producers to incrementally add new parts to a presentation or replace existing parts with new ones.

Discussion

RealNetworks RealPresenter [1] is currently one of the most known and complete web presentation tools. It takes advantage of RealNetworks' client-server tool suite, providing a solution that ranges from presentation recording to publishing. Nevertheless, editing options are limited - you can change the narration for a particular slide, remove a slide or otherwise start over. There are no provided facilities to insert new slides or reuse previously prepared ones. Furthermore, the editing model maintains the complete original audio/video encoded file and for each re-recorded narration, which corresponds to a particular slide, creates a new audio/video encoded file. This new file is then linked to the original file through SMIL [2] based on timing information. In the worst case, a n-slide presentation which has had $(n - 1)$ of its slide narrations replaced, will result in a total of n audio/video encoded files that need to be uploaded to a streaming media server. In contrast, our approach guarantees that a single audio/video encoded file is uploaded which will be as big as if it were produced in a single live presentation using RealPresenter

[1] without editing. In other words, our upload file is independent from the number of slide narrations being replaced. We achieve this by merging the individual slide narrations after all editing is done. This is possible because we store every slide narration separately which is reflected in the way the presenter records his/her narration. Apart from the fundamental difference in capturing the presentation, our tool provides additional capabilities not available in RealPresenter [1]. A brief comparison table can be seen at http://vulab.ias.unu.edu/research/publications/nkpresenter/table1.shtml.

User Environment

Given the wide availability of Microsoft PowerPoint, it has been selected as the host application for our system. As soon as the user has finished composing the slides and is ready for augmenting them with narration and other features, he/she may start NetKnowledge Presenter and fill in the metadata for the presentation. Next, the user is taken to the main editing interface, which contains an ordered list of the slides, a preview of the slide image and all the recording and playback controls. To record a narration, all the user has to do is select the desired slide and press the record button. Individual narrations may be previewed at any time. The user may also choose to watch a full preview of all the available narrations. In this case, the system will provide automatic synchronization with the correspondent slides, to maximize the presenter's sense of what his/her audience is going to be watching.

The interface allows many other manipulations such as reshuffling the slides order, deleting and inserting new slides. Slides may also be imported from other PowerPoint presentations or from the user's NetKnowledge slide library. This is one example of the reusability power offered by our tool. Slides are stored in a categorized way, so that retrieval is made easy. Similarly, at a later time, the author may modify or reuse parts of the presentations.

Implementation Details

We have implemented the system as a PowerPoint add-in. NetKnowledge Presenter is automatically available to the user, as long as he/she is logged in to his/her Windows account.

Slides are exported into a portable graphics format and scaled down so that it can be streamed more effectively. While many tools use the JPEG format, which is optimal for compressing images with great color amplitude (e.g. photographs), we have adopted the GIF format, since our analysis has shown that most slides are made of simple shapes and text, with a limited number of colors. The result is that the GIF files are smaller and they do not lose slide information.

The presentation publishing process works in conjunction with a server application also developed in our institute. NetKnowledge Presenter is responsible for packaging the presentation's metadata, slide images, narration and synchronization information and upload them to our server, which takes care of updating the online media catalog.

Conclusion and Future Directions

We have presented a new approach to produce web lectures, using existing technologies. Unlike past and ongoing developments, our work focuses on reusability by re-conceptualizing the way presentations are captured. The main strategy is to incrementally record the lecture in reusable pieces rather than in one pass. The result is ease of editing and scalability that helps delineate division of responsibilities, especially in the case of multi-author presentations. At the same time, it can be the basis for building a library of reusable multimedia contents. We have started using the prototype in our institute and so far, preliminary feedback has been positive. Our next enhancement is to allow the presentation to be recorded in a continuous mode yet without the knowledge of the user that it is being decomposed transparently.

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[1] RealNetworks Inc. RealPresenter - http://www.realnetworks.com/products/presenterplus/index.html
[2] W3C SYMM WG, Synchronized Multimedia Integration Language - http://www.w3.org/TR/REC-smil/

Virtual Museums from Four Directions: An Emerging Model for School-Museum Collaboration

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Abstract: The Four Directions Project has been working with American Indian Schools to explore the uses of technology for culturally responsive teaching. One approach Four Directions is exploring is school-museum collaborations for student-created virtual museum projects. A Four Directions Model for school-museum partnerships has emerged from these experiences. Two example projects are described and the benefits of virtual museum projects is discussed.

Museums and Schools in a Pluralistic Society

Museums have long been the repository of important cultural items. They make these items available to public view in exhibitions in specially designed architectural spaces, and more recently in the virtual spaces provided on the World Wide Web and on CD-ROM. By making their collections accessible to the public in carefully crafted and coherent presentations, museums serve an important mission of perpetuating our cultural heritage through the educational experiences they offer to the public.

Schools share a mission of cultural preservation with museums, making them natural partners in the development of effective educational experiences for young citizens. Schools are also responding to the challenges of the 21st century by integrating new technologies into classroom practice. The creation of virtual museums as classroom learning projects is one emerging strategy schools have explored that makes use of new digital media, the World Wide Web and multimedia authoring. Some of these projects have been created in collaboration with public museums (McKenzie, 1996; McKenzie, 1997; Roy & Christal, 2000).

Because of its history of colonialism and immigration, the culture of the United States is pluralistic, reflecting throughout vital contributions from hundreds of indigenous American cultures as well as from countries in every area of the world. American education, however, remains staunchly Eurocentric. It largely fails at being truly American, reflecting the diversity of the nation and diversity of learning styles (Banks, 1997). As a consequence, schools fail to take advantage of the cultural knowledge many non-European American children bring to school that can be used to advance academic success. Also, by not embracing the contributions to America's pluralistic culture made by non-European American students' communities, educators fail to motivate these students to excel at school. Culturally responsive teaching involves taking strategic advantage of the cultural knowledge and contributions of students' home communities to promote academic success (Gay, 2000; Pewewardy, 1999).

Many museums in the United States have collections that do reflect the cultural diversity of the nation. However, much of the interpretation that is presented in museum exhibitions tends to reflect the dominant Eurocentric world view. To resist this trend, the Smithsonian National Museum of the American Indian (NMAI) is setting a standard for interpretation of Native American collections by Native Americans. The museum brings Indian people to facilities as respected representatives of their cultures. Museum staff members collaborate with Native Americans in the interpretation of the items in its collections that came from their communities. For the NMAI, contemporary Native Americans, as direct descendants of the creators of its collections, act as culture bearers who have the most direct experience of the meaning that the objects hold. It is an expertise the museum values and relies upon.

This paper will present a culturally responsive emerging model for school-museum collaboration. The model has grown out of experiences of Native American schools working with museums with significant American Indian collections to create virtual museums that reflect their cultures and serve to present and preserve the students' indigenous heritage.

The Four Directions Model for School-Museum Partnerships

Four Directions is a five-year project funded through a U. S. Department of Education Challenge grant. Its purpose is to promote the development of technology-supported culturally responsive teaching for Native American students. The partners in the project include nineteen American Indian schools in ten states that are part of the Bureau of Indian Affairs school system, four university partners, and two museum partners.

The Four Directions project has been motivated by the lack of available curriculum that is responsive to the cultures of Native American children and the recognition that technology can provide a way to empower local communities to create curriculum that fits their needs (Allen et al., 1999). The need for culturally responsive approaches has been heightened by the historical circumstances of American Indian education. From the 16th century beginnings of formal education for North American Indians, education was seen as a way to coerce Indians into giving up their culture. By the late 19th century, forced assimilation was the official government policy. This policy was enforced in various ways including removing Indian people from their homelands and setting up boarding schools for Indian students that were located far from student's family and where students were forbidden to speak their language, practice their religion, or to express anything of their traditional cultures. (Adams, 1995). Many Native Americans clung to their cultures the best they could under the circumstances. In the 20th century European-Americans gradually learned to value the cultures of the continent's First Peoples and to celebrate the cultural diversity of the nation. American Indian schools began to include aspects of Native cultures in their curriculum, and since the mid-1960s, an increasing number of American Indian schools have come under direct tribal control (Szasz, 1977; Tippeconnic III, 1999). However, because of these historical circumstances, much of what remains of American Indian material culture resides away from their homelands in museums across the nation and in private collections.

The Four Directions project has been fortunate in having two museum partners that have allowed project participants to explore the potential of school-museum collaborations that give Native American students access to the important cultural property that remains in museum collections. These experiences are providing an evolving concept for museum-school-community collaboration that serves the missions and needs of all participants—what we are calling the Four Directions model for virtual museum collaborations. Three aspects of our experiences with virtual museum projects guide the Four Directions model:

- *Cultural Responsive Teaching* – Virtual museum projects are culturally responsive, because they teach to and through the culture of the child and bring community concerns and values to the center of the teaching-learning process. Students are motivated to excel because they are doing important, authentic work to recover and preserve their heritage. They gain from the knowledge of museum professionals and the wisdom of community elders. They develop skills in research, writing, social studies, science, mathematics, information literacy, and twenty-first century information technology.
- *Cultural Revitalization* - A common concern among Native American peoples is the recovery and preservation of cultures and languages. Much of what remains of traditional material cultures resides in museum collections far from Native American communities. Virtual museum projects provide a way for communities to "digitally repatriate" precious items of cultural heritage. In the Four Directions Model, virtual museum activities also take place in the Native American communities, where students research and record local materials that supplement the museum's resources for the virtual museum. Local resources such as oral histories, cherished heirlooms, traditional stories, dances, and songs, native language and contemporary arts get combined with museum materials to present the vision of a vital, living culture.

- *Cultural Collaboration* – Museums exist to preserve heritage and educate the public, but Native Americans sometimes object to the way museum exhibitions appropriate cultural property. Native Americans want the public to have access to authentic knowledge of their histories and cultures, but they believe that some aspects of their cultures should not be shared with outsiders. Virtual museum collaborations provide a venue where thorny issues of cultural property rights may be addressed and protocols for cultural collaboration may be designed and levels of accessibility decided.

The Model in Action: Two Examples

In the fall of 1998, three of the Four Directions partner institutions—the Pueblo of Laguna Department of Education, the Univeristy of Texas, and the Smithsonian National Museum of the American Indian (NMAI), began the first collaboration that brought Native American students, teachers, and community members to the NMAI George Gustav Heye Center Museum in New York City to create virtual museums. To help guide this first virtual museum project, Dr. Paul Resta drafted a concept paper, which is the first explicit example of the Four Directions model for school-museum collaboration. In it, he explains the rationale for the collaboration in the following way:

> For many years, Native American culture was undervalued and suppressed in America. Although the richness of Native American historical and contemporary cultures has begun to be recognized, exemplary curricular materials based on this richness are rare. In addition, in a rapidly changing world, much traditional wisdom will be lost before there is an opportunity for Native American students to learn about their own history and culture, and to share what is sharable with the world community. Teachers trained in methods of cultural sensitivity and in the use of technology may provide leadership in the accessing, preserving, and sharing of Native American culture with the world community. One means of doing so is for Indian schools and communities to use technology to collaboratively develop *virtual museums* (Resta, 1998, p. 3).

Objects from the museum collections were to be selected by students and teachers in close consultation with community elders, who would help determine which objects were sharable and to add their own knowledge, and perhaps their own voices, to the virtual exhibition.

Local community participation and development were priorities in the original concept paper. Each school community that was to participate in the virtual museum project would send a team of students, teachers, and community elders to the museum to work on selecting, recording, and researching the materials to be included in the virtual museum. In addition, a summer program was proposed for each participating school community. In the summer program, community members would bring valuable cultural materials to the school so they may be recorded in digital photographs or QuickTime Virtual Reality for a local virtual museum. Local landmarks, natural settings, and historical sites would also be recorded. Students could record tribal elders speaking about important objects, people, events and places in English and their Native language to add to the local virtual museum. Some of the sharable locally-created materials may be used to supplement the materials offered on the virtual museum offered on the museum's server. In exchange, the media created at the museum could be "digitally repatriated" to the local community for use within the community. Thus, there were potentially two virtual museums emerging from each museum-school community partnership. One offered by the museum and accessible on the World Wide Web that offered only materials that tribal leaders had deemed sharable in that venue. And a second, local virtual museum that was to remain within the community thatl may include more sensitive materials for community access only (Resta, 1998).

For this first school-museum collaboration, every aspect of Resta's concept could not be met strictly, demonstrating the flexibility of the partnership. The NMAI was in the process of moving its entire collection to a new facility in Suitland, Maryland, which made the full collection inaccessible at the time of the proposed project. The items in the museum's current exhibitions, however, were accessible to the project. This meant that very few artifacts that reflected a given student's specific Native American culture would be available. A compromise was struck whereby students from several of the Four Directions schools would decide which items from the exhibitions would be featured in a virtual tour of the museum as seen through the eyes of American Indian children.

In the spring of 1999 two school teams, one from Santa Clara School (Pueblo, New Mexico) and one from Hannahville School (Potawatomi, Michigan), traveled to New York to digitally record and research the student-selected items from the NMAI exhibitions. These materials were assembled into the Virtual Tour of the National Museum of the American Indian, which has been accessible via the World Wide Web since February, 2000 (http://www.conexus.si.edu/VRTour). In May, 2000, Marty Indian School (Lakota, South Dakota) sent another team to extend the tour. The additional material will appear in the tour in fall 2000.

The virtual tour makes extensive use of QuickTime Virtual Reality (QTVR), which had been identified at the beginning of the Four Directions project as having a unique potential in educational applications. Training in the creation of QTVR media has been offered to all of the Four Directions schools. There are two types of QTVR movies, panoramas and object movies. QTVR panoramas (panos) are made from a series of overlapping photographs taken from a tripod using a specially designed panning head. Software "stitches" the photographs into one seamless 360° scene. To interact with a panorama, one depresses the mouse button when the cursor is on the movie and moves the mouse cursor in the direction one wishes to "look" and the panorama scrolls in that direction. The second type of QTVR media is the object movie. It is made by placing an object on a turntable and taking a series of pictures at evenly spaced angles as the object is turned. To interact with a finished object movie, one depresses the mouse button when the cursor is over the movies and moves the mouse in the direction one wishes to rotate the object. A specially designed object rig enables the QTVR photographer to move a camera around an object vertically in order to make more complex object movies with both vertical and horizontal rotation. One may zoom in or zoom out of both types of QTVR movies. Also, invisible regions called hot spots may be painted anywhere on QTVR movies. Hot spots trigger special actions when clicked on, such as launching a new web page, labeling a spot on an object or in a pano, or bringing up close details of an object.

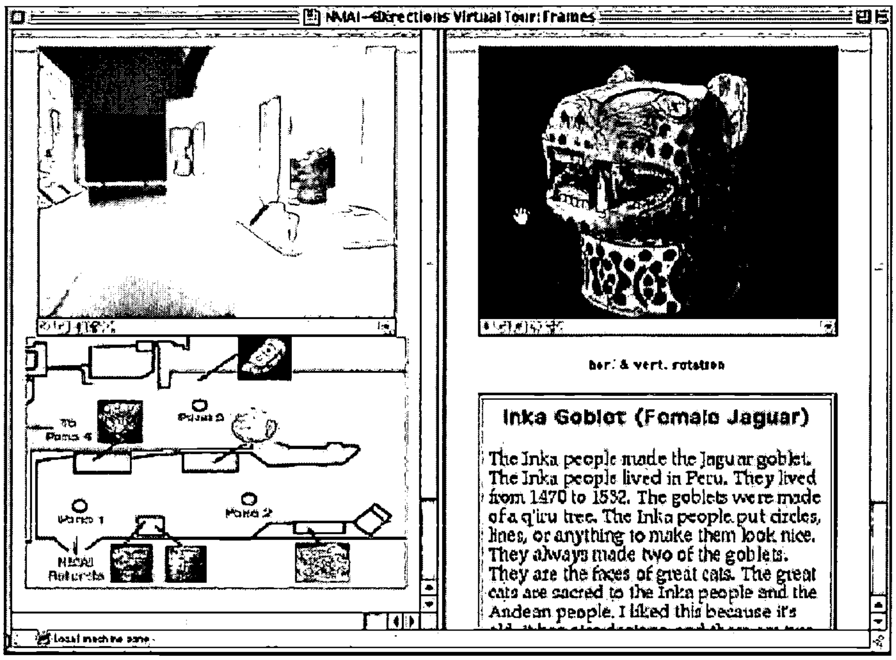

Figure 1: NMAI Virtual Tour Screen Shot

Both types of QTVR were used in the finished Virtual Tour, with the panoramas of the exhibition space serving as an interface for accessing the featured objects selected by the students. Clicking on a hot spot over the museum display of a featured object will cause the QTVR object to load in a separate frame, accompanied by an interpretive essay written by a student. Clickable floor plans of the exhibition space offer another method of navigating the virtual tour and accessing the virtual objects (see Figure 1)

Of the three schools participating in the NMAI virtual museum project, Hannahville has been the most successful in involving the local community in the creation of a local virtual museum using local resources. In a three-day open house session at the school, community members brought native arts, crafts, costumes, and cultural items that students recorded in digital photography and QTVR. Students wrote essays on the objects and used digital sound recording to add their voices to annotate their virtual exhibits. They used oral history techniques to record community members' renditions of traditional stories for their virtual museum. A year later, the school found a private museum in the region that gave them full access to its collection of Anishnaabe and historical items to add to their ongoing virtual museum efforts, an interdisciplinary effort which now involves the school at all grade levels. A publicly accessible component of the school's virtual museum activities is on the World Wide Web (http://www.hvl.bia.edu).

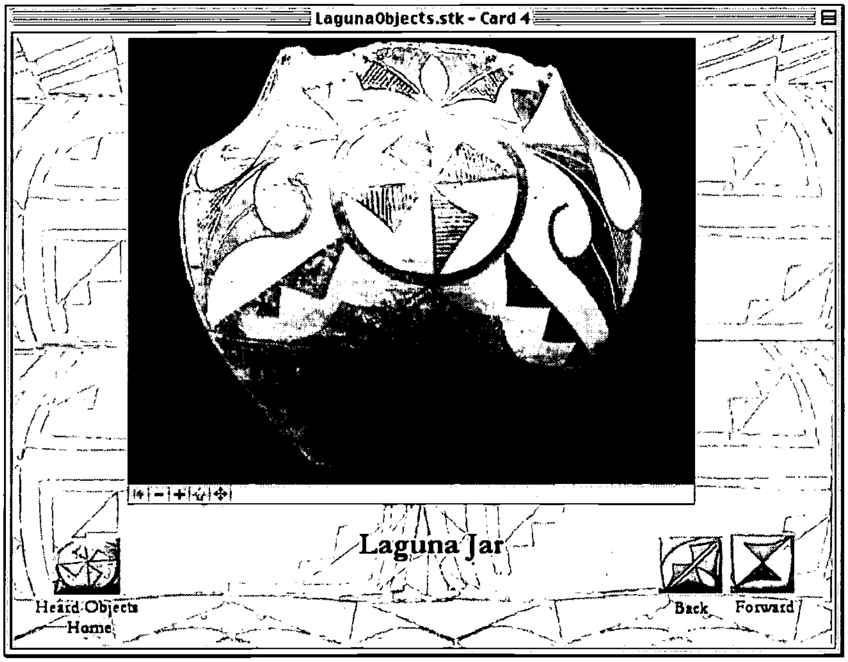

Figure 2: The Heard Virtual Museum CD-ROM

The Heard Museum in Phoenix, Arizona, is another Four Directions museum partner that has been involved in virtual museum projects with three other schools. In May, 2000, students and teachers from Dilcon Boarding School (Navajo, Arizona), Seba Dalkai School (Navajo, Arizona), and Laguna Elementary School (Pueblo, New Mexico) spent four days at the museum, documenting items for the purpose of illustrating virtual museum projects in their communities. Dilcon Boarding School and Seba Dalkai School combined the media that students created at the Heard with oral histories, QTVR panoramas and photographs created locally to make a virtual museum of the schools histories. Laguna Elementary School will use the media its students created for a virtual tour of the Pueblo of Laguna community. Teachers and project partners used HyperStudio to author the virtual museums, which were distributed to the Heard Museum and the three schools on CD-ROM. The Heard Museum plans to use the CD-ROM as part of an exhibition on American Indian boarding schools.

The Benefits of Virtual Museum Projects

Since these initial virtual museum projects, several other schools in the Four Directions project have been actively planning to implement similar partnerships with local and regional museums that have cultural items which hold special meaning for the school communities. Four Directions students, teachers, and school communities are modeling how other Native American schools can plan and develop virtual museums that inform the world at-large while they return images of objects to their cultural homelands. Created by Native people, these projects provide a venue for cultural collaboration and cultural exchange. It is an act of cultural recovery as it returns to the Native community objects long removed form their origins.

The Four Directions model also holds important benefits for the museum community. As professionals at the National Museum of the American Indian testify, the Four Directions project benefits the museum in several ways. First, it provides a way to fulfill part of the museum's mission, which is to be of service to its constituents (Native Ameicans) and to reach out beyond the walls of the museum to teach the museum's public (non-Indians) about the culture and histories of the Native people of the Western Hemisphere. The NMAI recognizes that it has a special responsibility to the people whose ancestors made the objects in the collections. Native Americans have said they want the museum to help them preserve their cultural heritage and to share its resources with Native communities. The Four Directions Project provides a collaborative framework in which to leverage the vast cultural and human resources of the NMAI. The NMAI, in collaboration with the University of Texas and with other Four Directions partners can help Native American students learn new technologies, contribute to cultural preservation and share the resulting project with people all over the world, many of whom will not be able to visit the exhibitions in New York. One of the exhibitions in the Virtual Tour has been dismantled to make way for a new exhibition. It is now only available on the World Wide Web.

The Four Directions model may also be adapted to other student populations with different cultural backgrounds. The contributions that minority and subordinated cultures make to the rich tapestry that is America are not given their full significance in the standard curriculum. Museums and local communities have resources that can rectify this shortcoming. The Four Directions model of school-museum collaboration for the creation of virtual museum is one culturally responsive strategy for taking advantage of those resources.

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An expert authoring tool for dynamic scenarios

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Abstract: The problem of constructing meaningful examples to teach about dynamic objects environments is complex enough to justify the construction of an expert authoring tool, which knows about the physical constraints and the rules governing the dynamic world. Such a tool can be used by teachers, preparing example scenarios and exercises, and by students for on-line active training. We describe the software architecture for the expert authoring tool, which has been implemented taking as test bed the domain of sail boats racing.

Motivations

Dynamic object environments can be conceived as environments where objects move according to rules that can be physical/mechanical on one hand and artificial on the other (e.g. authoritative regulations, sport or game rules). This is typical of games and sport environments based on skilful operation of mechanical apparatuses (e.g. sail boats racing). In this case, movements are subject the effects of the wind on boat speed, the result of steering actions etc. Moreover, specific rules exist to ensure a fair interaction with competitors. Racing rules issued by the International Sailing Federation are an example of a well-defined body of non-trivial behavioural constraints. Finally, a number of tactical rules and suggestions are usually available for achieving good performances and often determine the outcome of the competition.

Our purpose is to devise and experiment with general techniques in order to realise advanced authoring tools to be used in the construction of dynamic object scenarios, as defined above. Such tools, in order to be effective, will have to act as expert assistants, exploiting knowledge of the specific dynamic domain. The intended use is both for teachers preparing lectures and exercises, as well as for students engaged in on-line interactive learning. As our case study we have chosen the context of sail racing scenarios, which is in fact a well-tailored domain for experimentation. Detailed mechanical aspects such as boat rolling and pitching, which are normally of little interest when speaking about racing rules and tactics, can be disregarded. Moreover, even if the complete text of The Racing Rules of Sailing (ISF, 1997) expands over nearly a hundred of pages, there exist a limited number of core rules, involving several non-trivial and challenging concepts, which can be considered an ideal starting point.

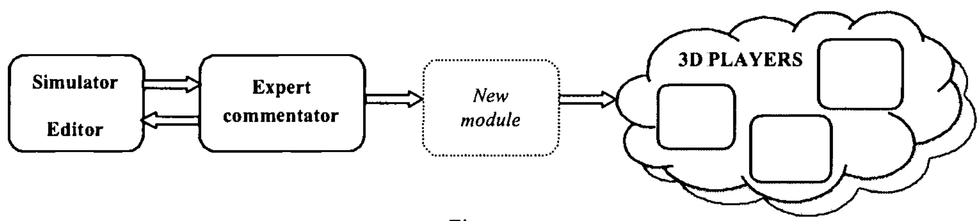
The under laying idea is that both learning and teaching can be based on a common paradigm, i.e. the preparation and the analysis of suitable dynamic scenarios in collaboration with the expert authoring tool. The teacher uses the automatic assistant to compose meaningful examples to be shown during classroom lessons as well as exercises for students, the students to invent specific scenarios to be investigated. For teaching purposes, example scenarios must be prepared with special care in order to focus on critical aspects of dynamic effects and/or subtleties of behavioural rules, more difficult for the student to grasp. In fact it is possible that even small changes in the scenario may cause large variations in the final outcomes.

The expert authoring tool is composed of three different modules: an editor of sailing scenarios, tightly coupled with a simulator, and an expert commentator working in close cooperation in order to give the user suitable comments and advices since the early phases of scenario composition.

Our tool, in its present form, is tailored to the sail racing domain, and does not face the issue of domain knowledge acquisition, which is a major concern of authoring system for ITS (Murray, 1999). The combination of the editor and the simulator reminds of an authoring tool for preparing scenes in a multi-dimensional world (such a CAD systems or a 3D modelling system). A key advantage is that it is task oriented and that dynamic scenarios can be created and immediately analysed by the user with the help of the expert commentator, thus offering the functionalities of an intelligent training tool.

General architecture

The architecture of the system (see Figure 1) is inspired to the one used in simulated soccer within the RoboCup initiative (Kitano, 1997). The two domains have similar characteristics: there is a simulator of a specific dynamic world where actors (players in the soccer case) need to act in respect of physical and environmental constraints and learn to achieve a goal (winning the game or the race). Looking at the two different domains allowed us to design an architecture that is general enough to simplify the overall system design when moving to other similar domains. Each module is implemented as a program interacting with other modules using a TCP connection.



Figure

The simulation *history*, which is the output of the *Editor* module, consists of a stream of instantaneous snapshots of the dynamic scene, one for each simulation cycle.

Each snapshot describes the current situation of the world: the position of the boats, the wind direction and intensity, and so on. The scene description is bi-dimensional, i.e. the positions of objects are given in terms of planar coordinates. The dynamics of the scene complies with the typical behaviour of sailing boats, since it is produced by means of a specially tailored editor, which works in close cooperation with a simulator, taking care of enforcing physical constraints. The editor understands high-level concepts of the domain, such as *trajectories*, and offers advanced and task oriented editing functonalities such as reuse and composition of large pieces of previously created dynamic scenarios, and the ability to apply desired adjustments and modifications.

The role of the *Expert commentator* module is to annotate with comments histories received by the editor. Some aspects of the racing rules knowledge deal with single snapshots, for example in the case of concepts such as windward or leeward boats. However, in general, an analysis of sequences of snapshots is required, in order to discover critical conditions in the dynamics of scenario evolution. In some cases, in order to check the rules, the *Expert commentator* needs to ask the simulator how a given situation will possibly evolve (this is the reason for the back arrow between the first two modules). The output of the *Expert commentator* is an *annotated history*, a sequence of snapshots with proper comments attached to them.

The 3D player takes the annotated history as input and produces a 3D movie of the dynamic scenario. Comments generated by the *Expert commentator* are output as text and/or as speech, exploiting the technology of Microsoft agents (Microsoft, 1999). The architecture allows for multiple players receiving the same data in multicast mode: this feature may be useful for displaying a simulation to a class during a lecture.

All communication among modules is based on a text protocol, in view of simplifying extensions. The architecture is modular and flexible: each module can be hosted on a different machine or replicated as needed. Modules can be implemented using different languages and technologies, provided they comply with the communication protocol. We have used DELPHI Pascal for the editor/simulator, C++ and CLIPS (Giarratano, 1998) for the expert commentator, Java and VRML for the 3D player. Modularity also enables extensibility: it would be easy to add a new module, as shown in Figure 1, if we wanted to do some more editorial work on the output of the *Expert commentator* module, prior to its rendering as a 3D movie. Another advantage of the proposed architecture is that modules can be made to work together in pipeline, with a module feeding a stream of data to the next in real-time, or they can be decoupled redirecting the output to a file, which can later on be used as input to next module.

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Improving assessment: Rubrics in a tertiary multimedia course

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Abstract: This paper explains how alternative assessment methods were implemented in a first-year tertiary course on web design. The aim was to make assessment clearer for the students to understand, and more focussed, using a rubric—a detailed, criterion-referenced marking guide. The results of a post-course evaluation of this action research showed that students strongly appreciated the use of this type of assessment. Our conclusion is that the rubric approach improves student satisfaction and can save lecturers time when marking.

Introduction

Assessment is a critical part of the learning cycle in a tertiary institution, but is sometimes treated as an extra burden rather than an integral part of course design. In addition, at a time of increasingly constructivist orientations in course design and presentation (eg. Duffy & Jonassen, 1992), course designers are reviewing their instructional regimens yet ignoring their assessment techniques. This misses the opportunity to make the linkage between assessment and instruction 'more natural, ongoing, and constructive', (Tierney, Readence, & Dishner, 1995, p. 482). Rubrics are part of a trend towards a greater variety and more authenticity in assessment. By integrating assessment into their instruction educators are both servicing their students better and making their teaching more satisfying (Yell, 1999).

Assessment has both summative and formative purposes — the summative purpose includes providing grades and feedback to students after the learning cycle. The formative purpose can enhance learning during a course, for example using rubrics:

> *Highly competent teachers use assessment measures to inform their instruction and ... as a means of instruction. Rubrics are frequently the tools used to identify key elements of proficiency [in that instruction].... These rubrics assist both the teacher and the learner in determining the necessary elements for each level of performance. (Skillings & Ferrell, 2000, p. 452)*

There is often a conspicuous discrepancy between the student-centredness of some courses, and the isolated nature of their assessment. As Skillings suggests, changes towards more student-friendly assessment can improve learning. In fact the evidence that a rubric—a structured, elaborated appraisal tool—can lead to greater student participation, greater satisfaction for the instructor and better student performance, is the reason for the action research reported in this paper.

All about rubrics

A rubric is sometimes called a marking guide or a scoring guide. In cynical mode Popham (1997) argues that the name was carefully chosen because of its decisive lack of opacity, since less opaque descriptors like scoring guide are therefore less technically attractive. There are many differing definitions of rubrics and their usage (Brudnak, 1998; Wenzlaff, Fager, & Coleman, 1999), nevertheless there is still some agreement on the content (Morgan, 1999). As ways of assessing student work have begun to change, rubrics are becoming increasingly popular. They are sufficiently popular in schools that they are now mandated by education departments across parts of Australia, UK and educational districts in the US, at both class and system level.

In its simplest form a rubric is a rating table which allows comparison of student work against important content listed in a table (Tab. 1). The essential characteristics can be summarised as follows:

- a set of content or standards which are being assessed — here arranged in rows;
- a set of levels of proficiency, for example from beginning to developing through to accomplished (see columns in Table 1), or even sad to neutral to smiley faces;

- each level contains specific, measurable performance characteristics, such as 'made regular/ some/ few pauses to check notes'; and
- any descriptor used in any cell should normally appear in all cells on that row – in a 'good' rubric there should be no hidden skills that magically appear (or disappear) as the level changes, under normal circumstances.

Level > Content items v	**Beginning (C to CR)**	**Developing (CR to D)**	**Accomplished (D to HD)**
Use of notes in public speaking	• made regular pauses to check notes	• made some pauses to check notes	• made few pauses to check notes

Table 1: Rudimentary example of a rubric for rating Notes Use in some public speaking activity

Some parts of the rubric are flexible. It is possible to have either detailed descriptors or checklist items in each cell; and the number of rating levels (three are used here) can range up from two, though less than six is strongly recommended (Schincariol & Radford, 1998).

Other parts of the rubric are less flexible. For example notice that the rating scale is not normative, like 'Good, Better, Best', but is explicitly measurable. The intention of the rubric is to rate student performance against some standards rather than simply comparing them with their peers. Creating rubrics is both an art and a science—just like all teaching—and a number of writers describe the detail of how rubrics can be developed (eg Montgomery, 2000; Morgan, 1999; Rose, 1999; Yell, 1999)

Assessment based on performance has become a popular alternative to traditional assessment (eg pencil and paper) in recent years, particularly with complex and subjective criteria (Schincariol & Radford, 1998). Instead of taking a traditional test with right and wrong answers, students are asked to demonstrate a skill eg perform an oral presentation, create a web page or design a rubber-band-powered vehicle. These efforts cannot be graded by counting right and wrong answers, and that is where rubrics are powerful. They simplify appraisal in situations more closely resembling 'real life' than less authentic and isolated traditional tests. Unlike traditional marking keys, rubrics are provided before rather than after any student assessment point, and are intended to be a unified part within a teaching program. Rubrics are therefore public, composed of clear measurable language and integral to the learning process.

The role of rubrics in learning

Because rubrics convey clearly and explicitly what is expected in terms of content and performance standards (Rose, 1999, p.30), they are a useful and motivating assessment tool. But Germaine (1995, p.1) argues that rubrics can also be powerful teaching tools, since they:

> *promote unanxious expectations; make grading criteria known to students; drive curriculum and pedagogy; reduce teacher subjectivity; ensure accountability; and maintain focus on content and performance standards and student work. (p.1)*

Students given explicit, embellished, measurable guidelines for their assessments are working on the outcomes that have already been determined as important for their success, and that focus can improve their learning effort considerably. They also provide clear guidelines for the course instructor and hence focus the teaching directive (Rose, 1999).

Traditional marking keys are the hidden runes whose contents students guess at, whereas rubrics are public. This has a two-edged benefit, namely students can evaluate the evaluating tool before it is used on them. Hence students can now think and talk about their assessments, and even examine their own expectations and standards. Such metacognitive actions extend the role of rubrics as powerful tools for learning (Skillings & Ferrell, 2000, p.455). Furthermore, as writers like Abbott (1997) have pointed out, metacognition supports the transferability of these skills to other, different learning situations.

A rubric would appear to have a particular advantage over less elaborated methods of assessment for non-native language speaking students. The repetition of language in the rubric and clear development of conceptual levels across a rubric table mean that there are more opportunities for language pattern recognition than occur in a narrative or unstructured assessment format. In fact such improvements, eg in motivation for weak students, have already been noted in school environments (Custer, 1996; Skillings & Ferrell, 2000).

It is possible to integrate rubrics further into the teaching and learning process. Much of the literature on rubrics talks of a student role in their design. There is merit in involving students not just in the fine-tuning but the total design of their assessment rubrics because of the evident value engendered by their participation, argues Stiggins (1997):

> *Involving students in the development of performance targets can be an effective instructional tool because students who are given the task of analysing quality work and its crucial components become better performers themselves. (p. 452)*

Rubrics advantages are not without a price. Firstly they still only address only a part of the spectrum of student performance and should not be overrated. Although they appear to have broad educational justifications, they are not a replacement for a rich appraisal program says Yell (1999). Nevertheless he also points out that educators will find more and more uses for them as their proficiency improves. Secondly Wenzlaff et al. (1999) argue that there is no 'best' format for a rubric, and that "perhaps there should not be" (p. 43), which might explain why some teachers seem to 'fine-tune' their rubrics endlessly. They point out that the expertise of the user is at least as important as the actual rubric format. Still, if a rubric focuses an instructor's attention on course-relevant processes and performances, then time spent fine-tuning is easily justified.

Thirdly students who meet rubrics for the first time can find them overwhelming and even confusing. 'I liked the idea but as a "first off", was not clear about its purpose until assignment 2', complained one student. We realised in hindsight that rubrics need even more careful introduction than we expected.

Fourthly, because they tend to be standards-oriented rather than normative, rubrics represent a shift in philosophy from the traditional norm-referenced methods. In fact rubrics are not intentionally a grading system but simply a way of identifying weaknesses and strengths. It is true that a student who scored, say, 'Accomplished' on all criteria could argue that they deserved a high grade, but this is a trivial example. After all, grading students whose marks are extreme is always much easier than grading the rest. The issue of grading is critical because if the rubric is to be useful in a tertiary setting, it must allow marks to be compressed somehow into a single grade. Our method uses the principle of 'conjoint progress' — no student should be awarded, say, a D (for distinction) unless they had satisfied all the criteria for the D in all the content areas. In other words there should be no 'averaging out', just as making a cup of coffee cannot be averaged—missing a single step, eg 'adding a teaspoon of coffee' fails to complete the act of making the cup of coffee.

Consider three students S1, S2 and S3, whose three marked rubrics look like the table below (Tab. 2). The table uses blocks to represent cells from a rubric. For example, a row which consisted of a single filled block would represent a Beginning Level performance for that student, eg S2 on Criterion 3. Multiple filled blocks mean improved levels. The likely grade for S1 is the same as S2 and S3, since none have conjointly made progress of more than one cell to the right. Whilst S2 and S3 are clearly better than S1 in some areas, overall each has a weakness in a critical area already identified by the rubric, which undermines their overall 'value' (perhaps employability). So, in this case, all these students should be awarded the same grade.

	S1	S2	S3	
Criterion 1:	■□□	■■□	■■■	Key
Criterion 2:	■□□	■■■	■□□	■ = ✓
Criterion 3:	■□□	■□□	■■■	□ = ×

Table 2: The 'conjoint progress' principle allocates students S1, S2 & S3 the same grade (see text).

In essence, then, rubrics provide a way to improve the meshing between the appraisal and teaching parts of the learning process. So called 'objective tests' require effort in their construction, but can speed marking. Similarly rubric development can be laborious but it can reduce the qualitative dilemmas at marking time, especially when considering performance-based measurements. As well as guiding and motivating the learner, their detailed structure is helpful for weaker students. Also, they serve as an elaborated reminder of the instructor, and there is evidence that they support metacognition and transferability of thinking skills as well. Novices will find, as we did, that their skills improve with use. Their advantages need to be weighed against the effort of construction, the need for explanation, and the likelihood of continual fine-tuning. Our conclusion was that a satisfactory assessment rubric would therefore meet six criteria, listed below (Tab. 3).

1	An n x 3(?) table of Standards (Rows?) against Levels of proficiency (3 columns?)
2	Contain specific, measurable performance characteristics in each level
3	That a descriptor appearing in any row ought appear in all or most cells on that row
4	Be available well beforehand so as to guide the learning as well as the assessment
5	Be student-constructed or at least student-adjustable
6	Be amenable to some marks compression process ie to produce a grade

Table 3: Rubrics Criteria — derived design criteria for a satisfactory rubric

Action research case study

IMM 1122 'Publishing on the Web' is a first year elective in a course for students studying multimedia at Edith Cowan University in Western Australia. It has around 110 enrolments each year, covers introductory html, web pages, site design, and introduces vector graphics enhancements using Flash™. This unit was designed by the staff involved for the first semester of 2000. All the resources and an on-line bulletin board were made available via the unit web-site. At the first lecture, students were introduced to all aspects of the course, including the concept of an assessment rubric for their two assignments. The rubric was made available on the unit web-site some weeks before each of the two assignments. It was planned to provide it earlier, but it proved challenging for novices to construct, and satisfying to keep adjusting.

In an attempt to involve the students in the process of rubric design, assignment one had two submission dates, a week apart. Initially a paper design and their personal extensions to the standard rubric were sought. A week later the final electronic assignment was due in, to be marked according to the initial rubric as well as their additions to the rubric. A printed version of the rubric was used to mark their assignment—see extract below (Tab. 4).

Since each cell of the rubric was composed of mainly exhaustive criteria (eg:'☐ at least one working image map') rather than examples, it was decided assignment two's rubric should include a summative item in each cell, saying '☐ meets criteria for lower rating' (see bold text in the right hand cells of Table 4). This had two consequences. First it meant that there was less repetition needed across the cells. Although this contravened one of the Table 3 rubrics' criteria, it also made it a more manageable size. Secondly it meant a marker could make a rapid judgement more readily during the grading process.

	Beginning - C to CR	**Developing – CR to D**	**Accomplished – D to HD**
Web Page Widgets (10 marks)	☐ Form/s: reset, buttons work ☐ Correct use of HTML table tags, incl. captions, borders, cell spacing ☐ At least two list types ☐ Working frameset & frames etc	☐ **Meets 'Beginning' criteria and...** ☐ Simple working JavaScript eg. inside tags ☐ Working Mailto: tag or form Mailto: ☐ FTP or file download (eg. mov, wav) provided ☐ Clear variable names in pages, frames, forms ☐ etc	☐ **Meets 'Developing' criteria and...** ☐ Variety of JavaScript eg. status bar, use of date fields, browser name, etc ☐ Makes allowances for browsers without JavaScript ☐ Data Validation in forms etc
Web design (10)	☐ etc ☐ etc	☐ **Meets 'Beginning' criteria and...** ☐ etc ☐	☐ **Meets 'Developing' criteria and...** ☐ etc ☐
Content (4)	☐ etc ☐ ☐	☐ **Meets 'Beginning' criteria and...** ☐ etc	☐ **Meets 'Developing' criteria and...** ☐ etc

Notes. comments, strengths, weaknesses etc: *F* *C* *CR* *D* *HD*
Approximate mark and grade (circle one set): *15+* *18+* *21+* *24+*

Table 4: Extract from the Assignment 1 rubric, with summative entries in bold text in the right-hand cells.

It was realised that the checklist rubric approach would allow either a detailed marking scheme or an impressionistic global one. The detailed one simply added ticks, assuming, quite unreasonably, that the items were of equivalent value. The global marking method was supported by noting the volume of ticks in each cell and making a judgement about progress towards the higher ratings. Tutors were free to use either format for marking, within the constraints of the principle of conjoint progress, described above. Students were reminded of the mastery principle with the anecdote about flying with the pilot who passed, with 50%, by scoring 100%

of her take-offs and scoring 0% on her landings. By making this issue clear beforehand, it was felt that some potential misunderstandings were avoided.

Student feedback

All students at their first practical class were asked to complete a short pre-course questionnaire and at the last practical class were asked to complete a similar post-course one (35 collected). It is not possible to ascertain the views of those from whom no form was received, which includes those who chose not to attend the practicals, but we can think of no abnormal reasons for their lack of data to skew the results we report here.

Students were asked to rate a range of questions from 0 (low) to 10 (high); and were then given space for a comment. The average rating for the rubric idea was 7.1 and pleasingly the most common score was 10. Almost 80% of students rated the idea of using a rubric at a 6 or better, whilst 17% rated it from 0 to 4. Their rating for the course overall was similar, with 7.2 as the average satisfaction rating.

The range of positive responses ranged from observations like 'helpful' (with a rating of 7), to 'great idea' (with a rating of 10). A further sampling of their ratings and their associated comments follows:

6 Good idea, very helpful (if you use it)
8 I think it works well in a lot of ways
8 Good, I could check off things as I did them
7 Good for those who had NO idea (what was wanted)
8 Really gives you good indicator of what to include in the asnt instead of just guessing

It appears that some understood it better than others, but their judgements are largely supportive. Although one comment in the list suggests a student who was taking a rather mechanistic and unthinking approach ('I could check off things'), it is nevertheless true that they are working on priorities which the rubric writers have already identified as important. Without such a list they might not have any confidence that they were addressing consequential topics in their assignments.

It would be improper to ignore poor evaluations, as they are the students that have to be 'turned around' for assessment averages to improve. Here are comments from the (fewer) negative evaluations:

1 Criteria far too high for a 1st year unit
1 Didn't know about it until the second assnt
0 Pointless since you do not evaluate according to a criteria but rather one student against another
2 Makes it more mechanical and less creative - you just put stuff in for marks

It is sometimes harder to summarise negative comments than positive ones, as there are many reasons for the state of dissatisfaction but all satisfied people are in approximately the same—ie satisfied—state. Two observations are in order. Student 3 seems to have made a philosophical judgement that is at odds with our stated aims. As before, there is a student (#4) with no interest in the rubric as a learning tool, and sees it as simply an elaborate checklist. Allowing such students more say in the content of the rubric (criterion 5 in Tab. 3) may address this concern. Overall it would seem that scrupulous explanations may improve student understanding, when introducing rubrics concepts.

Our attempts to allow students a more significant role in the extension of the rubric, though laudable, were judged as unsuccessful. At marking time, we found we were 'juggling' both the assignment rubric and the assignment itself, which we rated as unsatisfactory. Until we feel greater confidence in the use of rubrics, we sense that such a facility needs to be treated differently. Fortuitously the second assignment had only one deadline, and tutors rated this as preferable, feeling that it had not seriously undermined the extra value that the rubric had brought to the unit.

The completed rubrics were handed back to students with their assignments. Student comments after each assignment indicated general contentedness, and later strongly supported the approach, but there were some concerns by the students about tutors' ability to use them properly. For example in the course evaluation one student commented, 'useful, but my tutor did not seem to mark by it, so rather pointless'.

Conclusions and recommendations

This paper demonstrates one way that tertiary courses can successfully utilise less instructivist approaches to assessment. The identified Rubrics Criteria (Tab. 3) were implemented with relative ease, especially after experience gained designing the first rubric. Although it seems that the rubrics concept needs careful utilisation, both to improve staff skills in its implementation as well as student understanding in its use, its robustness is comparatively obvious.

It appears that students enjoyed this unit's use of rubrics, although it was the first time they had seen such a device and even though it caused some difficulty for a small number of students. The strong balance of student support for the rubric concept and their overall satisfaction with the course suggest that the rubrics were a helpful part. Indeed, we assert that the rubrics helped many students better focus their effort on the delineated criteria in this unit on web publishing.

Eventually we envisage both staff and students having better procedural and conceptual understandings of rubrics. Immediate improvements could include better introduction of the rubric and its role; a tutorial activity where the students jointly mark some provided representative work samples; we can imagine students reviewing the unit's rubrics (displayed on a web-site) and suggesting improvements and additions—this might be handled by providing a specific on-line bulletin board on the topic, perhaps even for marks.

Change processes like this take time and need review, so it was ironic to read one of the criticisms of rubrics was that they encourage fine-tuning. We argue they warrant continued refinement, since they are as satisfying to the educators as they are educationally useful to the students involved. The reason is that rubrics can precisely centre your attention on what is and is not important.

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The WWW&OVER project: real-time distance education and the role of the Street Singer

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Abstract

The paper describes the present state of the WWW & Over project to design techniques for the remote control of hypermedia teaching materials. It reviews the main features of the new version of the prototype for distance teaching, where teacher and students interact at a distance in real time on teaching materials created by the teacher. Also described are the first experiments in real distance-teaching processes during a university course, the results of which show that transmitting the video image of the teacher – which is normally regarded as crucial for recreation of the 'real' classroom is not in fact indispensable. It was found instead that the teacher's voice and its coordination with his/her actions is essential for the success of a distance lesson. Since the project has applicative purposes in environments consisting of low-cost and low-performance networks, this finding on the one hand encourages experimentation with the techniques adopted by WWW & Over, while on the other it rules out the use of numerous systems based on audio/video streaming in view of the substantial delay that arises between the real event and its perception by users.

Introduction

Perhaps still to be found in Sicilian popular culture are the *cantastorie*, strolling minstrels who comment in song on news events depicted on painted placards. Teachers who project slides during a classroom lesson are in the same technical situation as the *cantastorie*. Though there is a substantial difference between them, we shall show that it has no bearing on our argument. The *cantastorie* uses his voice to sing, while a teacher more simply performs an oration in prose. In the beginning was the blackboard; then came film strips, OHP transparencies, slides, the video recorder, and finally, and inevitably, the computer. Each of these devices has its place in the expounding of arguments for didactic purposes. If we concentrate on the applied context in which topics are expounded by means of computer, we find that the lecturer, like the Sicilian street singer, manoeuvres the visualization of images to reinforce the arguments expounded in his/her oration. At the same time the lecturer, again like the *cantastorie*, uses images to give coherence to his/her discourse. In this case, the images provide guidance for the lecturer during his/her oration. During the lecture, the lights in the room are usually dimmed to give sharpness to the images projected, and the lecturer is usually hidden behind a computer monitor. It is generally believed that this state of affairs does not greatly affect the nature of a frontal lesson characterized by the physical presence of the teacher in the room. As a consequence, the majority of the approaches tend to virtualize the teacher's image by transmitting television pictures in order to recreate direct classroom communication between teacher and students at a distance.

The results presented in this paper suggest, however, that the teacher's virtual presence depends much less on his/her image than on his/her voice [Land et al, 1999], [Kötter et al, 1999]. During the last academic year, part of a course at our University was taught entirely at a distance. The students were from two different faculties but they attended the same course (Introduction to Databases), one-third of which was taught without the lecturer being physically present in the classroom. The teacher was alternately present in one of the two classrooms in the two faculties, and his image was projected in the other classroom (30 kilometres away) by means of a simple telephone link. The lesson was piloted by the prototype briefly described in section 2 of this paper. Besides the technical results, the feature that we believe warrants most detailed analysis is the feedback provided by the students (around 50 of them) at the end of the course. Put briefly, it emerged that the role of the lecturer as *cantastorie* (image, expressions, gestures) is less influential than, and because of, the interest aroused in the listeners by his/her voice.

2. A prototype for real-time online learning

Distance teaching has for years been a central concern of the training community, but it is still not as widely used as would be desirable. The association between the World Wide Web and distance learning is by now well-established, and many products for the creation and management of teaching materials for use on the WWW are now available [Becher et al., 1999].[Mioduser.et al,. 1999] Thanks to the growth of the Internet, numerous users are able to exploit the potential of the Web [Bos et al., 1996], But although the Web allows the rapid transmission of multimedia lessons and the easy and rapid updating of information and materials, it does not solve the problem of lesson management. Besides the speed of transmission lines, the technology amply meets the needs of the large-scale use of distance learning, but there are still numerous problems connected with the 'pull' metaphor typical of the WWW [Colazzo et al., 1996]. A further critical aspect is the difficulty faced by teachers in the rapid production of teaching materials, if they are not IT experts and are unacquainted with specialized tools [Ibrahim et al., 1995],[Ehner et al, 1999] The distance between teacher and student creates obvious problems, because the physical relationship that arises in a 'real' classroom cannot be easily recreated in a 'virtual' one where teacher and student are not in physical contact. But the main criticism of the model of distance education that predominates today, based mainly on the WWW, springs from the following simple consideration. Students cannot be assigned control over their learning process by being allowed to navigate unsupervised among the teaching materials. This is because the students' lack of knowledge prevents them from distinguishing the most important concepts and from navigating in accordance with the teacher's wishes [Ping-Jer Yeh et al., 1996]. Only the teacher who has prepared the lesson knows which is the best route, which concepts should be memorized, which points may be ambiguous, and so on.

The aim of the WWW&Over project is to create a tool for the delivery of multimedia lessons via Internet which enables the teacher to exert more direct control over them. The system derives from a project begun in 1993 [Colazzo et al., 1995] in which the interactivity is created via a TCP/IP peer-to-peer network comprising the teacher's computer and the student computers linked thereto. This type of link is currently enjoying enormous success, especially in the area of file-sharing via Internet (Napster™ being a case in point). Under our approach, teacher and students are able to interact during a lesson without being physically present in the same place. The system enables the teacher to intervene in his/her multimedia lesson from his/her work station, while the students' computer screens show the slides and the teacher's actions at that particular point of the lesson. It thus simulates physical presence in the classroom, flanked by the broadcast voice and image of the teacher via videoconference and by an events management system (control console) used only by the teacher during the lesson. Our initial preoccupation when flanking our prototype with a videoconferencing system to broadcast the teacher's image/voice naturally concerned the bandwidth of the latter. In fact, although the purpose of the prototype was to minimize this aspect, the broadcasting of video in real time proved to be a problem. The findings of the experiment are interesting, given that it used was a 160x120 pixel image. The main impact of the prototype was the creation of a lesson environment which approximated a 'real' classroom as closely as possible, and thereby enabled the teacher to use multimedia technology without having to equip the classroom with videoconferencing equipment that the majority of teaching institutions are unable to afford. The solution was based on the use of standard communication protocols like TCP/IP. This makes it possible to distribute a single version of the application to both teacher and students and to use the teaching hypermedia differently according to the mode chosen. In this way, all the material used during the lesson is directly available to the students on their hard disks, so they do not have wait, for example, while an animation is being downloaded, as instead happens with Web-based courses.The WWW&Over project is a multi-year project and therefore consists of numerous components. Here we shall analyse only its part relating to real-time lessons. This part has been called the **'Control Console/Panel'**, the distinctive features of which are now listed:

- the possibility of creating a remote lesson as similar as possible to the traditional frontal lesson by connecting a telecamera to the student computers to gain visual surveillance of the whole class:
- the limited use of network resources made possible by the presence already in the student computers of the multimedia teaching materials (sounds, images, film clips, etc.): these are not transferred, merely 'piloted';
- the use of *de facto* standards for the transmission (TCP/IP) and of an *ad hoc* protocol for managing the distance lesson;
- simplification of on-line connections by users;
- different modes of use (on-line, off-line, teacher mode, student mode): this allows the student to use the materials for self-study as well;
- different visualizations on the teacher's application and the student's screen, so that the former can monitor the current state of the latter;
- multi-user integrated electronic communication system (Chat), with messages differentiated for all students or for only some groups, or person-to-person communications;
- interaction on the materials between teacher and students, with role reversals, direct question-asking via the slides, the highlighting of parts of the slides, etc.;
- recording the actions made by the teacher and/or students on the teaching materials.

2.1 Salient aspects of the prototype

The system comprises two distinct parts.

- The authoring system, where lessons are created using an editor similar to Powerpoint™ but simplified in those parts less suited to didactic purposes and with emphasis on giving dynamism to the lesson. The authoring system was created with Toolbook, a widely-used multimedia authoring system of which the multimedia creation functions have been utilized. This part of the system is not described here.
- The reader system, i.e. the component of the prototype which reads the lesson and enables the teacher to use it. This component is described in what follows.

For the moment the prototype is in Italian. As said, the multimedia teaching materials produced by the authoring system are previously distributed to the students. Thus, when the application is opened, the system asks the user what type of role s/he wants to perform during the lesson (fig. 1). The student is also asked for his/her IP address or the name of the remote host with which the teacher is waiting to be connected. The system is therefore heavily based on the idea which is today called peer-to-peer, also because we believe this to be a winning approach in a didactic environment. Already in its early versions [Colazzo et al., 1998] the system used a 'push' approach, given that, as said, the pull model is unsuited to on-line training environments.

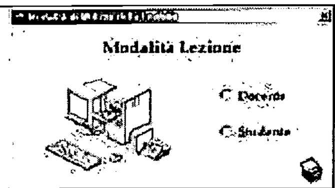	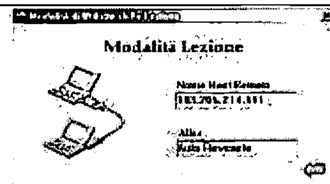
Fig.1 Choosing the role played in the lesson	*Fig.2 The connection to the teacher's computer*

The prototype's network configurations are of substantially two types:

- in the first, the students', i.e. the 'clients' are directly connected to the server, the teacher's application;
- in the second, there is an intermediate node – the Repeater – between client and server.

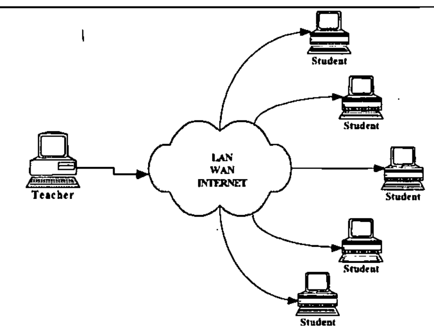	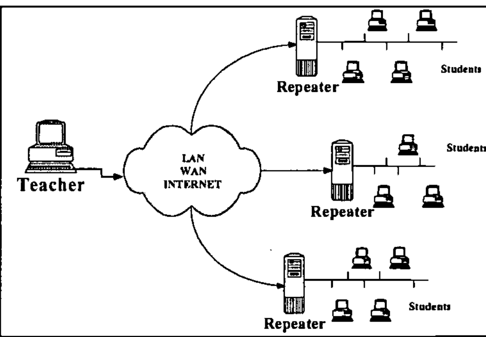
Fig.3 The prototype with teacher and students directly connected	*Fig. 4 The prototype with different classrooms using repeaters*

In the former case, a star-shaped structure is used which concentrates all the connection management operations on the server (the teacher's computer). This structure can be used efficiently only when there are a few clients. In the presence of numerous clients, transmissions between server and clients can be mediated by the Repeater. The latter is an application which sends the messages from the Server to the clients and vice versa. By means of the Repeater, the teacher's application can handle the transmission of data more efficiently and rapidly, given that the number of connections is relatively small. Most of the workload, in fact, is borne by the Repeater, the sole function of which is to handle connections and to duplicate data for each client.

2.2 Managing the lesson in real time

Once the lesson has been created and its dynamism established by the prototype author, at the beginning of the lesson the teacher exercises complete control (should s/he want it) over everything in the work environment depicted in figure 1 by means of the 'control console' shown in figure 5. The teacher can also use a navigation bar, which is naturally not visible to the student until s/he asks to intervene. Besides the navigation bar, the teacher can use the sequencer, which is the lesson 'control panel' real and proper (fig. 6). The Sequencer organizes the lesson pages with their objects into the sequence defined by the teacher. Each item in the sequence can be easily identified by the name given to it by the teacher or created automatically by the system.

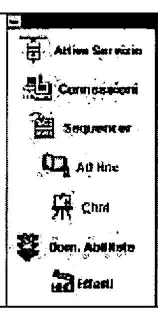	Activation of the service: the teacher accepts connections from the students Visualization, management and control of current connections Device which sequences the actions to be performed during the lesson Lesson mode developed *ad hoc* by the teacher Use of the multi-user Chat Clearance for intervention in the lesson by users Management of slide/object transition effects

Fig. 5 Control Console of the prototype and explanation of the buttons

An icon determines the visualization status of an object, so that an object in the sequence can be:

Alway visible	Currently visible	Currently hidden

The teacher can therefore use the sequencer to follow the sequence of objects created at the authoring stage, or s/he can vary it according to his/her wishes. When a particular slide is being shown, the situations on the computer screens of the teacher and students may be the ones presented in fig 7 and 8. Note the highlighting of the elements already visualized, and also of the next element in the sequence. This gives the teacher a series of advantages while s/he conducts the lesson and transmits information to the students.

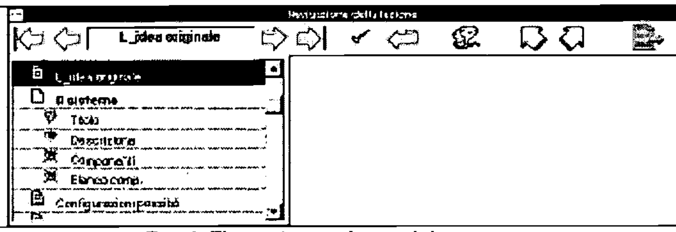

Fig. 6. The navigation bar and the sequencer

- The teacher can choose what to let the students see and what not to let them see.
- All the elements on the slide can be visualized to maintain the sequence of the argument, unlike in the case of presentation products, where what the speaker sees is also what the audience sees. This engenders less cognitive overhead for the audience because they only see the objects being discussed by the teacher at that moment.
- The lesson control tools are only visualized on the teacher's computer, so that the students' screens are not cluttered with buttons, arrows, cursors, and so on. This, too, reduces the students' cognitive overhead and enables them to concentrate solely on the slide.
- Only some of the elements on the slide can be re-viewed, an option which is extremely useful in the management of animations, for example.
- The teacher can jump to slides other than those in the sequence without the student noticing. S/he can thus change the route through the material without the students realizing, deciding impromptu the next slide to show.
- The presence on the teacher's computer of other software for example a word processor program with the written text of the lesson – without disturbance to the student.

3. The experiment

The experiment in teaching the 'Introduction to Databases' course at a distance was conducted at the University of Trento's two campuses located in Trento and Rovereto. Involved in the sessions were around 50 students, who divided between economics/business studies and information engineering. The students were attending the course for completely different reasons, given that it was a compulsory course with compulsory attendance for the information engineering students and an optional subsidiary course for those attending the economics faculty. This radical difference in motivation was extremely useful for creating a sample of potential on-line learners that was as heterogeneous and complete as possible. During the sessions the teacher was assisted by three other persons (two of them in the remote classroom) who helped with preparation and management of the lesson and dealt with technical problems without interrupting its progress.

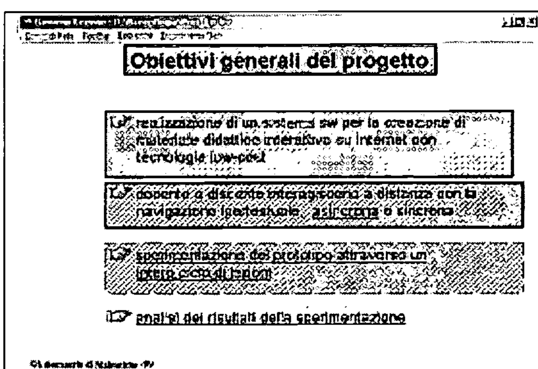

Fig. 7: a slide as seen by the teacher

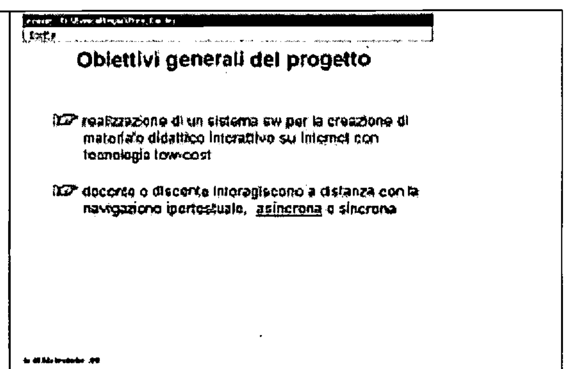

Fig. 8: the same slide as seen by the connected students

3.1. Technical data on the experiment

As said, one of the purposes of the project is to enable the use of low-cost technology, so that students who do not have costly videoconferencing equipment or fast communication lines can take part in lessons. Used for the experiment, therefore, were standard hardware and software components and low-speed communication lines: two Pemtium II 350 PCs, a 64 Kb/s ISDN line, two standard low-cost webcams, two video projectors for slides and videos, NetMeeting™ 3.0 for the videoconference. Used to collect the data was a questionnaire comprising twelve open-ended questions designed to yield the following:

1. a general evaluation of the method and its suitability for teaching purposes;

2. a qualitative assessment of the teaching materials used by the teacher, in particular of the language used, the clarity of the slides and animations;
3. assessment of the quality of the audio component and of the importance or otherwise of the video component;
4. assessment of the pace and duration of the lesson: this being crucial for students accustomed to taking notes, etc, at the pace typical of a traditional lecture;
5. criticisms of aspects to be improved or changed;
6. an overall evaluation of the experiment and its improvement or otherwise between the first and last session;
7. judgements by the students according to their faculty and number of lessons attended: different backgrounds and different types of course may have introduced biases in assessments of the experiment.

4. Analysis of the replies to the questionnaire

Analysis of the (anonymous) replies to the questionnaire revealed considerable interest in, and appreciation of, the method and advantages of distance teaching. Detailed analysis of these aspects would be inappropriate here, given the evident disturbance effects arising from the novelty of the experiment and the close match between the experiment and the students' interests. Rather, we briefly review some aspects emerged from the questionnaire.

a. It was very apparent that a poor-quality audio signal was distracting for the students. By contrast, the quality of the video signal was less important than we had expected. It should be borne in mind that the quality of the video was rather unsatisfactory, given that the transmission rate was around 2/3 frames per second, and the size of the window was 160x120 pixels. This poor video quality was deliberately introduced so that we could ascertain the student's real interest in being able to see/distinguish the teacher's gestures, face and expressions. It seems as if the teacher's image was a contact with reality and nothing more, and that its non-intrusiveness was appreciated because it did not interfere with concentration on the contents of the slides.
b. The duration of the lesson (around 2 hours) was judged to be about right, although numerous students asked for a short break after the first hour, especially when complex matters were being dealt with. The information flow and stimuli were indubitably greater than those of a conventional lesson. Unfortunately, it was here that errors in gauging the pace of the lesson were most apparent, as explained below.
c. The tools for management of the lesson enabled the teacher to 'navigate' rapidly and efficiently through the teaching materials while supplementing them with a large amount of further information. The pace of the teacher's exposition should be carefully assessed and tested. The computer medium accelerates the transmission of information but hampers focusing on it by the students, and it does not give them enough time to take notes.
d. Again with regard to the pace of the lesson, the multimedia materials on the slides (generally images and animations) were regarded as essential for clarification, but the teacher was urged to synchronize the presentation of these materials with the time taken to read and understand them.
e. A large number of students said that that it was important to have printed materials on the topics addressed during the lesson, probably so that they could cope with the above-mentioned problem of note-taking.
f. The respondents stressed the importance of reducing communication via the microphone in the classroom or through a chat facility to the minimum. They also asked for interaction on the materials being used by the teacher. Instead, there was no request at all for some form of visual interaction, which confirms that video is only an accessory and unidirectional (teacher-to-student) aid.
g. Curiously but significantly, the students were reluctant to interrupt the teacher when he was present in the classroom, because this was deemed to clash with the purposes of distance teaching. Interruptions in a real classroom give the students time to pick up the thread of the argument, but in distance learning situations this 're-boot' is time-consuming and distracting.

We now provide some details concerning the analysis of the questionnaire replies. The teaching method used was judged to be 'satisfactory' or 'very satisfactory' by around 94% of the respondents, without marked differences between the two faculties. Most criticisms were expressed by those who had taken part in all four sessions: in this case, in fact, the students had sufficient information with which to express an opinion closer to the reality and less conditioned by the novelty of the method. The language used in the slides was regarded on average to be clear. The use of pictures, diagrams and animations was particularly appreciated (especially by the economics students). However, the replies highlighted the students' difficulties in taking notes while simultaneously following the teacher's explanations. This was because the pace of the simulations was much faster than that required to write examples on a blackboard. Consequently, the teacher had to alter the pace of his exposition so that the students had time to copy and understand the principles or concepts being presented.

The time aspect is generally little considered by electronic presentations. Moreover, the prototype for the remote control of lessons, given its technical characteristics, introduces practically no time-lag between the two remote components of the lesson. As a consequence, the delays that normally occur in distance communication are not possible in this case. As to the video transmission, this was regarded as useful but not indispensable by 79% of the economics students, but by only 50% of the engineering students. When opinions of the quality of the audio were analysed, account had to be taken of environmental conditions and of technical aspects. The two classrooms were of different sizes, the acoustics were also different, and a 64 Kb/s ISDN line was used for both the audio-video flow and the prototypes. This latter aspect was dictated by the need to verify the minimum conditions for satisfactory functioning of the system, this being indispensable for assessment of whether the lesson could be followed by students at home, where the transmission band of the channel used is certainly not comparable to that of university networks. The data collected show that synchronization of the audio with the teacher's actions is of key importance. This is a very significant aspect, in that it makes the distribution of the audio in streaming format rather complicated. We had decided, in fact, to distribute audio/video in streaming format, due to the evident advantage of being able to exploit the multicasting characteristics of these technologies, and thereby reach a number of users with a single transmission. In the light of our preliminary experiments, and above all in view of the questionnaire results, we realized that besides the normal delay deriving from the remote transmission, streaming products introduce a further (and substantial) delay due to the streaming algorithms, which make this delay unacceptable. The assessments of the audio were decidedly positive, especially among the Economics students, whose classroom had better acoustics. Of course, the last thing we thought of in this complex experiment was to analyse the sound quality in the room where the students were sitting? Also interesting is analysis of the pace of the less and the speed at which arguments are expounded. There was a certain divergence between the opinions expressed on these aspects by the two groups: according to 35% of the economics students thought that the pace of the lesson was too fast, while the percentage fell to 13% among the engineering students, 4% of whom indeed declared it to be too slow (obviously influential here is the different levels of background knowledge in the two groups). One of the twelve questions on the questionnaire asked the respondent to indicate aspects to be improved, those to be changed, and functions to be added. The replies can be summarized as follows:

- To improve: the quality of the audio, synchronization between what the teacher is explaining and the slide being shown; some students wanted better video quality (but not a larger-sized window).
- Change: the pace of the lesson (according to the economics students), the characteristics of the rooms used for the sessions, the transmission band.
- Add: verbal interaction with the teacher, hard copies of slides to use during the session.

Conclusions

The paper has described the main results of an experiment in real-time distance teaching in which the teacher and learners interacted on teaching materials from physically distant classrooms. Used for the experiment was a prototype currently under development at the University of Trento, the aim of which is to set up an environment for the creation and management of on-line teaching materials. The experiment was positively evaluated by the students involved (21% very positive, 79% positive). None of the respondents expressed negative assessments of the experiment, and there were no significant differences between the results for the two faculties involved (Economics and Engineering). The experiment yielded some surprising findings on the usability of these systems with low-cost IT infrastructures. The students did not find fault with the extremely limited and qualitatively poor use of video, but they emphasised the need for improvement in the quality of the audio, and for adjustment in the pace of lessons. This clearly indicates that also the teacher should be 'trained' in how to manage lessons of this kind. Although they seem entirely similar to their traditional counterparts, the remoteness of the students and teacher interferes with the efficient conduct of the lesson, so that the teacher should learn how to overcome the differences in speed between the classrooms and his/her delivery.

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Some Observations on Student Use of Electronic Communications in Second-Year Biology Courses

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Abstract: This paper considers the student use of electronic communications in two second-year university Biology courses. Over a three-year period, student contributions to a Web-based discussion forum, an e-mail list serve, and e-mail directly to the instructor, were recorded. A number of characteristics of these electronic communications such as the number of student users, time of day used, types of use, and differences in student performance between the on-campus lecture, distance education correspondence, and Web-based versions of these courses will be discussed.

Introduction

While computers, by themselves, have not yet revolutionized education any more than previous educational technologies such as the motion picture, educational radio, teaching machines, and television, they have become useful tools, which are beginning to change the face of education. One area which has seen such change is Computer-Mediated Communication (CMC). The types of CMC analyzed in this paper are e-mail and Web-based discussion forums.

The Courses

Biology 2040 (Human Biology) and 2041 (Environmental Science) are second-year, non-major, non-laboratory courses which are regularly offered in on-campus lecture and off-campus correspondence formats. Biology 2040 is also available as a Web-based course.

Characteristics of CMC Use in the Courses

An analysis of the time of day students used CMC showed that there was some use of CMC throughout the 24-hour period (divided into 4 hour time blocks), and in fact over 45% occurred at times outside of regular classroom hours. These findings seem to support Cavalier's (1992) contention that CMC allows students to participate in 'round-the-clock' dialogues.

The levels of use of CMC in the different formats of the two courses varied considerably. While the percentage of students using CMC in the Web-based format of 2040 was much higher (61%) than for any other format (8.9-23.1%), it is interesting to note that almost 40% of the students in the Web section made no use of CMC. An earlier study (Collins 2000b) tends to suggest that students who are frequent users of CMC tend to achieve higher final course scores than infrequent users. While use of CMC in the on-campus formats was predictably lower (23.1% in 2040; 17.3% in 2041) than for the Web-based format, CMC in the off-campus correspondence classes was even lower (8.9% in 2040; 11.7% in 2041). This is surprising given the fact that distance education students' main method of communication with the instructor is by e-mail, while on-campus students have access to the instructor both in the classroom and in his office.

The main use of e-mail in all three instructional formats is for questions relating to test and exams. The second most common use for both correspondence and Web-based formats is for administrative purposes (i.e. scheduling meetings etc.). In the on-campus sections the second most frequent use is for questions relating to assignments, but this is merely a reflection of the fact that assignments are more often used in these sections. It is interesting to note that in an earlier study (Collins 1998) the percentage of e-mails about administrative and other matters amounted to only 2% but has grown to 20% in the present study.

In an earlier study (Collins 1998) there were also differences in the types of use related to student postings in the discussion forums. In the 1994 2040 class, content-related items accounted for 45% of postings, while class discussions accounted for only about 20%. In 1995 these percentages had changed dramatically, with the content-related items only accounting for 8% of postings, while class discussion accounted for almost 70%. During the period of this present study content-related items, class discussions, and assignment-related queries accounted for 70% of the postings in the on-campus classes. In the same period in the Web-based 2040 classes, however, items relating to tests and exams accounted for over one-third of the postings, with content-related items making up 18% of postings, and student discussions accounting for only 15%.

Student Performance

The results of an analysis of final course scores indicate that students in the Web-based sections generally perform at a lower level (mean = 71.4) than those in the traditional classroom format (mean = 76.9), and these in turn perform at a lower level than students in the correspondence sections (mean = 78.5). The findings from this study then are in marked contrast to other similar studies (Navarro and Shoemaker 1999; Wideman and Owston 1999) which found that students in Web-based courses did better than those in both on-campus and correspondence courses. Several explanations have been advanced for the differences (Collins 2000a).

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Linking Organizational Knowledge and Learning

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Abstract: Universities and corporate training centers are under pressure to offer increasingly flexible as well as individually relevant learning. Instead of trying to develop a stream of Web-based courses to run parallel to "business as usual" courses, a department can focus on gradually building a knowledge base in which key resources from individuals in the department or organization, from external sources, produced by learners, or re-used from previous courses can all be available for re-use in various combinations and in different views for different learning situations including learners in varying locations. With a focus that changes from "distributing content" to "building and (re)using resources" a new way of thinking about "courses" occurs. These processes require good technology; agreement on locally relevant standards; simple procedures for adding, finding, managing, and re-using resources; and a change in mindset for all those involved. How we are doing this is described.

Types of Learning and Pressures for Change

Within organizations, four general types of learning can be identified, as shown in Fig.1:

1.Structured information; informal access	2.Structured information; organized access
3.Unstructured information; informal access	4. Unstructured information; organized access

Figure 1. Four types of learning in organizations

In universities, Category 1 is typically represented by the library; in companies, by the knowledge management system in place in the organization. In both universities and companies, Category 2 is represented by courses, where learning materials are prepared or selected, and learner interaction with those materials is pre-determined by the course designer. Category 3 occurs for learners less often in universities, until learners are senior enough to have informal contact with those having knowledge and experience. For the professional staff in universities and companies, Category 3 learning occurs most frequently; on the job, via contacts with one's colleagues in house and outside or by casual contact with resources, such as via e-mail between colleagues or via borrowing a document one sees in a colleague's office when dropping in for a chat. Category 4 occurs in universities most often in a graduate or professional seminars; when the opportunity is created for a small group to share and discuss experiences with each other, led by a knowledgable leader who can relate those experiences to a broader concept or issue and stimulate reflection and transfer. In companies, such seminar-type learning situations may also be organized but they are usually not explicitly planned by the training department. The best examples of Category 4 in companies may be management-trainee seminars.

Each of the categories in Table 1 has its strengths, but also its limitations. Traditionally those responsible for Category 1 in both universities and companies are not those responsible for Categories 2 and 4. No one is responsible for Category 3; it just happens. In universities, "courses" fall mostly in Category 2, until the graduate level, when Category 4 predominates. In company training departments, Category 2 predominates. Category 2 is most often translated as content delivery, with the participants on the receiving end of the transfer.

In this context, two pressures are being experienced. (a) The first is the case for both universities and company training: the pressure for more flexibility. Particularly for the Category 2 experiences, learners may differ in when, where, and how they can optimize their acquisition of this knowledge. In universities, this pressure has led to more and more "distance education" and in companies to "e-learning". In both cases, it is assumed that knowledge will be pre-organized and delivered; what needs to happen is to release the learner from the constraint of having to be in a certain room at a certain time for this to occur. A less-understood aspect of flexibility is the need of learners to identify what forms of prestructured learning experiences are best for them. (b) The second pressure relates to relevance. The need for university courses to be relevant in the future careers of the students is becoming sharper as more and more students are already established in those careers and have an immediate basis from which to judge relevance. In companies, the need to relate formal learning to issues of importance in the workplace is also clear. In companies, where courses tend to be short in duration and chosen on a somewhat individual basis, the relevance problem is seen to be solved by the "voting by their feet" method: learners will enroll in the course that they need. If portions of the course are not useful to them is not much considered. In a two- or three-day course (typical in companies), as long as something is learned, the time spent unnecessarily is usually not seen as a concern.

Relevance in company training is easier to establish than in university settings. Real problems and issues facing employees in the company exist, and can be used as the basis for training. This occurs, but often in an abstract way. Courses are often seen as transfer of facts and concepts, with the presumption that the learner will be able to apply those in his work. The strengths of Categories 1 and 3--enterprise-specific experience--appear to be rarely used as the basis of Category 2 learning events, particularly those "on the Web". This tendency is increasing due to the pressures for time- and distance-learning. To offer courses at a distance and at learner-determined times, courses are being "bought" from the cheapest (often external) source, the criteria are that the courses be "standards compliant" and put on the Web. Explicit use of in-house experience, particularly the experiences of the learners, is unlikely to occur in a course acquired externally. By offering some access to a "tutor" who can answer questions about the pre-determined course material, it is assumed that a good substitution for a face-to-face setting has occurred.

But there are problems with this "solution". How can all these courses be found? How long does it take to develop them? How can this occur while "business as usual" still goes on within the traditional university or company training center? Is the expertise of the in-house course leader and of the participants being exploited? Is the learning experience good enough? What is the return on the investment in the short and long term? Are any of the benefits of Categories 1, 3, and 4 being integrated into Category 3? And do the results of the learning that occurs in a Web-based Category 2 course become available for others in the organization?

In our experience, in both university and company settings, the answer to providing more flexibility in learning is generally interpreted as pertaining to Category 2, and is generally being answered by making or finding pre-structured, organizational-neutral courses available via the Web with little or none of the strengths involved with Categories 1, 3, and 4. Particularly in companies, the connection between "e-learning courses" (Category 2) and Categories 1 and 3 is almost non-existent, and Category 4 barely exists in the first place. In universities, Category 1 becomes peripheral, as in-house libraries can never offer so much as portals on the Web. Category 3, "informal learning from colleagues", is hoped to occur through some entries on a discussion board, and Category 4 is outside the range of instructional designers of Web-based courses.

In our approach, we want to turn these tendencies around. Flexibility in terms of time and distance is important, but not our first aim. Pre-structured content is important, but not our first aim. What is our first aim? Learning from experiences, from one's own and from those in one's organization, and building upon these experiences for all four different types of learning categories. With learning from experience as a guiding theme, the boudaries between the four cells in Figure 1 start to blur, and "distance education" and "e-learning" take on new forms. A course becomes a guided opportunity to learn from experience, and to contribute one's own experience as learning materials for others.

Key Points for Learning from Experience

There are several key differences in the "learning from experience" approach compared to the "learning from neutral content" approach. These are identified in Table 1.

Learning from content transfer	Learning from experiences
Content is preselected, prestructured, and delivered	Content is encountered from a variety of sources, and partially is contributed out of one's own experiences
Learning relates to hours of time spent on reading or listening or attending face-to-face sessions.	Learning relates to finding and interpreting examples from practice, seeing how they relate to important competencies and objectives, and contributing to the collective knowledge base.
The starting point of a course is its content, prepared by in advance by professionals, perhaps not even having any contact with the organization.	The starting point of a course is the activities that learners will do, in order to bring new resources into the learning setting.
To be time and distance independent, a course must be instructor independent; tutors need to be available to answer questions relating to the pre-defined study material. Perhaps a forum can be available if some wish to use it (must will not).	The good instructor should be extended over time and distance. His main task is to lead learners to making the connection between theory and practice, starting with their own practice. He is not replaced, but extended.
Content and standards determine quality.	Building on and contributing to the learning resources and learning community of the organization determines quality.
Standards are necessary to make use of materials produced elsewhere, and to sell your own materials elsewhere.	Standards are necessary but need to be a combination of external indexes and also locally meaningful indexes.
"Offering instructor-neutral courses on the Web" is the guiding theme.	Building on and using the experience base of the organization is the guiding theme of learning activities.
Learning is completing courses.	Learning is becoming an active member of a professional community, knowing how to locate appropriate knowledge (also in human form) and apply it in one's work.
Learning is studying pre-written content.	Peer-to-peer learning is central; pre-written content is a resource, but may also sometimes by written by one's peers.

How do these principles work in practice? They involve technology, pedagogy, and new ideas about instructional design (Collis & Moonen, 2001). "The only way to keep pace...is by rebuilding business processes to take advantage of the collective knowledge base" (Eckhouse, 1999). They involve the convergence of courses and professional development, of formal and informal learning. "The advantages in technology and changes in the organizational infrastructure have increased the significance of virtual knowledge sharing, knowledge refining, new knowledge building and virtual networked learning for professional development." (Vänskä 2001). "Potentially explicable knowledge that has not been articulated represents a lost opportunity to efficiently share and leverage that knowledge" (Zack, 1999). "People to people" connections (Hinrichs, Kelly, & Bakia, 2000) are critical. An "experience management" architecture (Layton, 1999) needs to replace a "course management system". Figure 2 shows such an architecture, based on an object-oriented database.

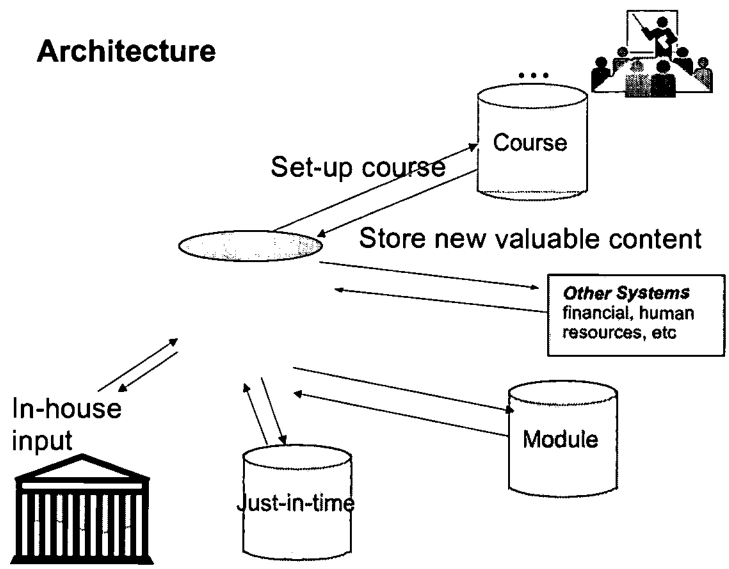

Figure 2. Building on experience. Use of an object-oriented database to both acquire new records of experience and also to offer different views and combinations of experiences for different learning settings. (De Boer, 2000).

Making it Happen

How does this happen in practice? We know, in that we have been working in this direction in our own institution, the University of Twente, for several years and also are implementing these ideas in various company settings. The following steps (Table 2) are the ones we have used; each is based on a considerable amount of literature and experience (see Collis & Moonen, 2001; see also http://teletop.edte.utwente.nl).

Table 2. From content delivery to building on experience

Steps	Strategies and tools
1. Start where instructors are at; extend their strongest skills so that learners who are not present can also take advantage of these skills.	1. Begin by extending an existing course, not "creating" or "buying" a "Web-based course"
2. Shift the focus from content to activities	2. Assume you can go on, for awhile at least, with the existing textbook or course reader; don't start by trying to put it "on line". Focus instead on new forms of activities that will bring new resources into the course.
3. Plan activities around learner contribution, and learner (re)use of resources contributed from a variety of sources	3. Use a Web system that makes upload and download of resources easy, for both instructor and learners. Uploaded resources need to become objects in a database, indexed or managed on the fly to make them immediately available for re-use.
4. Plan activities so that learners who are present in a face-to-face session create a base set of resources, which can be built upon by learners who are not present.	4. Use a Web system linked to a database; write activity descriptions that involve building upon the inputs of others; commenting, synthesizing, adding to, comparing to one's own ideas, etc.

Table continues

Table 2, continued

5. Gradually add more self-study content materials, but preferably based on the input of others in the organization.	5. Re-use good input; move toward an idea of a course site as a collection of resources, with the course focusing on structured use of and addition to those resources.
6. Make activities meaningful, and required.	6. Plan activities so that each participant's contribution is visible, valuable, and needed in order to continue with the learning activities. Activities are aimed at contributing to the learning resources, not individual practice exercises.
7. Assess via contributions	7. Assess the adequacy of course participation via what is submitted to the course Web environment. "Passing" a course is not a matter of only attending course sessions or completing an individual examination, but rather of showing one can relate to, build upon, and add to, learning-related resources.
8. Aim for contribution and flexibility, distance and time are not the key points.	8. With a contribution approach, learners can participate at locations of their choice and within certain time periods. The same learning resources can also be used for "just in time" and individual learning. Distance and time flexibility gradually and naturally increase.
9. Think of content as coming from a variety of sources.	9. Use the Web environment (based on a database) as a tool to bring together different views of a variety of content objects: those produced by professional instructional designers, those created by the instructor, those contributed by learners, and those documents found in house or on the Web which may not be created as "learning objects" at all.
10. Be less concerned about the "perfection" of the content objects and more concerned about the contribution and re-use processes	10.. Be very careful about how activities are described, about what is expected in sub-tasks, about how to monitor progress, about how to bring in peer interaction, about how to evaluate and determine completion. Re-use model contributions.

Figure 2 shows how the building process of a course can occur as the course progresses, with on-going input from both the instructor and other participants. In this approach, the course environment grows with each learner.

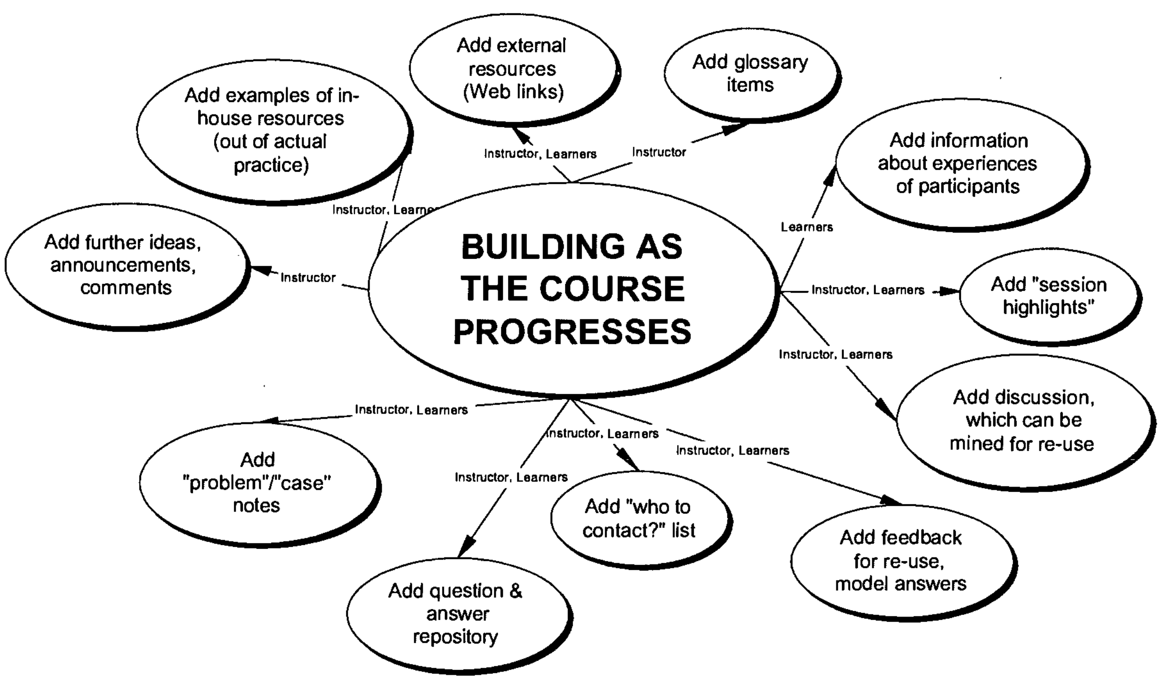

Figure 2. Building as the course progresses. The key is in the activities for the participants.

And the Technology?

What is needed for this approach? The technology is a main and indispensible factor. A system built upon an object-oriented database that offers flexibility in terms of the templates that can be developed to support input and output from the database is critical.. Tools for easy download and upload, in page designs of the instructor's choice, are necessary. An easy-to-use method to index, find, and re-use contributions and resources from a variety of sources, and to present these via different views generated by the database is important. A system for metadata that integrates external standards (as far as they are meaningful to the organization) and also local tags, such as those relating to competencies in an organization or objectives in an university program is important.

These requirements are not utopian. They are part of our own *TeleTOP* system for a number of years (http://teletop.edte.utwente.nl;). TeleTOP is not so much a "course management system" as a flexible way to make use of a database. We have, in our courses at the University of Twente, moved to universal use of the TeleTOP system, and toward an increasing amount and variety of "learning by contribution" methods. We are continually researching how to carry out these new pedagogies, what their impacts are on the instructor and learners, and how to streamline these sorts of approaches via a combination of new didactic strategies and continually improving technologies (Gervedink Nijhuis, 2000; ;Strijker, 2001; Van der Veen, J., De Boer, W. F., & Collis, B., 2000). We see these changes as both evolutionary and revolutionary. But without the technology, standardized throughout the organization and built around the "building on contributions and experiences" ideas we would be very much handicapped in moving forward.

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Planning for E-Course Success

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Abstract

This presentation will present a rather unique method of planning and designing a web site for e-learning. The following phases will be discussed: trouble shooting the project, initial overview of entire project, dividing the project into small portions and assigning people to each of these portions, periodic studies of the entire project in light of the development of each small portion and how the entire project is fitting together, periodic beta testing by students, the first launching of the project, and assessment of the project. One of the unusual aspects of this planning is trouble-shooting using a strategic planning process. Strategic planning is presented in some detail to allow others to use this process in their planning processes. Learning styles are used to determine the course elements for the web site, and Newton's second law is used as a basis for the distribution of assignments to various team members for the development of the web site.

We start with a basic law of physics, Newton's Second Law: $F = ma$. In this equation F is the force, m is the mass, and a is the acceleration. Solving this equation for the acceleration we have $a = F/m$ and we see that for the same amount of force, the smaller the mass the greater the acceleration. Applying this equation to web-site design and development, we have the important principle that to achieve the maximum acceleration of development we need to have the mass at any given time as small as possible. Recognizing the mass as the amount of material on which we are working and the force as our efforts, I think that everyone now quickly recognizes the principle. If we have everyone working on many aspects of the site, the site development will not be achieved at maximum acceleration. We must have the individual team members working on a series of small contributions. However we have to plan initially so that everyone is working on the appropriate assignments in the appropriate order. Therefore planning must be done initially on the project as a whole. After the initial planning, the team needs to have most people concentrating on small portions of the project with periodic reviews of progress as well as periodic reviews of the appropriateness of each component in light of the entire project. Of course if the team consists of one person, the person must divide his/her time wisely so that he/she concentrates on just small portions at a time. Regardless of the team size, the project must consist of the following phases: trouble shooting the project, initial overview of entire project, dividing the project into small portions and assigning people to each of these portions, periodic studies of the entire project in light of the development of each small portion and how the entire project is fitting together, periodic beta testing by students, the first launching of the project, and assessment of the project.

Trouble Shooting

The trouble shooting of the project is a phase that is often ignored or just dealt with as the problems arise. It is much preferable to do a thorough examination of the project initially, in which the strengths, weaknesses, and possible trouble spots are studied. We have found that strategic planning is a tool that lends itself well to this initial phase. Strategic planning is a management tool that was very popular in the late 1970's and early 1980's and is now becoming a popular tool again (McNamara 1999; McNamara 1995). It is a method of managing an organization so that it can do its job better. It is used to determine mission, vision, values, goals, objectives, roles and responsibilities, etc. The process of strategic planning involves intentionally setting goals and developing an approach to achieving those goals. However I have found the process to be very useful in systematically developing an approach to most any application, including web-site design and development. Before proceeding to demonstrate and discuss the application to this topic, we need to define some terms within the strategic planning process. While defining these aspects of strategic planning, we will also look at some hypothetical examples of each.

I. Goals

Specific targets or results the group wants to achieve in a short time period of usually one year or less. Goals should be specific, quantifiable, concise, acceptable, and compatible with higher organizational goals. *Example:* CH 1 web site must be ready for use on Jan. 1, 2002.

II. Objectives

Objectives are specific targets or results the group wants to achieve in a longer time period of usually more than one year. Objectives should be specific, quantifiable, concise, acceptable, and compatible with higher organizational goals. As time tables progress, objectives will become goals. *Example:* All core chemistry classes (CH 2, CH 3, CH 4 in addition to CH 1) must be on-line by Jan.1 2003. This objective is compatible with university goals.

III. Strengths (S)

Strengths are factors internal to the group that are considered relevant to the group's competence and over which the group has direct control. *Examples:* The group is very capable with some members having web development experience. All but one of the group members has tenure.

IV. Weaknesses (W)

Weaknesses are factors internal to the group that are considered in need of improvement or change and are detrimental to the group's competence. The group has direct control over these factors. *Examples:* Group members do not have workload allotted to the development of the site by the department chair. One member of the group is not tenured. Not all pieces of the development puzzle are in the group (no one is a programmer).

V. Opportunities (O)

Opportunities are environmental factors external to the group that can directly influence the group's competence in a positive manner if utilized, but over which the group has no direct control. *Examples:* The Presentation Technology Services (PTS) group on campus has much of the software and hardware available for web site development. The university wants publicity portraying the university as technologically savvy.

VI. Threats (T)

Treats are environmental factors external to the group that can directly influence the group's competence in a negative manner if not reacted to, but over which the group has no direct control. *Examples:* PTS is very busy and has an inflexible schedule. There are no university funds for new servers. Time spent on web site development does not count toward tenure or promotion.

VII. SWOT Matrix

Now we can make SWOT matrices, which will be SWOT items applicable to each goal and objective. Note that the S & W are items over which the group has direct control and the O & T are items which impact the department but over which the department has no direct control. We don't actually have to construct the explicit SWOT matrices; the important point is to be able to construct all of the SWOT elements and then to analyze them for a particular application.

Briefly analyzing the above, we see that we have a pretty good team except that we don't have a programmer and that need must be addressed. The programming can be done off-site (expensive) or the team could hire a programmer from an undergraduate or graduate student pool. We see that PTS has the equipment and software needed but we can't depend upon them to provide for people time help. A server must be obtained, so someone needs to determine if another server on campus has available space for the project (usually the case) or if space can be rented. Also the type of material will dictate some particular needs of the server, such as if it needs to be a Real server. One member is not tenured and time spent on web development does not count toward tenure. This is not an uncommon problem and is a major problem for which we need a solution. We can try to change the departmental and college tenure and promotion committee about the validity of such work toward tenure and promotion in the area of teaching. Also since the university is interested in having publicity about being technically savvy, it seems that the best short term solution is to see if the administrators will allow the work to count in the category of university service, for that category usually does exist in a tenure document.

The time spent in identifying the above specific portions of strategic planning and planning for overall success of the project is very valuable and should never be overlooked. Typically the time required to do the strategic planning is two weeks and this can be very effective use of time. In this hypothetical case, the items have been identified and solutions for possible problems offered. We know that now we are going to develop CH 1 and the other courses will be developed in the designated time line.

Determining Project Components

The second overall step is to determine the specifics about the development of the course. We have to first know our audience (Herrington & Oliver 1995; Kolb 1976; Kolb 1985). Knowing the learner styles of our audience will allow us to develop a web site that appeals to all of those learner styles. This is a critical stage of development that often is overlooked. Once we have determined the needed course elements to fit the learner styles that we will probably have in our course, then we will be ready to begin the web site development. The time to analyze the needed course elements is usually only one week, however the time to then determine which of each element will fit into a particular portion of the web site can be another week. Below is included a portion of a presentation made by the author at EdMedia00 (Combs 2000). This table can save people time in determining which elements are needed for a particular audience.

Learner Type	***Needed Course Elements***
Visual Learners:	Graphics (illustrations, films, slides, and diagrams), flow charts, discussion bulletin boards, and animations.
Auditory Learners:	Films, sound-enhanced slides, Microsoft Net Meeting
Read/Write Learners:	Written web material, referrals to other web sites, written assignments such as chapter summaries, suggested exam questions, etc.
Kinesthetic Learners:	Different web pages for different materials (makes them take a needed break), short web pages, memorization drills, animations requiring input, non-web assignments (surveys, lab experiments).
Sequential or Global Learning:	Give a good overview of each section and provide a logical progression through the material that can be chosen by the learner.
Inductive Approach:	Facts and observations given, principles developed
Deductive Approach:	Principles given, consequences and applications deduced
Active Learners:	These learners need group work. We can make assignments to groups of students and require presentation of results over the web using a course management system such as WebCT. Case studies appropriate to the discipline can be used very

effectively in this component. Reports of these assignments should be due often (every two weeks).

Reflective Learners: These learners need time to think over the material before trying it out. On-line quizzes that are taken at the time of the student's choosing appeals to these learners. A thorough assignment due at the end of the semester also appeals to these students.

Now if we want to develop the course for all types of learners – which we should – we see that we need on-line quizzes, bulletin boards, chat rooms, e-mail, overview of each section, appropriate graphics, flow charts, animations, films, sound-enhanced slides, and written material corresponding to the requirements listed above. All of this material also needs to be set up in such a way that students can easily choose which sections they need to attend at any given point in their study – student-centered direction.

As it is very important that we understand the learning styles of students, it is equally important that students understand their learning styles. We recommend the establishment of a web site that can be used by the students to understand various aspects of their learning styles. We set up a learner skill evaluation site that can be used by others as well: http://erkki.kennesaw.edu/skills/ .

Task Assignment

Now the trouble-shooting has been completed, the types of material needed for the entire course has been determined, and we are now ready to assign tasks to various members of the team to continue our design process (Demeester 1999; Henke 1997; Mackintosh 1999). Content experts need to begin writing the content along the guidelines developed during the study of learning skills of students. The content experts then are not to just reproduce their notes. The written material needs to concisely explain some topics in each chapter and each section needs to have web-based material such as other web sites pertaining to the same material, videos of selected material, animations appropriate to the section, interactive java applets helping the students to practice their understanding, an audio slide presentation of an overview of each chapter, and quizzes placed appropriately in each section of each chapter. Some of these content items will be created by other team members so the content experts will have some means of communicating to such members the exact type and content of the needed additional material. Also everyone must remember the a = F/m principle so that although everyone knows the overall project, all team members are individually working on small pieces of the project. Such projects are rather massive, and the completion of small pieces is very rewarding feedback to each member.

Project Production

Timelines need to be established for every portion of the project with dates also established for a comprehensive examination of the total project during development (Oliver, Herrington, Omari 1996). Teams of student volunteers need to be established that will serve as beta testers for the project as it is being developed. The development team must never forget that the project is being developed for student success. This must also be considered an iterative phase for as pieces of the project are developed, modifications of the flow of the project may be envisioned that were not determinable before beginning the project. Every team member must stay flexible and be willing to modify content and flow as the project matures.

Product Launch

After the process of Trouble Shooting → Component Planning → Task Assignments → Project Production → Beta Testing, comes the long awaited day of launch. It is recommended that the first formal offering of the course be to a small group of students who will also be involved in recommending changes and/or additions to the project. However the process is never over as the site will have to be continually monitored for updating web references and for monitoring each area for learning effectiveness.

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When Good Courses Go Bad: The Anguish of Online Dysfunctionality

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Abstract: An online course dies a miserable death amidst learner, instructor, and administrative angst, its brief life illustrating not only the importance of online community but also the conditions in which it can exist. Students' limited energies must be nurtured in a focussed environment and supported by teaching expertise that understands the delicacy of this balance.

Introduction

In the short, dramatic history of online learning, we, the believers, revel in our success stories. Watching our risks bear fruit brings satisfying moments for deserving educational pioneers. This narrative tells the story of an online course gone wrong, resulting in dysfunctional community. It uses as a backdrop the literature of social learning theory, community, and constructivism and demonstrates the critical importance of design, emphasizing key differences between assumptions underlying classroom teaching and those underlying online teaching, It also highlights the delicacy of the learner-instructor-content interaction and the trust and respect that bind it together.

Setting the Stage: Design Issues

The course was developed by a seasoned classroom instructor in collaboration with an experienced distance educator for an online master's program at a large Canadian university. A group of 13 adult learners, all professionals in their fields, embarked on their learning quest with enthusiasm and passion. But their energies quickly paled, their participation all-but-died, their ultimate evaluative responses were disheartening. What happened?

The course looked good online. WebCT was the platform. Modularized online notes were supplemented with a text and a package of readings. We had attended to the design features that are understood to be necessary to online success (Anderson & Garrison, 1998; Bullen, 1998; Stacey, 1999) and we built in interactive activities to instill "community." Among other things, WebCT allows for a social discussion forum, a calendar, and private in-course email exchange. Each of these features was utilized to aid coherence, community and clarity.

Materials were sent out early with a letter from the instructor outlining the course, his expectations of learners, reading, assignments, and important dates. Because the major assignment involved learners forming into project groups, detailed project instructions were set forth at the outset with an exhortation from the instructor to begin forming groups. This information was delivered to learners both in hard copy and on the course website.

Learning activities for each module included short "Notes" sections, written by the instructor specifically for this version of the course; relevant discussion questions, drawn from the assigned readings; and reminders of the ongoing course assignment tasks. Overarching the weekly content modules and discussion was a major group project. As a part of the project, groups were to post bi-weekly progress reports for all to see. An individual research paper, due at the end of the course, comprised the final assignment.

Lights, Camera, Action: And Then What Happened?

Student evaluations described an unsatisfactory learning experience, a poor distribution of energies (theirs and the instructor's) and a resultant impatience with online learning. Samples of responses included:

- I did not learn as much from this course as I hoped. Perhaps it is because the WebCT forums were rather sparsely contributed to.

- I needed more timely feedback. Where is the instructor? I have to proceed without him.
- The instructor tried to increase online discussion but people were generally not responsive.
- Instructor did not offer enough direction or advice. Online discussion was not well facilitated.
- Online forum should be been more structured to motivate students to participate.
- Instructor must be more involved and certainly be more helpful.
- The conferences on WebCT did not have good continuity.

Denouement: The Analysis of Failure

One month into this 13-week course, the instructor issued an impassioned "Help! Input Requested" message to students, realizing both intuitively and from feedback that the course was struggling. Complicating the fall-out from an inherent design problem, a series of interpersonal dramas began to unfold – the result of instructor inexperience with online teaching. Both issues are examined below.

A basic design flaw in the course's assignments resulted in a strident fracturing of students' attentions and learning energies. A type of "community schizophrenia" developed. In short, students were asked to undertake a major group project that got underway at the beginning of the course. Their allegiance to time and creativity was thereby funnelled into sets of small groups from the outset. At the same time, their attention was requested to develop a sense of community in fora created for large-group discourse. While building community online is recognized as advantageous to constructive learning (Jonassen, 1992) in this case its development was fatally thwarted: subset communities that fulfilled learners' needs for interaction were established at the small-group level; learners with finite amounts of time to devote to their learning activities chose to invest their time where the greatest payoff of marks lay – in the group project. Student interaction with community, measured in postings, was very low: 54% of the students posted less than 10 messages; 31% posted 10-20 messages; only 15% posted more than 20 messages. Total postings were 173. (Courses of comparable length and size can easily engender 2000+ postings in a semester.)

A second, damning contribution to the downswing could be described as the "cult of the personality": faculty previously successful in F2F venues, skilled in the application of personal power to learning situations, perceive themselves to be suddenly rendered impotent without the physicality of experiencing learners visually and personally. In this case, the struggling instructor threw his teaching energies into supervision of the small-group projects, *himself* jumping ship from the poorly-attended forum discussions, giving them the appearance of virtual ghost towns. Students *and* instructor became increasingly disheartened and lonely.

A new book on communications by Peters contends that "In the end, the presence of others, their proximity and available to touch, is what matters." Those of us who have created and taught successfully online know that we can work around the absence of traditional "touch." However, the downward spiral of this course would probably not have occurred in a F2F environment, where the physical presence of the instructor would have mitigated the first signs of dysfunction within the group. Trapped by distance, with no solidarity and good faith waning, the course unraveled like a ball of wool –design, learners and instructor scattered like anguished pieces of yarn across the unforgiving Internet.

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Informal Interaction in Online Teaching and Learning

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Abstract : The purpose of this study was to examine whether the use of a computer system developed to support informal interactions in an online learning environment increases the interaction among course participants and helps reduce their feeling of isolation while working in an online course. The universe used in this experiment consisted of five graduate students who agreed to participate in this research given their interest in the subject and their academic profile. The course was centered on the discussion of selected readings and mandatory assignments related to those readings. In general, participants affirmed that the educational experience using the system was satisfactory and were willing to take more online courses using the system, since they considered that the experience had been enriching when compared to other distance education they had taken in the past.

I. INTRODUCTION

The lack of interaction between students and professors, particularly in online courses, is stressed by the fact that students do not have well defined schedules nor specific places to access course materials and engage in learning activities. In fact, Blanchard (1989) states that the lack of direct interaction between students and professors is a severe limitation of distance courses, even if compensated by other benefits. In traditional learning environments, interaction among students and professors can have an important influence in student performance (Chickering, 1969; Endo & Harpel, 1981; Feldman & Newcomb, 1969; Jacob, 1957; Terenzini, Theophilides & Lorang, 1984; in Lamport, 1993). In remote courses the opportunities for these interactions are limited even though their importance has been highlighted (Barnes & Lowery, 1998).

Traditional learning environments provide opportunities for formal interaction, mostly during regular lecture hours. In addition to this, hallways and cafeterias as well as in the classroom while waiting for a class to begin provide opportunities for informal interaction. These opportunities are generally non-existent in distance education.

According to Kraut *et al.* (1990), informal interactions are those that do not have a defined schedule or place, are spontaneous and not planned. In distance learning environments, besides the formal interactions, mentioned by Gunawardena (1995), informal interactions are of great importance since they provide the means for the establishment of a social presence favorable to learning (Gunawardena, 1995: Gunawardena and Zittle, 1997). The use of computer-mediated communication in these learning environments allows for all students, regardless of their gender, ethnic group, social class, or with special physical or emotional challenges, the same opportunity to interact with their classmates (Mowrer, 1996). Pascarella *et al.* (1978) found evidence that in traditional learning environments students with frequent informal interactions had better academic performance than predicted from their pre-enrollment characteristics, whereas students with few informal interactions tended more often to perform below expectations.

In distance education, asynchronous electronic tools play an important role, allowing interactions among students and between students and the professor. Some of their advantages are: flexibility in the continuous communication of the group and freedom from restrictions of space and time, but the same asynchrony presents a serious disadvantage in terms of the response time required by the instructor or student to respond to a request. Student interest might decrease because of these delays while fostering feelings of frustration and loneliness.

One of the main challenges of distance education is to alleviate the isolation felt by students. Face to face encounters and telephone calls have been used in the past to maintain personal communication among participants. These solutions however, require additional resources and might be difficult to implement in large distributed groups.

Based on our experience with this problem of limited communication and interaction among participants in online courses, we designed, developed and currently use a software tool meant to encourage informal interaction and reduce the feeling of isolation among students.

II. INFORMAL INTERACTION SYSTEM

CENTERS (CollaborativE INformal InTERaction System) allows students and instructors who access a course's web site, to be aware of, and interact with, others visiting the site at the same time. The following is a typical scenario that illustrates the characteristics of the system:

A student logs into the system and reads the task assigned to him for the day. While reading the assignment, he gets confused with part of the material but realizes that one of his classmates is consulting the site and sends him a message, asking if he can clarify the doubt. The other student responds with his opinion while mentioning that he is not sure whether his answer is correct. Then they notice that the instructor of the course logs into the system and send him a request for interaction, consulting him on the issue they are discussing. The instructor responds clarifying the matter. The characteristics of CENTERS are the following:

1. It allows lightweight interactions in the context of online courses. These interactions do not require the additional overhead found even in e-mail or discussion forums.
2. It allows web navigation in a completely natural way, without interferences, since the display of the system occupies only a small amount of space in the screen and the user can decide to navigate anonymously if so he wishes.
3. It displays and updates information about users connected at the same time. When a new user enters the site all current users are notified of his presence while their names are displayed on his own screen (see left frame in Figure 1).
4. It provides two mechanisms for textual communication with other people who are connected to the site: a chat and sending instant messages.
5. The user can use the two communication forms simultaneously; that is, he can send and receive instant messages from one user while in the middle of a conversation with another one using the chat.
6. It allows a user to quickly load the page that another user is currently looking at, this allows for synchronous navigation and facilitates the discussion of online material.

To help evaluate the use of the system the following features are included:

7. Stores the frequency of user access to the site with the following data: Name of the user, date and time of login and log-out, and IP address of the computer from which the connection is made
8. Keeps record of all messages, including the sender's and receiver's name and date and time when the message was sent.
9. Keeps a log of acceptance and rejections of chat requests.

Besides increasing the opportunities for informal interaction the system offers the advantages of its ease of use; its ability to synchronize users to the same web page, and its integration within the course documents, thus not requiring user intervention to install or configure any software. Figure 1 shows the main screen of one of the web sites in which we installed the system with four users connected at the time. The following section describes our experience with the use of the CENTERS system in an online course.

III. EXPERIMENT

The purpose of the study was to examine whether the use of CENTERS increases the interaction among course participants and helps reduce their feeling of isolation while working in an online course.

The universe used in this experiment consisted of five students from the Masters in Education and Technology at the University of Colima, Mexico. These students agreed to participate in this research given their interest in the subject and their academic profile. The online course: Models of communication in distance education, is an elective within the masters program and lasted five weeks.

The course was centered on the discussion of selected readings and mandatory assignments related to these readings. Students were required to write summaries of each reading in preparation for their discussion and publish them in the course's web site. At the beginning of the course, students were asked to access the course's web site at least once a day.

The students were asked to complete two questionnaires, one at the beginning of the course, which allowed us to characterize the students enrolled in the class, and the second one at the end of the course designed to gather the students' impressions about the course and the system. The first questionnaire asked students their age, gender, and previous experience with online courses and electronic tools, as well as their expected needs of interaction with instructor and classmates for their successful completion of the course. The second questionnaire required students to evaluate the course, and give their opinion on the interaction opportunities provided by the system and its relation with their progress in the course as well as whether they felt in touch with the rest of the group. This questionnaire consisted of 25 questions, 12 with two possible answers (yes or not), 10 that used likert scales and 3 open questions.

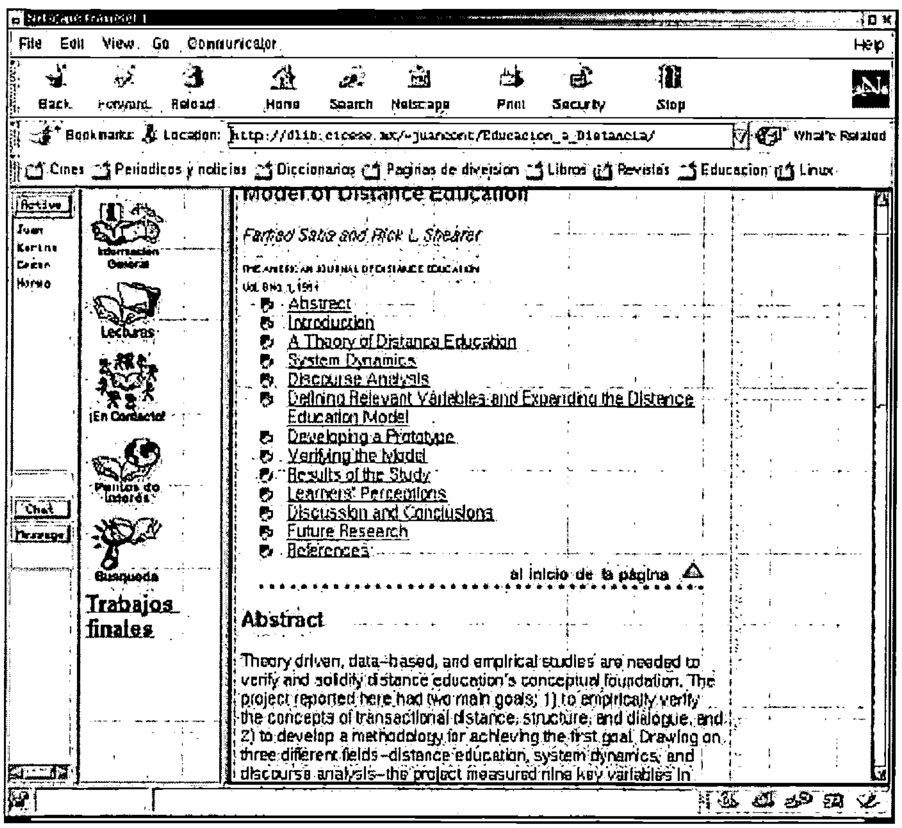

Figure 1. Screenshot of the online course with the CENTERS system.

IV. RESULTS

The frequency of access and number of messages sent per student per week, obtained from the system's reports, is shown in Figures 2 and 3. The answers to the questionnaires revealed the following:

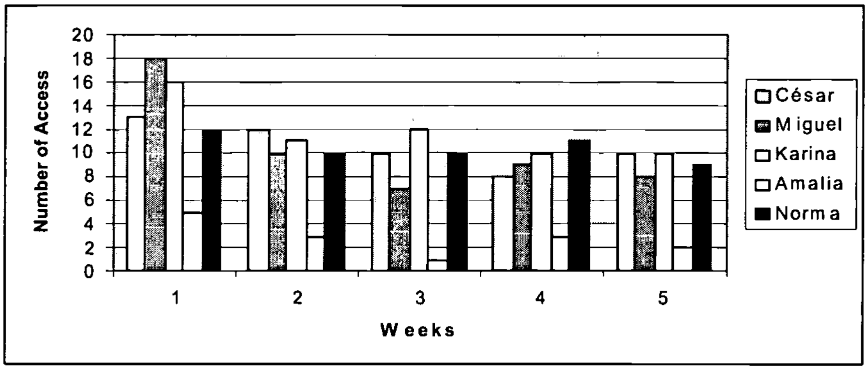

Figure 2. Number of access to the site per student per week

Four out of five students estimated that the opportunities of informal interaction provided by the system were sufficient to solve their doubts, and one considered these opportunities to be scarce. The system's records indicated that this last student had the lowest number of accesses and interactions.

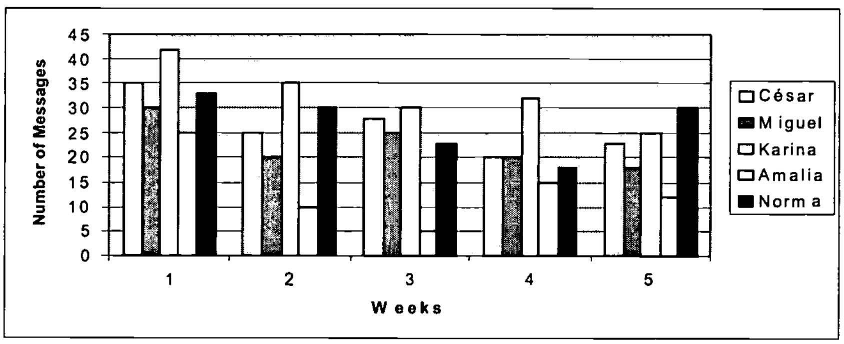

Figure 3. Number of messages per student per week

All five students indicated that the possibility of interacting with their classmates and course instructor facilitated the group's integration.

When asked to rate the quality of their interaction with the instructor on the scale: Excellent, Good, Regular, Limited, Null, all students judged their interaction as Good.

All five students reported that knowing who else was connected to the site at the same time helped them to feel like an active part of a group and to reduce the feeling of loneliness while working in the course activities. They rated as high the frequency with which they verified who else was simultaneously connected in the scale: Continuously (5), very often (4), some times (3), scarcely (2), never (1), the average was 4.2 or very often.

Four of the five students considered CENTERS to be useful in supporting group and individual activities. In addition, they qualified the system as an excellent aid for consulting doubt synchronously.

All five students considered that the informal interactions they had during the course helped them to better understand the study materials, since they could discuss their doubts with their classmates and instructor at the moment when doubts arose, since very often somebody else was connected at the same time.

In general, the participants affirmed that the educational experience using the system was satisfactory and were willing to take more online courses using the system, since they considered that the experience had been enriching when compared to other distance courses they had taken in the past. The answers to the open questions indicate that the students considered that the informal interaction system was useful in the context of that particular class, but depending on the class activities, the system would have different levels of usefulness.

V. DISCUSSION

The course participants considered that the informal interaction opportunities provided by the system proved to be sufficient to satisfy their needs for interaction with classmates and the instructor. In addition, they considered that the system allowed them to: participate in a greater number of interactions and that these interactions helped them increase their comprehension of the course and establish better social relationships with their instructor and classmates. The previous assertions became evident when analyzing the records generated by the system during the course and the answers to the questionnaire applied at the end of the course.

Additional comments provided by the students about their interactions in this course were that when they realized that somebody else was accessing the site they often sent messages with social content to that person. In the case of the instructor, they sent messages to greet and welcome him, which enriched the interaction student - instructor. In addition, the records of the system show that briefly after a student entered the system, several messages were sent to him by other students, and these greeting messages were always answered. In many cases, these messages worked as a preamble to a conversation related to the course, and students considered this educational experience as satisfactory. Quoting one student "this course was an enriching experience that changed my impressions about distance learning education and my study and collaboration patterns."

These results are in agreement with those reported by Pascarella, Terenzini and Hibel (1978) for traditional learning environments. They found that the informal interactions that students had with the instructors in some cases caused them to change the way they approached learning. Also, they support Spady's (1970) hypothesis, which states that informal interactions between students and professors have a positive influence on the academic performance of the former.

Among others, Jacquinot-Delaunay (1999) and Froissart (2000) emphasize the fundamental role of the variable "loneliness" or "isolation" among the causes for students abandoning distance learning programs, attributing it even greater importance than to a poor academic background. The results of the present study indicate that students in this course felt less isolated than in other distance courses that they had taken which provided only asynchronous means for interaction. If these results were generalized, this kind of tools could help lower the high attrition rate of this type of courses.

The results obtained in this study are encouraging, although not yet conclusive due to the limitations of the study, among other reasons by the small study sample, the profile of the participants (graduate students, specialists in educational technology), the short duration of the course, as well as the novelty of the system that might have contributed to its frequent use. Nevertheless, this pilot study encourages us to continue with the development of tools that allow and encourage informal interaction in distance learning.

Future work will consist of exhaustive testing of the system in online courses of different disciplines and academic levels in order to obtain and analyze patterns of informal interaction, if they exist, as well as to make comparisons between the requirements for interaction and the degree of satisfaction provided by the system.

NOTE: The documents for the online course described in this paper will be available at:

http://dlib.cicese.mx/~juancont/Educacion_a_Distancia/

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Using Educational Dialogues to Design Systems for Learning

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Abstract

In this paper, a model is presented that uses educational dialogues to support the design process for learning support systems. This model assumes an iterative life cycle model of software design, in which dialogue can be both an input (in the form of data for analysis) and an output (the result of learners using a well-designed system). The model has been derived from analysis of patterns of system development, and is related to approaches to cyclic models in educational theory and research methods. Two contrasting studies are used as illustrative examples of this iterative life cycle. The paper concludes by presenting a comparison between this approach and related developmental models: Kolb's experiential learning and Action Research.

Introduction

In this paper, a model that uses dialogue to support the design of systems for learning is presented. This model is argued to provide a structure that links pedagogically motivated empirical studies of student-tutor-system interactions to problem specification and system design, and to result in the creation of learning technology systems capable of supporting learning. Contrasting case studies are presented to support this claim.

The importance attached to dialogue in this model stems in part from the work of Lipman (1991), who has argued that dialogue with a 'community', including teachers and other learners, can play an important role as part of an interactive learning mechanism. As well as articulating and explaining a concept to peers and tutor, the learner will also internalise these dialogues. Self-reflection on these concepts can be fine-tuned and regulated by reference to a history of external dialogues that the learner has been exposed to. Furthermore, new conceptual understanding can be 'tested-out' by exposing them to further external dialogue within the 'community of learning'.

The model described in this paper has emerged from an analysis of ongoing development work. Its proposed strength is based on the realisation that common structures appear in a diverse range of development activities. In particular, this methodological framework has been synthesised from developmental work in subjects as diverse as Musical Composition (Cook, 2000) and curriculum design (Oliver and Conole, 1998; Kewell et. al., 1999b), demonstrating its transferability and validity. Our life cycle involves five steps: 1) problem specification, 2) educational dialogues and interactions are analysed and modelled, 3) results from dialogue analysis can be used as the basis for the design of technology-based educational systems and/or can be used to inform our educational practice, 4) a system is implemented that can be used to foster informed or principled educational dialogues, and 5) the system is evaluated with users. There are various issues involved with each step:

- At step 1 we need to decide if the application area is domain specific or more generic.
- Step 2 requires us to decide on what dialogue analysis and modelling techniques to use. There is a great number of techniques available, a discussion of which is beyond the

scope of this paper (see http://www2.unl.ac.uk/~exbzcookj/workshop/workshop.htm for the proceedings from a workshop that included talks on some of the approaches that are possible).

- It is not a question of direct transfer of expertise from human to machine, but rather to use human expertise, when *modulated* (rather than *transferred*) to the computational medium, as an appropriate starting point for system design, which can then be refined on the basis of evaluation with users.
- When moving from design to implementation two possible choices are that of going for an implementation of the whole design in one go (the big bang) or of adopting an incremental approach that involves the repeated use of prototypes to elicit user requirements. In our model we favour the latter approach.
- Evaluation can also be problematic. As has been discussed, a common problem with evaluation is that designer will adopt a familiar strategy, as opposed to the most appropriate strategy, and hence will not be able to address key issues. In addition, it may prove appropriate to use different evaluation strategies at different iterations within the cycle (Oliver, Conole et al., 1998).

The purpose of this paper is not to provide solutions to all of the above issues. Rather, we make use of two studies to explore aspects of these design issues and develop a deeper understanding of this model. To this end, the paper concludes by presenting a comparison between this approach and related developmental models: Action Research and Kolb's experiential learning.

The first study: a support tool for musical creativity and reflection

The first study used steps '1 through 5 and back to step 2' of our life cycle to develop a learning support tool for musical creative reflection. Cook (1998) has used a dialogue analysis and modelling methodology to develop a computer-based pedagogical agent for supporting musical composition learning. Cook has explored the life cycle as follows:

1. *Problem specification.* Evidence supports the view that the use of sequencer software in the current training of composers in higher education appears to limit creative thinking in some learners.
2. *Dialogue analysis and modelling.* Cook (1998) has analysed teacher-learner dialogues in a formal manner; one outcome of this analysis being prescriptive models of interactions described at the level of participants' goals and communicative acts (the latter being seen as a way of achieving goals).
3. *Design of technology-based educational systems.* These dialogue models (generated by step 2) were then used in the design of an computer-based pedagogical agent called MetaMuse (Cook, 2000) that was able to engage in interactions that aimed to promote creative reflection.
4. *Implementation.* MetaMuse, a pedagogical agent for supporting undergraduate musical composition learning, has been developed as a result of employing the design approach described above.
5. *Evaluation of the system with users.* MetaMuse has been evaluated with users (Cook, 2000). The sample size of users used in the evaluation, at 17, was small and so some caution is required when attaching significance to these results. Given this reservation, however, the results seem favourable: the total average response score for user attitudes to MetaMuse — elicited by questionnaire following a session with the system — was

3.63 (out of 5). However, a question that asked users to evaluate the help screens and messages provided by MetaMuse received the lowest average score (2.76 out of 5). The help screens and the language used by MetaMuse clearly need improving. (Provision of help was not a focus for the initial version of MetaMuse.)

Current work involves two related projects. The first project aims to improve the guidance and explanations provided by MetaMuse by incorporating model-based training techniques (new problem, step 1 of the life cycle). The goal of such an undertaking is to provide enhanced access to learning over the Internet in a domain (musical composition learning) that has traditionally had little computer-assisted support (i.e. training in musical composition). The second project involves an analyses of transcriptions of pairs of collaborating learners using MetaMuse (generated by the study described by Cook, 2000). The initial evaluation of the MetaMuse pedagogical agent (i.e. step 5 above) did not provide adequate insight into the following question (new problem, step 1 of the life cycle): what are the interactive means by which learning agents engage in cooperative problem-seeking? This second project will, therefore, commence from step 2 initiating a second loop around the life cycle (i.e. more dialogue analysis and modelling).

The second study: pedagogic re-engineering

In contrast to the first case study, the second project started from a different point in the model. This work concerns Media Adviser (Kewell et. al., 1999a), a software tool that supports "pedagogic re-engineering" (Nikolova and Collis, 1998): changing the structure of a course and the nature of its activities in order to take advantage of Learning Technology. The software supports a five-stage process of course description, analysis to identify strengths and weaknesses, identification of alternative teaching techniques, the creation of revised curriculum plan(s), and a planning process that identifies the steps needed to implement the new curriculum. Media Adviser comes into its own when used as a discussion artefact (Kewell et. al., 1999b), and consequently dialogue has been used as an integral part of the tool's development (Oliver and Conole, 1998).

The project involved implementing a software tool based on an existing design, and then testing this with users. This then led to the refinement of the software tool, involving an analysis of users' dialogue, redesign and re-implementation.

4. *Implementation.* The specification for the functionality of Media Advisor and a high-level design outline was given to the project team, who implemented a prototype.
5. *Evaluation of the system with users.* The software was used as part of a professional development programme, in which users worked together to address problems of curriculum design. This process was observed and video recorded, and the data was subsequently transcribed.
2. *Dialogue analysis and modelling.* The dialogues that were observed in the evaluation phase were analysed in order to identify strategies for use, potential refinements and unanticipated needs or issues.
3. *Design of technology-based educational systems.* The software tool was refined and extended to address the findings of the analysis phase. This included enhancing the visual feedback on course profiles provided by the tool, increasing the flexibility of its modelling component, and allowing users to customise content with a 'save and load' facility. In addition, the navigation through the software was re-thought.

4. *Re-implementation.* Following the design of additional functionality and revisions to the interface, the software was re-implemented.

In summary, then, this second study started at step 4 of the model, progressed to step 5, looped back to step 2, and then moved on through steps 3 and 4. Current work on this project involves a second round of empirical evaluation of the software tool.

It is worth noting, however, that this project work built on existing research that can be mapped onto steps 1, 2 and 3 of the first cycle of the model. What this illustrates is that any research or design process is likely to draw on the full range of steps in the process, but that these may be carried out by separate researchers or project teams. Consequently, any self-contained team may only be aware of their progress through sub-sections of the model.

Discussion

The cases described above illustrate the model elaborated in this paper. However, it is useful to consider whether this model is actually innovative, or if it is simply a re-naming of an existing approach. To demonstrate the distinctiveness of this model, this section includes a comparison between it and two other models, each of which relates to a different aspect of its process: Kolb's experiential learning and Action Research.

Kolb's experiential learning cycle

Just as systems design has shifted from system- to user-centred models, current theories of learning have moved from teacher-oriented to learner-oriented. Particularly relevant to this discussion is the model provided by Kolb's experiential learning cycle (Kolb, 1984). This model can be taken to explain the process whereby the designer learns, through experience, how to improve their system. Importantly, the "experience" phase of this model relies on first-hand immersion in (or observation of) real use.

This cycle fails to capture key elements of the model described in this paper. At a simple level, the mapping between stages (e.g. abstract reconceptualisation and design, experimentation and implementation, concrete experience and evaluation) highlights that the process in this paper is geared towards a practical process, rather than reconceptualisation. It is a process that deals with creation and development, as opposed to being purely concerned with the development of knowledge.

Additionally, the design process involves a 'scoping' element (problem specification) that is missing from Kolb's cycle. The experiential learning cycle assumes that the remit for learning is given; the model in this paper places the responsibility for this scoping with the designer.

Finally, experiential learning also leaves the nature of "experience" undefined; in this model, a tighter focus is presented. The purpose of this is to concentrate on dialogue as a key indication of learning and development (e.g. Lipman, 1991). This reflects the aim of this model, which is to design systems that successfully support and structure learning through dialogue.

Action Research

Action Research is closely related to experiential learning, and follows a similar cyclic model (see, e.g., Zuber-Skerrit, 1992). The key difference between the two approaches can be argued to be one of emphasis. Experiential learning is closely linked to personal development (sometimes in the guise of Action Learning; e.g. Peters, 1998), particularly through reflective practice. It also focuses on the acquisition and development of concepts. By contrast, Action Research normally includes an element of dissemination (making it partly a public process, rather than an exclusively private one) and is concerned with the identification and development of theories. In particular, it is viewed as one method of building grounded theories, and has been linked to Habermas' conception of the organisation of enlightenment in critical communities (Zuber-Skerrit, 1992).

This model described in this paper does not place such predetermined restrictions on the designer, but instead responds to their personal interests. As a consequence, the process could lead to *either* type of output, depending on the focus of the work and the context in which it is carried out. For example, immediate, local solutions can be created through the design process. In addition, more general schemas for design can evolve through the repeated application of this process, and through reflections on problems that emerge.

One way of determining which of these emphases will emerge lies in the choice of evaluation strategy employed during the cycle. Traditional assumptions about transferability of evaluation findings suggest that highly authentic approaches will be best suited to local solutions, whilst controlled evaluations will support generalisations (Oliver et. al., 1998). Either approach could be adopted within this model.

One commonality between all of the models discussed in this paper is the use of iteration. One of the strengths proposed for Action Research, for example, is that the process is incremental and iterative, leading to a process of continual improvement. A similar argument is made for the model outlined here. This is particularly true given its emphasis on users and learning, rather than systems and teaching, which lies at the heart of improving the usability of learning technology.

However, one key difference between these models concerns the scope of their iterations. Action Research, as with experiential learning, assumes that iterations will involve complete repetitions of the four-stage process. The model proposed here is more versatile; in it, iterations may occur at one of four levels:

1. Re-implementation of the tool, necessitated by the identification of bugs or errors
2. Revisions at the level of design, aimed at improving usability (a link back from evaluation to design)
3. Reformulations that respond to unexpected patterns of use or to the recognition that current analytical techniques have not adequately explained the structure of the dialogue (a link back from evaluation to analysis)
4. The identification of a completely new (but probably related) problem, requiring a distinct project that may replace or run in parallel with the original one (a link back to the start of the process)

Conclusions

In this paper, a range of cyclic models for development or the identification of good practice have been identified. A further cyclic model has been elaborated which focuses on the role of dialogue in design. This has been shown to be distinct from existing models, in particular in terms of the flexibility of its iterations and its focus. Two key features of this model are worth emphasising.

Firstly, it is iterative in nature, which necessarily engenders a continuous process of research and development. Above we have described how our model has already investigated a limited set of cognitive and social processes that underpin the process of creative system design and innovation.

Secondly, it illustrates how existing models can be adapted and customised in order to provide a detailed and relevant step-through for design processes in specific areas. Indeed, because of the diverse domains presented in our two studies, we claim that our model has a high degree of transferability and validity.

The current version of this model represents at least one iteration through a reflective cycle, such as that of Action Research, for the authors. It draws on the identified models, and on experiences of applying these in a research context. Reflections on these experiences identified refinements and changes, and also commonalities between practice in different research projects. These reflections led, in turn, to the model described above. This can be viewed as an attempt to develop a theory that can be used to explain and structure the design of systems. The next step will be to undertake further iterations of self-reflection in order to refine the model further. One aspect of this will be to consider how this model relates to project management and to the structure of research projects. The work will involve applying the refined model, both to further iterations of the cases described in this paper and to new projects, and then further developing the model based on these experiences.

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Building Tissues: Computer-based experimentation in plant tissue design

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"Building Tissues" is part of a hypermedia package "Constructa Plant" that aims to address some of the conceptual difficulties students have with understanding plant anatomy and provide an interactive tool for learning about the structure and function of plant tissues and organs. The "Building Tissues" section of the package allows students to experiment with (in the sense of trying out) various design elements for tissues created to perform a particular function. Students are required to select a function that their tissue should perform, choose the most suitable shape for the cells, cell wall thickening agents and cell contents (i.e. the presence of organelles such as plastids, mitochondria and golgi bodies and a single vacuole, such as is normally found in plant cells). Alternatively, the student may decide that the cells making up a particular tissue should be empty/hollow (i.e. dead, containing no protoplasm). Cell arrangment and connection must also be specified and the size and position of pores, if required to allow for flow of substances between the components of the tissue. Feedback on the completed design is given concerning its performance and suitability for carrying out the specified function. Students may then, on the basis of the feedback, go back and alter specifications and "retest" these changed features. This design trialing activity aims to move away from students rote-learning tissue structure and to rather promote understanding of the relationship between structure and function.

Students proto-testing the package enjoyed the creative nature of the Building Tissues section of the package and felt that it had promoted and/or reinforced their understanding of structure-function relationship in plant tissues. Pre- and post-testing of the students' recognition of important structural features in tissues carrying out specific functions confirmed this perception.

One-to-One Technology: A Model for 21st Century Education?

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Abstract – This paper outlines, in an in-depth manner, how Carmen Arace Middle School in Bloomfield, Connecticut transformed itself from an 90% minority underachieving school with "bright flight" and very little technology into a nationally recognized technology innovator. The "digital divide" has been conquered through every student and teacher using the One-to-One NETSchools Laptop system through a school-wide infrared network. This report documents some of the dramatic changes in instructional methodology, professional development for staff, improvements in achievement test scores, attendance and reductions in discipline incidences. Samples of the school's laptop curriculum can be found at http://www.blmfld.org/araceweb/cazine.htm.

The Community - Bloomfield, Connecticut is a town of unexpected contradictions and unfulfilled potentials that is working to create a school system for the 21st Century. Located in the north central part of Connecticut, it contains rural vegetable, tobacco and dairy farms as well as one of the best known insurance companies in the nation, Cigna. Adjacent to the state capitol of Hartford, it is a racially isolated town with a 90% minority school-age population. While having a long history as a racially diverse community, stretching back to being an original stop on the Underground Railroad, today its population is a dichotomy of white senior citizens and African American families and their children living side-by-side in quiet neighborhoods.

The Problems -But unfortunately, Connecticut Mastery Test (CMT) scores in the 1990's showed a low level of educational proficiency that was reflected across all grade levels. On the CMT's of Reading, Writing and Math Bloomfield's failure rate was abysmal. 1996 Statistics showed that <u>only</u> 33% of our fourth graders, 17% of the sixth graders and 15% of our eighth graders met state goals on all three CMT tests. This highlighted that there was a major problem in our schools, especially in the middle school.

The Solution - That solution turned out to be the NETSchools laptop program. NETSchools Corporation, a private corporation founded by retired IBM executives, had a pilot program involving a specially designed student laptop called the StudyPro™. This infrared linked laptop was capable of surfing the Internet, providing email, word processing, and spreadsheet capabilities in a Windows95 framework and it was virtually kid-proof as well. With a magnesium case, water resistant keyboard, wireless network capability, and six hour battery life, students would be able to have an all purpose tool that could not only extend technology access in school but also at home beyond the normal school day. This technological tool gives students a 24 hour-a-day educational resource.

The Project - After extensive research, and serious discussion, it was decided to attempt this pilot project. But this tool would not be for just a small group of students and teachers, boldly it was decided to provide the program for the entire population of Carmen Arace Middle School, 800+ students 5th through 8th grade and the staff of 70+ teachers. It was an expensive undertaking, but from the minute it's potential and promise were explained to our students and families, support began to build.

The Parent Teacher Organization spearheaded a community-wide intensive effort to bridge the "digital divide in our community. Through their diligent efforts support grew by leaps and bounds. That support culminated in a unanimous vote by the school board, in front of a standing room only crowd, to fund the two million-dollar price tag over a five-year period. The school board of Bloomfield had made a decision to silence the skeptics through a decisive commitment to reverse the backward slide and redefine the culture of education in our schools.

The Program in Action - Since that vote three years ago, dramatic changes have taken place in the middle school. But this was not change for change's sake; it was a comprehensive and detailed plan to ensure the success of the pilot project. Before a single student laptop was issued, teachers were provided with their own laptops and received six-months of intensive and ongoing professional development. This training addressed not only how to use the technology, but the most effective ways to use this new tool for changing instruction. NETSchools created a bank of Internet resources, the Automated Information System™ (AIS) that matched Bloomfield's curriculum objectives as well as the state's Connecticut Mastery Test (CMT) and CAPT objectives. They provided further training in effectively utilizing these resources.

The First Three Years - As we look at the time frame 1998-2001 we see that the culture of learning in the school has been redefined by this technology. We have moved away from the traditional idea of using technology for technologies sake and have moved toward creating a school-wide culture of using the technology as just another tool used to create an end product.

There has been a significant increase in "on-task" time with problem solving and higher order thinking skills becoming a daily part of the student's routine. Students daily conduct research on the Internet during their classes. We have moved toward the concept of the "online textbook" that consists of websites that precisely match the curriculum and the teacher's objectives for that day. Often a class may begin with a teacher saying "open the email I sent you today and click on the first link". Using the NETSchools Desktop Monitor™ teachers can then "lock" students into a particular web page and avoid off task surfing of web sites. Students use the resources of the Net to download trade books a chapter at a time to their laptops thereby saving the cost of yearly purchasing of paperbacks.

The laptops change our instructional techniques dramatically. In accordance with the latest research lessons are performance based with well-defined product outcomes. Students use standard word processors to take notes and write reports; they construct a wide variety of schematic drawings, data charts and graphs using paint and spreadsheet programs. The finished product is then emailed to their teachers. Teachers see an improvement in the thinking skills and the technology skills of students. There is increased excitement from students and teachers.

Communication between school and home now takes place in the form of weekly emails from the school to parents via the student laptop. We also send out this ***Thursday Family Email*** to over 250 home and work email addresses. This process brings a three to five page email directly to parents. The email system has also created a new way for parents to communicate with their students. Parents can email their children in school to confirm plans or changes in plans and this lessens the workload on over-burdened secretaries in the main office.

The Internet has provided a wealth of opportunities to transform the traditional activities of our school. Our school website, http://www.blmfld.org/araceweb/cazine.htm is a constantly changing resource that is directly tied to what is being taught in our classrooms that week or that day. Students have designed web projects which get posted to the school's website, as well as examples of quality work. Our teachers have started posting lesson plans with performance-based objectives as well, enhancing peer-to-peer professional development. Teacher teams have weekly technology professional development times in which they are constantly improving ways to use the technology in the instructional environment.

The Initial Results - These dramatic changes in instruction have helped bring about dramatic changes in the CMT scores at the middle school, this year 50% of our sixth graders and 58% of our eighth graders met the state goals in reading, a 35% increase over the previous year. Writing and Math scores have increased as well with comparable increases of approximately 25% in both areas (See charts on CMT Results four-year Comparison and Degrees of Reading Power 3-Year Progression).

Our students feel better about themselves as learners and the evidence shows that those feelings are justified. Recent achievements include:

- A team of our 7th grade girls placed first in the **1998-99 National History Day Contest**, their topic "How Technology has effected Archeology" they had conducted email interviews with archeologists in the field as well finding 60 original source documents ion the internet. In 1999 -2000 another team placed first in the **Connecticut History Day Contest** for their project on the "1964 Voting Rights Bill" which included an email interview with Rosa Parks.

- We have had numerous students take honors and first place awards in the **BrainQuest** and **WORDMASTERS** national competitions. On a daily basis our students interact and compete in online math and other subject area quiz sites. In each activity they build their own abilities and confidence that they have what it takes to succeed.

Unexpected Benefits for School Climate- Beyond pure academic indicators, we have seen unexpected positive changes in school climate; student and teacher absenteeism has decreased; discipline referrals have decreased by approximately 50% (See chart Carmen Arace Middle School Suspension Days) initial projections show that grade level retention will be down as well. There is more involvement of the community and families in the schools with increased attendance at school events. Likewise, more students are involved in after-school activities and clubs with approximately one quarter of the student population staying after school on any given day.

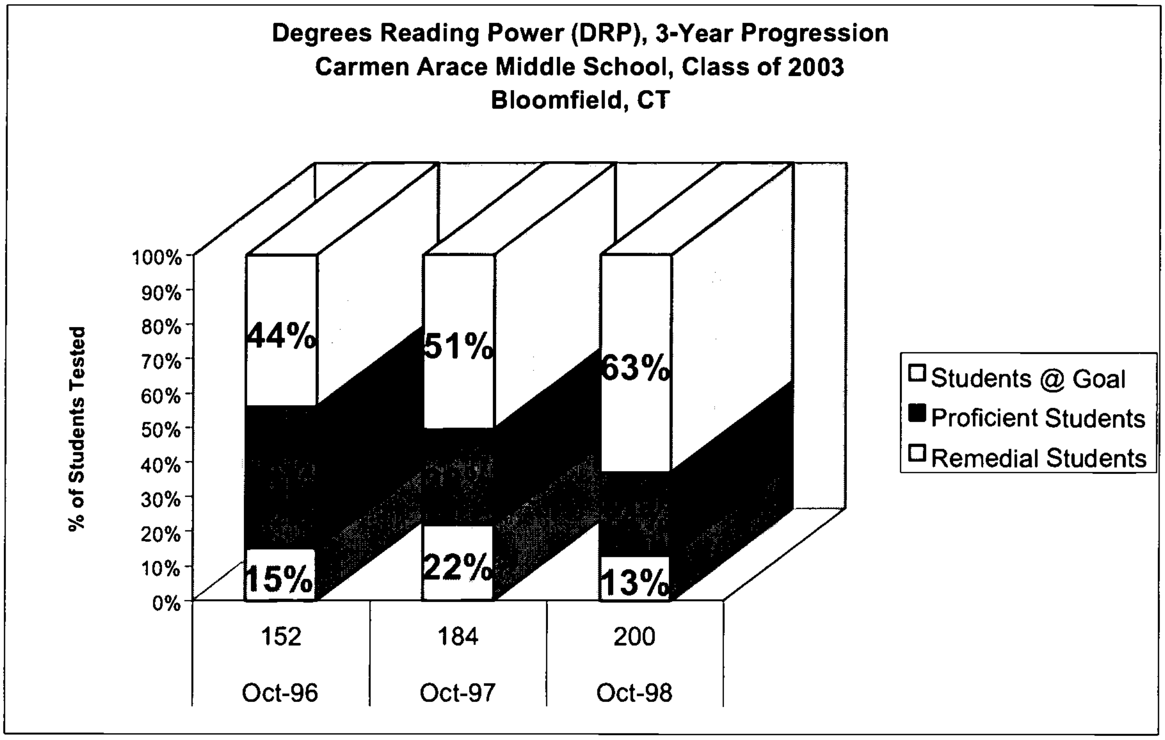
Unexpected Benefits for Teachers - Teacher's roles have changed as well and their efforts have been recognized. Teachers serve more as facilitators in the learning process and feel more valued as professionals. They feel empowered and energized by these dramatic changes and this has propelled them toward achieving exceptional results. Teachers from our school now regularly present workshops at state, regional and national conferences. Staff recognition has included two **Presidential Awards for Excellence in Math and Science Teaching 1998/99 & 2000/2001**, **Connecticut Arts Teacher of the Year 2000**, a **National Christian Educator Association Teacher of the Year Award 1999** and recognition of our principal as the **Connecticut Outstanding New Principal of the Year 1998-99**. Finally, we are proud to report that our school was chosen by the Connecticut Association of Schools as **Outstanding Connecticut Middle School of the Year for 2000 - 2001.**

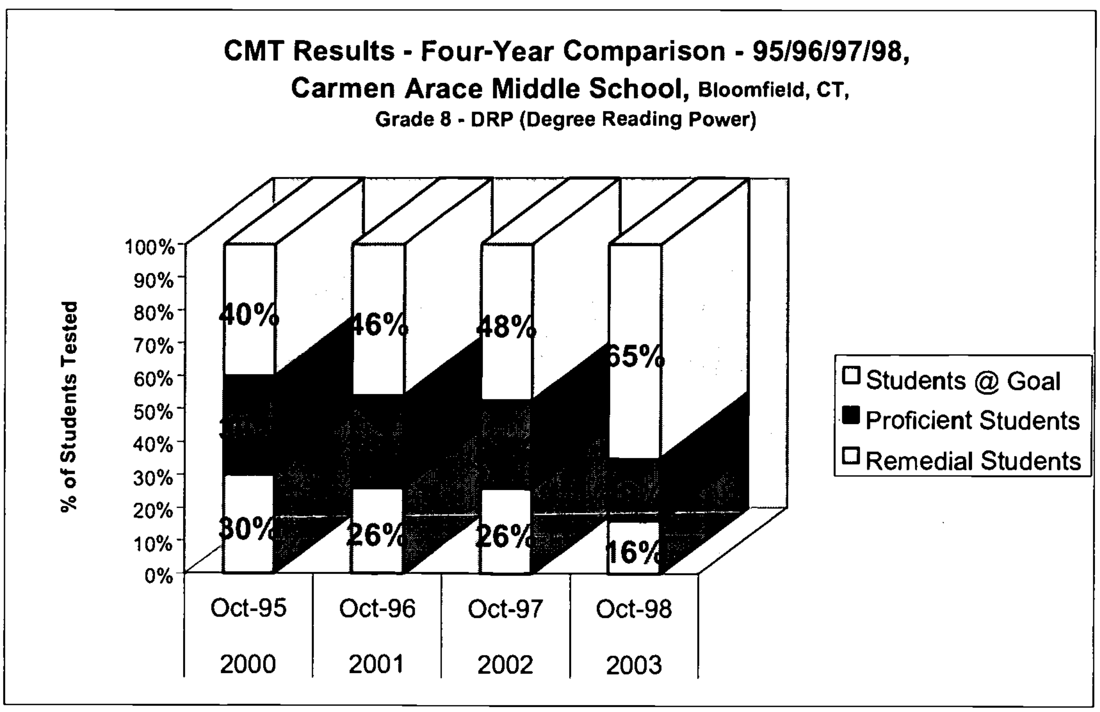
National Recognition – Most recently, **Carmen Arace Middle School** has been featured in an article in the May 1, 2000 edition of **TIME** newsmagazine, an extensive feature article on the **Associated Press** wire service and a report on Cyber-ethics on the **Cable News Network (CNN).** Also, the **National Association of Secondary School Principals, Lucent Technologies** and **Technology Higher Edge Journal** rewarded our school's technology initiatives and achievements through selection as one of the eight **National Technology Excellence Awards** winners. The Technology Excellence Awards program recognizes schools that enact far-reaching technology initiatives. The Technology Excellence Awards are designed to award true commitment, even when faced with limited resources.

If you are interested in finding out more information about **Carmen Arace Middle School** and the technology initiatives occurring here please contact **Mr. Jerry Crystal, Director of Technology Integration** at jcrystal@blmfld.org **or call 860-286-2622 x380**

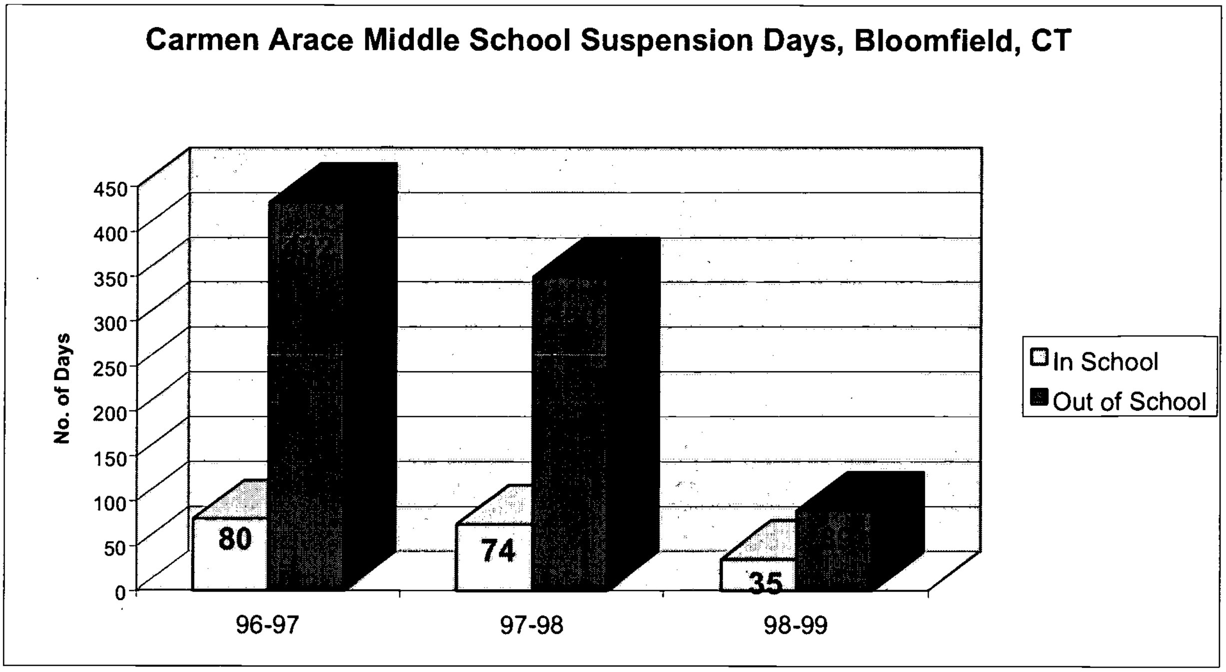
Carmen Arace Middle School TECHNOLOGY PROJECT GOALS
Improve Student Achievement **Increase Excitement: Families, Community Teachers and Students** **Increase Student Enrollment** **Improve Community and Parental Perceptions of Education** **Introduce More Effective Instructional Strategies & Methodologies** **Increase Collegiality and Teamwork Among Staff and Students** **Redefine Learning Culture** **Improve Workforce Readiness** **Increase Parental and Community Involvement**

Achievement Test Results and Comparisons





Discipline Referral Comparaisons


Carmen Arace Middle School Suspension Days, Bloomfield, CT
No. of Days
450
400
350
300
250
200
150
100
50
0
80
74
35
96-97
97-98
98-99
In School
Out of School

389

Generating Creative Vital Orientations in Cyberspace

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Abstract
In my article I would like to focus on the subject of generating creative vital orientations in cyberspace, discussing it within the following topics:

- applying the subject of creativity to the contexts of the present day and development of societies of knowledge;
- indicating the fundamental importance of the new media for the development of an individual's creative potential;
- presenting several examples of applying computers, the internet, and hybrid products as realisation of an individual's creative potential;
- constructing meanings of the author's idea of "creative vital orientations" within the possibilities of their development by the modern means of communication;
- attempt to indicate the connection between the chance of development of an individual's creative potential and utilising the influence of modern electronic devices based on neuro-transmitters as carriers of electromagnetic waves.

Conclusions of this article indicate the possibilities and opportunities created by virtual reality for the realisation of an individual's potential of development, increasing his or her creativity and its realisation and expansion to numerous fields of activity. Many of the discussed topics are hypothetical, however there is a number of premises that indicate the association of the two spheres is legitimate, and in the near future it can become more realistic than we are currently inclined to believe.

Creative vital orientation from transgression to trascendence

Category of vital orientations is particularly interesting to me not only because I proposed its definition and conception but also because it substantially reflects the dynamism and complexity of life of a contemporary person in the world of constant changes and unclear choices. In post-modern (informational and technological) societies it is especially important to develop a vital orientation that will enable self-creation to an individual. I perceive it as an evolutionary process and I place it on continuum from transgression to transcendency. Transgression means going beyond the limitations of human fate, which is evolution "from", and transcendency means pursuing and aiming "at". Self-updating and realisation of one's potential of development are quintessence of transcendency. Therefore, I proposed conception of "creative vital orientations" where creativity is perceived as an intersubjective value, i.e. one rooted in the axiologic conscience of a person, is a basic value. (A.Cudowska 2000b) I drew from the perception of creativity proposed by humanistic psychology (A.H.Maslow, C.R.Rogers) and definition of creative attitude by E.Fromm, as well as the philosophical concept of creativity being an indication of positive misadaptation to reality and realisation of an inner human need. (M.Szyszkowska 1998) I further determine the conception of creative vital orientations on three datum planes: ontologic, psychologic and pedagogic ones. (A.Cudowska 2000)

The subject of this article is an attempt of reflection on possible application of virtual reality to generating creative vital orientations of an individual. It is not unlikely, on contrary it is highly probable that such reality will have stronger and stronger influence on creation of new activated society of jointly responsible and governing citizens in modern humanistic democracies. (E.Fromm 2000) Thus creative attitude of an individual toward himself /herself and toward the natural, cultural, and social world has special meaning. Only an individual who is creative in everyday life appears able to build new "ecohumanistic" society consciously. (L.Michnowski) 21st century is to see the development of information society (Naisbitt 1997) in which knowledge would be a strategic resource (Pachocinski 1999) and source of well-being. Human knowledge resources double every six years and there is clear tendency for the time span to narrow. Capacity of computers for data storage and processing and their availability over the internet double every 18 /12 months. (K.Denek 2000) In "Revolution of hope" E.Fromm anticipates possibilities of hypermedia for development of humanistic democratic society in which every individual would perceive himself or herself as an active participant of the governing process and have substantial influence on functioning of the whole organisation through activity in small groups.

New media and creative potential of an individual

Notion of creativity is present in all dissertations about future. It should be understood not as mere ornament but as response to the needs and demands of the present day. In today's societies, where post-figurative culture gradually becomes dominant (M.Mead), former illusions come true. Quantum computer was but a vision of Richard Feynman recently, and nowadays it has been made and used for the first time. The machine uses the phenomenon of magnetic nuclear resonance: in the outer magnetic field there is some liquid in which atoms are placed. The nuclei of the atoms behave like small magnets as they arrange themselves parallel or anti-parallel to the lines of the magnetic field forces, which corresponds to zeros and ones of the binary code. We can alter location of the atom "magnets" to stimulate various physical arragements (Wiedza i Życie 1999, 10).Perhaps next informatory revolution and the beginning of quantum calculations are not too distant. Concequences of such facts for an average computer user are difficult to predict nowadays, however they are probably impossible to overlook. This, however, does not change the fact that with all our knowledge, accumulated in 20th century in bigger amount than during the entire history of mankind, we still cannot actually prove that it is our intelligence which makes us dominate other creatures (op.cit). There are many different theories nowadays as to how human body developped intelligence through its biological evolution. Even A.Russel Wallace as the co-originator (with K.Darwin) of the theory of creation of species had doubts whether human brain is not too complicated an organ to have its development explained only by the necessity of survival of species. After 120 years, this question of Wallace is still the central problem of brain evolution theory (K.Szymborski 1999). Creativity is strongly connected with intelligence which may explain why the nature of creation process has not yet been defined and it is so difficult to determine the predictors of development of creative attitudes in an individual which are desirable in the light of contemporainess. The human being is born helpless and vulnerable and then spends most of his or her life learning things. They commit their time and energy to competition with other people and use their intelligence to solve problems they have mostly created themselves (op.cit). Even though we spend considerable parts of our lifes educating ourselves, the traditional school system has minute achievements in the field of moulding creative orientations and creative attitude to life. There is a common opinion supported also by research (see A.Gurycka 1989), that in the process of education the natural and creative expressiveness of a child, their cognitive curiosity and commitment are successfully destroyed until there is little of them left for life of an adult. An adult person, as E.Fromm puts it (1989), mainly wants to know things while many scientific discoveries were made thanks to surprise with and interest in something that had been looked at without astonishment by others.

The Internet and civic society

It seems very appropriate to search for possibilities of stimulation of creativity and moulding of creative vital orientations through technologies offered by computer and the Internet. Not without a reason was the latter called the biggest garbage heap in the world, however we cannot ignore the fact that it is also a treasure chest with the newest information which will be available at schools perhaps in ten years, or never at all. We can already read newspapers and magazines on-line, there are information services and some publications are available only in the electronic version. It is estimated that in Poland there are approx. 2 millions of the internet users, which is still not much if compared with other highly developped countries. The technological revolution started in Poland in 1990 by connection with the international computer network EARN, via junction in Kopenhaga, certainly has some social repercussions, too, also in the field of education. Register of the most common keywords submitted to the popular search engine of Netoskop indicates that the number of people who look for specific information in the Internet is growing. Research shows that an average 'online' Polish person is young and well-educated (students and academic degree holders are more than 80% of all users). Online contacts create specific subculture whose members create virtual societies that use a special language code. During the flood of 1998 Polish Internet users showed great commitment and civic responsibility as their quick exchange of information enabled providing better aid to the victims. Thus we can speak about creation of small groups as proposed by E.Fromm in his conception of humanistic management (2000). Within those groups there is the process of exchanging information, discussions, and making decisions. There is active participation of an individual in the problems of his country or of specific communities. The hypermedia seem to comply with all conditions mentioned by E.Fromm, which are essential for creation of a civic society. The conditions are: small number of participants in discussion so that it is free from demagogy or manipulation and so that there is access to objective information. In this context we can also mention the "Virtual Commune" project realised in Raszyn near Warsaw. Within three years all the residents will obtain access to the Internet with the modern line of AOSL and the local online services are being created. Settlement of office matters, contact with the doctor, shopping, bank account management, borrowing from libraries with online videos and books, reading electricity and gas bills, discussion with local administrators, it all will be possible online. It is not difficult to imagine what consequences such situation will have for the local community, and then also to the whole society. This can influence the moulding of vital orientation of individual, because it profoundly changes the way and quality of experiencing our everyday reality. Nevertheless, it would be naive to expect that such changes may take place automatically. Certainly it is necessary to prepare the people so that they can adapt to the cyberspace as active subjects participating in creation of the social reality. Most probably, without proper education this cannot be realised. Especially as the Internet can be a medium for broadening the user's social contacts. American sociologic analyses seem to prove it by showing eg. that the electronic media users, the Internet users among them, are almost standard "electronic citizens," community of young people (between 20 and 40 years old) 48% of whom are females. People who use the net particularly often, so-called "super-connected" ones, believe in democracy and free market much more than the "non-connected" ones. In the light of the creative vital orientation category I am interested in, it is important that such people make changes willingly, that they perceive the idea of variation as the motor of development, they are more tolerant than average and they know more about the social and cultural life. They spend more time reading than the "non-connected" ones. According to the analyses, net surfers are well-informed, they participate in social life and they advocate liberty. They participate more than average in local and national elections and they see technology as a tool for democratisation of social life, providing better quality education, and increasing economic opportunities. They would prefer to speak for themselves rather than rely on local politicians (M.Hausman, 1999). Even if we do not take results of this report too seriously as it was conducted among a different society and culture on the basis of declaration of data prepared to order of the Internet magazines. "Wired" and "Merill Lynch Forum", still we can find some premises that are important for the discussed topics. Especially as recently announced introduction of wide-band communication net (GSM/WCDMA), where the moblie phones resemble small terminals rather than telephones, and using the internet through them is no longer shocking (K.Leski,1999). Moreover, the choice of communication services is so large already and it grows so quickly that detailed description would substantially divert from the topic.

Hypermedia as supportive for education

Possibilities offered by cyberspace in terms of moulding attitudes, adding new meanings and establishing more contact with the individual are seemingly still underestimated by the educators. The better prepared for the use of informationary media the individual will be, the more profound their ability of realising their creative potential. Virtual reality seems to create opportunities for overcoming the limitations of information access and division into the better and worse informed ones. Proper education and development of hypermedia and Internet skills may be a successfully eliminate the phenomena of social exclusion and marginalisation. Cyberspace may then offer chances for human development, however it can also create some dangers for them. Itself it is neither of the two and it is subject to what people make it. Although nowadays the assumption of virtual reality as a place for successful development of creative potential of individuals may seem unreal, as the task had not been realised for such a long time by the traditional education system. We cannot exclude it completely either, though, because by overcoming the shortages and limitations of traditional education it creates new forms and areas for dialogues. Online meeting creates a chance for educators to get beyond the economical client-institution paradygm in favour of a more democratic and partner-like relationship. The teacher is given a chance to build his real authority on his knowledge, skills and personal qualities instead of the illusory authority he has because of occupying a specific place in an institution. I believe that it is important to notice these opportunities already, even if their realisation requires more time, because reflections on this problem should go before the educational practice.

In my opinion, creative vital orientations of individuals can be formed only within areas of variety and possibility of making choices where the role of the teacher (master, guide) regardless of technical possibilities of the media is constituent for the process of "maturing" of individuals and of creating their own vital orientations. It appears also that modern "superlearning" techniques may provide particular inspiration for the process of self-development and realisation of one's creative potential. There are many indications that such techniques offer possibilities of a more creative life. R.A.Wilson believes that the new generation of appliances that stimulate the mind will become the turning point in the evolution of the planet (S.Ostrander, L.Schroeder, 1997). Music, and especially Baroque music, is a famous and long-applied (though not on large scale) means of expanding creative potential of the mind. Such music synchronises waves of both hemispheres of brain, it increases the ability to acquire knowledge, speed of this process and duration of remembering. This fact can be very important also for the process of generating and developing creative vital orientations, changing old thinking patterns and most of all stimulating the will to change it.

Electrostimulation vs development of creative potential of an individual

Some of those mind-stinulating appliances are a positive "dividend" from the "cold war" period (eg.). (eg. using electromagnetic fields on people). The Russian were the first to draw a map of frequencies that affect emotions, memory, mental strength, or conscience. So called "toxic frequencies" were developped that enabled electronic destruction of memory. Many positive phenomena like means of expanding memory (op. cit) were discovered at the same time. There is scientific evidence for those phenomena, although they may resemble science fiction stories. Western scientists confirmed eg. excellent results of brain electrostimulation method in treatment of memory disorders caused by alcoholism or drug addiction (recovery time 3-5 days). Electrostimulation causes production of new cells in brain and regenerates its functions (eg. research in University of Wisconsin, University of Luisiana, in Molecular Biology Lab, or in Hampton). Electrostimulation can also cause setting of bones and regeneration of organs. When delivered through acupuncture points it stimulates the electric field of body and has deep influence on the mind, reactions, and behaviour. The idea of applying electrostimulation to moulding of creative vital orientations does not have to be completely unreal. If human emotions and changes of different states of conscience emit different kinds of energy (which was discovered by Dr Leonard Ravitz from Yale), then also energy used as the media can produce specific emotions and states of conscience. The concept seems even more realistic if we notice that electric stimulation of certain areas of brain produces a considerable amount of neurotransmitters that are responsible for learning, pleasure, and creativity. Aryeh Routtenberg, neurologist from Northwestern University, was one of the first scientists who made that discovery (op.cit), which led to invention of Brain Tuner 5+ by physicist Bob Beck (magnetic field expert). The tuner emits frequencies of three ranges of neurotransmitters that are essential for a human being: enkephalin, catacholamine and betaendorphin. B.Beck arranged those frequencies in beams and collected together 256 frequencies like a resonating musical chord. The tuner is smaller than a walkman and it is operated by a 9-volt battery. It is equipped with electrodes with stethoscope-like endings adjusted to the hollows behind ears where the acupuncture points transfer electrostimulation. Research conducted eg. in University of Wisconsin proved efficiency of BT5+ in treatment of drug addicts, increasing intelligence quotient and improving performance of nervous system. The tuner – harmless to human body – needs to be worn only 20 min. a day and people who use it claim that it strengthens memory, enhances learning process, boosts energy, helps to concentrate and reduces pain, anxiety and depression. Thus, nowadays there are possibilities of developing the creative potential of an individual (Ostrander, Schroeder 1997).

Recognition of opportunities and dangers

Application of the subject of creative vital orientations to this topic seems therefore justified, however the possibility of moulding such orientations with appliances emitting elecromagnetic waves positive for human beings may seem rather unrealistic. Nevertheless, in the light of huge expansion of human knowledge and development of its branches it is not unlikely to become more realistic in the near future. This demands for realisation of possible dangers. One of serious dangers involved in application of cyberspace to development of creative potential of an individual is certainly limitation of the individual's "vital space". Closing it within limits of virtual reality, channelled thinking process within infohighway limited by the capacity of a specific net search engine. Also the use of electromagnetic fields on a human being may certainly raise many doubts of ethical nature. We do not have absolute knowledge of what effects neurotransmitter stimulation of specific areas of brain may result in. Such non-researched areas imply the necessity of very careful and deliberate attitudes to currently observed effects of treatment by such appliances as BT5+ mentioned above. Cyberspace, electromagnetic waves and even sounds undoubtedly offer us many new possibilities of supporting creative potential of an individual. And although I believe that we should remain considerably skeptic and careful about them, we also ought to realise the opportunities and hope that they create for adaptation. of new values in the life of an individual. Perhaps many current barriers against application of the hypermedia no longer lie in technological limitations but in our thinking patterns, dominated by left hemispheres of our brains and affected by our one-sided rationalism (D.Goleman 1999). This article is an attempt to inspire overcoming such barriers within our perception of creativity, opening to new and intriguing spheres, and anticipation of possible scenarios of development of creative potential of an individual.

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The Rhetoric and Reality of Change: A Model for Supporting Higher Education Faculty Adoption of Web-Based Instruction

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Abstract: The faculty at Marshall University historically have used a model of distance education for non-traditional graduate students that involved driving 1-3 hours to teach in remote sites. This strategy is changing as web-based instruction is rapidly becoming an important tool in meeting students' needs. The faculty have developed a unique strategy for dealing with the issues related to this significant change in delivery strategies.

History

Marshall University is a regional university located in southern West Virginia, USA, serving 16,000 undergraduate and 4,000+ graduate students. Within the university, the Graduate School of Education and Professional Development (GSEPD) has as its mission the delivery of graduate education to a rural and widely dispersed population.

The GSEPD offers MA, EdS, and EdD degrees in Leadership Studies, Counseling, School Psychology, Elementary and Secondary Education, Special Education, Reading Education, and Humanities. On-line course delivery at GSEPD began with one course which was developed in the Fall of 1997 by two faculty members. From this early effort, the participation in this method of delivery has grown to 35 full-time faculty members and a cadre of part-time faculty involved in teaching over 400 web-based courses, greatly enhancing the outreach effort of the school.

Challenges and Opportunities

The evolution from the two initial faculty members to the current extended team of web-based instructors has presented a melange of both challenges and opportunities. The challenges have included (a) the labor intensive nature of developing and maintaining web-based courses, (b) the need to provide system support, (c) the complexity of staffing and workload issues, (d) faculty and student training needs, (e) class size, (f) academic integrity and quality assurance, (g) fee structure, (h) course ownership and intellectual property rights, (i) the availability and access to library services, (j) the provision of student support and training , and (k) the environment of constant change. The collaborative and informal environment already in existence among the faculty in the GSEPD was critical in addressing these challenges. This informal peer-support network presented the opportunity for faculty mentoring. One important element of the support system was a monthly group meeting of faculty members using web-based instruction. This activity allowed faculty members to share pedagogical ideas, explore technical issues and solutions, and brainstorm strategies for new course development. Other issues addressed were student training, demonstration of "best practices", and evaluation of web-based instructional strategies. This users' group welcomed faculty members who were new to web-based course delivery and offered support and encouragement.

In recognition of the need for additional support for inexperienced users of web-based instruction experienced faculty members designed and implemented hands-on computer sessions, provided one-to-one mentoring and conducted workshops for part-time faculty. Part of the mentoring process involved assisting new faculty users in training new student users. The faculty support process was also aided by a strong, informal relationship with the university instructional technologists and with computer services personnel.

Moving the academy from the rhetoric of change to the reality of change required incentives and support for faculty involvement and development. The Marshall University Graduate School of Education and Professional Development has provided encouragement, recognition, and financial support to attend regional, national, and international meetings, course development funds, purchase of hardware and software including laptop computers, ISP access and support, and the support to host regional WebCT conferences.

Outcomes and Lessons Learned

Inherent with new endeavors is the anticipation of outcomes and new information. One expected outcome of incorporating technology into a delivery system that has already experienced success in distance education was the compatibility with the historical mission of the GSEPD. Other expected outcomes were improved access to courses and programs, a more effective use of school operating funds, and a more efficient use of faculty resources.

Unanticipated outcomes resulting from the move to web-based course delivery included (a) increased faculty attention to course planning and development, (b) increased cross-disciplinary interaction, (c) a change in the role of full-time faculty, (d) an evolving role for part-time faculty, (e) the emergence of a differentiated staffing model, (f) the use of a broader array of instructional strategies, (g) a renewed sense of collegiality and sharing, (h) an expansion of resources available to support courses, and (i) the emergence of new strategies for student assessment.

The acquisition of new directions and strategies resulting from implementing change is often well worth the reality of change. As a result of adopting and incorporating web-based instruction we learned that (a) the age of the faculty member did not appear to be a variable in determining receptivity to web-based instruction, (b) web-based instruction is appropriate for most types of courses, (c) not all courses lend themselves to asynchronous delivery, (d) web-based instructional delivery expands the range of instructional strategies, (e) web-based instruction is most appropriate for non-traditional students, (f) opportunities for student-teacher interaction are increased, (g) web-based instruction is effective in achieving student outcomes, (h) web-based instruction costs as much or more than traditional instruction, (i) web-based instruction requires more, not less, faculty resources, (j) web-based instruction requires more faculty preparation time and is labor intensive, (k) the need for articulating the purpose for using web-based instruction is crucial, and finally (l) faculty support systems for delivery of web-based course delivery must be more informal than formal, available on demand, and include one-to-one faculty mentoring.

Summary

In conclusion, the GSEPD faculty continue to be challenged and encouraged by technology-based course delivery. The informal, peer support network adopted by the faculty, the student support and training component, and the recognition and incentive system offered by the administration has contributed to a model that supports a regional mission of graduate course delivery to a rural, widely dispersed population. The rhetoric of change is good, the reality of change is hard, and the results of change are rewarding.

The Canadian TeleLearning Network of Centres of Excellence: A National Multidisciplinary, Multisectoral Approach to Catalyzing Innovative Research and Effective Online Learning Practice

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Abstract: The presentation will present a state-of-the-art strategy developed by the TeleLearning Network of Centres of Excellence to spearhead research in online learning applications, train students, transfer knowledge and technology, and inform practice and policy development in schools, post-secondary institutions, and workplaces. In particular, opportunities for international collaborations will be identified.

The TeleLearning Network of Centres of Excellence (TL•NCE) was selected by the Canadian government in 1995 to be Canada's Network of Centres of Excellence for online learning research, development, and commercialization. CE has become a key repository for evidence and research results as well as solutions and strategies for the effective use of network technology in schools, post-secondary institutions, workplaces, and for continuing education. The TL•NCE is one of the few organizations in the world that integrates research, practice, and private and public sector interests into an ambitious interdisciplinary program. Since 1995 it has been transitioning from a national to a global program involving 45,000 individuals in over 200 organizations from 44 countries.

The TL•NCE is led by Dr. Linda Harasim, who is recognized internationally as a pioneer in designing and delivering online education and training and demonstrating the effectiveness of new collaborative learning models supported by computer networks. Dr.Harasim is joined by 80 leading researchers in education, computer science, and engineering science from 24 Canadian universities. Research teams work in partnership with client organizations such as the Bank of Montreal, Bell Canada, CANARIE Inc., C2T2 (the college and institute system in British Columbia), IBM Canada, Industry Canada, Nortel Networks, Silicon Graphics, and Cisco Systems.

The TeleLearning NCE Research Program

TL•NCE researchers are developing and testing leading telelearning approaches based on collaborative learning and knowledge-building. The research conducted within the program is broad and includes study of learning models, socioeconomic factors, and technologies. Research themes include Kindergarten to Grade 12 Education, Post-secondary Education, Workplace Training, and Educating the Educator.

By applying and developing innovative new approaches based on solid pedagogy developed and tested for delivery using networked learning technologies, TL•NCE researchers have made significant advances towards improved student learning. Research results have been reported in more than one thousand publications. In the post-secondary Virtual-U field trials, over 15,000 students and 500 instructors have participated in courses delivered via Virtual-U. The data includes data on instructional designs, impact on instructor and student workload, user satisfaction and practice, quality of learning, assessment issues, and student completion rates. Research showed that 100% of 100 courses studied in depth used collaborative learning approaches with high levels of completion.

The TL•NCE Knowledge and Technology Transfer Program

In addition to its research program, the TL•NCE is mandated to disseminate its research evidence to educators and trainers and provide advice to policy makers and decision-makers in the public and private sectors. A few examples that show the range of research and dissemination initiatives that have positioned the TL•NCE as a knowledge repository and advisor of choice are listed below.

Research Reports and Workshops: The TL•NCE serves as a lightning rod for issues and opportunities in online learning or eLearning. Public organizations and private companies approach the TL•NCE for information on the latest market developments and research results. Quarterly workshops are organized such as "21st Century Business Models for Online Education Markets" which brings leading experts and organizations together to explore strategies for success and pitfalls to avoid when deploying new business models in this emerging market. The TL•NCE research report series has proven to be a valuable resource for those seeking to stay abreast of topics and included a competitive analysis on online post-secondary education (www.telelearn.ca/g_access/news/comp_analysis.pdf) and the costs and benefits of Web-based training (www.telelearn.ca/g_access/news/costbenefit.pdf).

Creating New Companies: The TL•NCE is contributing to the growth of the supply sector in Canada. Researchers are developing and enhancing a variety of software tools and systems based on collaborative learning and knowledge building and 9 new spin-off companies were created to provide access to leading products and services. Recently, an eLearning virtual incubator, InVentures Incubator Inc. (www.inventuresinc.com), was launched to support the creation and success of new online education companies.

Transferring Knowledge: The TL•NCE serves as a primary channel to a network of online learning experts, providing consulting, training, and assessment services in all sectors of education and training. Research results are communicated through workshops, a research report series, monthly e-mail bulletins, and a Web site. A new company, TeleLearning Solutions Inc., was created to provide a premier access point to the knowledge of TL•NCE researchers and members, as well as other organizations across Canada and internationally. , the TL•NCE has a goal to increase the capacity of the industry in Canada by attracting and training hundreds of young Canadians to the field. Over 300 graduate students have or are currently participating in the TL•NCE research program. The 150 graduating students have been quickly recruited by universities and private and public sector organizations interested in the student's specialized knowledge and multidisciplinary, multisectoral experience.

How You Can Become Involved

On April 1, 2002, the TL•NCE begins a second phase of its program that will expand successful pilots and create large-scale testbeds that are part of organization- and institution-wide strategies. In addition to a continued focus on learning processes and outcomes, research teams will study advanced technologies and intelligent networks, business and organizational change models, and global and cultural issues. TL•NCE researchers are seeking new international research collaborators in addition to learning from related research conducted around the world. The following are several other ways an international organization can link with the efforts of the TL•NCE:

Attend TeleLearning'2001 in Vancouver, November 10th to 13th with the theme, "The Future of the (e)Learning". Last year's conference drew over 500 delegates from countries such as South Korea, Mexico, Denmark, Taiwan, the United Kingdom, and Finland. See www.telelearn.ca/conference.

Participate in the Global Educators' Network, www.vu.vlei.com/GEN/welcome/welcome.html, an international online forum that brings together communities of educators to discuss the latest issues and lessons learned in online education. Currently, more than 500 participants from 40 countries are collaborating online.

Contribute to the Open Source Initiative, TL•NCE's model of choice for evolution and distribution of software tools. Join a cadre of international research organizations in China, Finland, and the U.K. that have already committed to participating in this initiative.

For Further Information: See www.telelearn.ca

The flexible learning model at LITU

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The poster will present and demonstrate the model of learning that has been developed for courses in the field of Information and Communication Technology in Learning Environments.
The learning model is constructed in the same way for all courses, irrespective of content or target group. Students on campus and on distance courses meet a learning environment and learning resources consisting of four main parts; a course manual, an electronic conference and mail system, a CD-ROM, and web-based information. Regarding the role of the instructor, he or she is more of a coach than a transmitter of knowledge. The students are, in turn, responsible for taking the opportunity to study in a flexible problem-based learning environment and devoting great care to plan for and carry out their learning process. Our experience is that the students take on their learning and assignments in a more independent way.

THE 'REDI' PROJECT. On-line educational resources for the development of professional multimedia skills

Ricardo Dal Farra, National Ministry of Education, Argentina

The National Institute of Technology Education, part of the National Ministry of Education in Argentina, began a few years ago to work on new educational profiles trying to integrate the complex neccesities of the work world of today with the basic concepts (in all senses) that the school should transmit to students. From those profiles were developed a group of modular curriculum structures for the secondary level, being one of them the Technical Vocational Pahthway in Multimedia Communication, based on a competences learning process proposal.

Reinventing the TV and the Video in School: Report of an Workshop for Training Teachers

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Abstract:
The present paper is a report on the workshop "The Use of TV in School", which brought teachers from the public educational system of Paraná state into contact with the Brazilian educational television channel called TV Escola (School TV), and which made possible the discovery of new uses of the television and VCR in the classroom. Faced with the challenge of creating a class with pedagogical material and a VHS tape for a group of people who had just met, the teachers developed works of quality related to each one's creativity in order to allow oneself to dare, transform, alter, to touch and to give movement to the event. With candies, colored papers, box of different shapes and sizes, magazines, scissors, discussions, smiles, tears and testimonies, the teachers accepted the challenge and recreated the TV Escola, allowing for a new path for a higher quality education in our country.

Introduction

TV Escola is a program developed by the Distance Education State Bureau, of the Brazilian Education Ministry, and consists in a TV channel which airs its shows via parabolic antenna to the elementary schools and high schools. The necessary kit for the reception and use of that channel (consisting in a parabolic antenna, a television set, a VCR and 10 tapes to start the recordings) is distributed for free to all the Brazilian public schools with over 100 students. Inaugurated in 1996, that channel airs 14 hours of programs every day, being that 4 hours are always new. Due to its great variety of titles, it constitutes an option of technical and pedagogical quality for the perfection of the education in our country. Its main purpose is that the shows it airs be recorded in VCR tapes for later use by the teacher in the classroom or in his/her own professional training and updating. In addition to its shows TV Escola also offers printed material, which is sent to the affiliated institutions as educational tools for the use by the teachers. Examples of such printed material are the Revista da TV Escola (School TV Magazine), the Cadernos da TV Escola (School TV note books), and the books of the Série de Estudos de Educação à Distância (Series of Studies on Distance Education). In spite of all that effort, however, a significant number of teachers do not use the videos from TV Escola in the classroom.

In order to increase the number of technological tools available the government of Parana state gathered 400 teachers from a number of cities in that state at the CETEpar (Parana Center of Excellence in Technology) in an event called "Tecnologia educacional: uma janela para o futuro" (Educational technology: a window to the future), which took place in December, 4 to 8, 2000. During that event, which aimed at offering to the teachers an opportunity to make contact with different technologies and varying ways of using them in their pedagogical practice, we offered the workshop "A utilização da TV na escola" (The use of TV in school), which will be described bellow.

Methodology

The workshop was developed with eight different groups of teachers, totaling 40 work hours and 240 participants. Each team of 30 teachers worked for three hours in the afternoon and two more hours in the next morning. Such a division in two work stages made it easier for the teachers to think about the issues which were developed earlier, allowing them to sustain their opinions with a greater confidence.

The beginning of the first stage was directed to stimulate the integration of the group. Thus, as they arrived at the mini auditorium, the teachers received candies wrapped up in colored paper. Their look of surprise was difficult to conceal. When all were seated, we asked them to gather according to the color of the candy paper they had received. Once more the movement and imbalance in the room indicated that the work groups were beginning to organize. With the teams already formed, we allowed some minutes for each one to introduce him/herself, and what we could see was a series of timid and embarrassed speeches. We did not interfere with that tense mood. Following that moment, each team was asked to answer a question related to general issues about the TV Escola, and eventually a real cooperation among the members of each group occurred. When all teams had their answers ready, we called their attention to their own reaction to what had been asked from them: when they gathered around a common idea (to answer the question), they began to behave like a team and, consequently, got better results. Once again there were smiles and positive comments from the teachers. It was easy, then, to relate such a practice to the kind of work we were suggesting. That was how they should fathom their work with the TV Escola: different, creative, daring, but above all, a team work. Little by little their resistance was being conquered. The teams commented on the surprises they were experiencing in the workshop.

Now feeling more comfortable, each team received a box (there were four boxes of different size, shape and color, which represented different kinds of schools). Inside them, in addition to the answer to the specific question made to each team, they found scissors, newspapers, paper, colored pens, glue, magazines and a tape with a show of the TV Escola. Except for the tape, the rest of the materials were the same in every box; the choice of such materials was not random and they were selected because they were objects easy to be found in any school of the public system, where they worked. After they received their boxes, each group had 60 minutes to plan a class resorting, necessarily, to the VCR tape of TV Escola, together with the other contents in the box which they found appropriate. At the end of that work hour, they had to present their classes to the rest of the group. The challenge was to be creative in order to elaborate a different class.

We noticed that each team found great difficulty to plan a class. As we observed, their main problem was that they could only approach the tape under the light of their own field of knowledge. They asked that we changed the tapes, not understanding that they were the ones who had to change. Following some additional minutes of imbalance, and finding support in our interventions, the teams began to shape their ideas and to break with their own paradigms. Classes began to be presented which emphasized new interpretations of art pieces, new approaches to literary texts, dramatizations of the life cycle, parodies, drama and plays to be sung. All that based on the tape by TV Escola. Teachers once afraid of using the VCR were finding in such a technology the possibilities for pedagogical innovation. Such a finding could be witnessed in the over 200 evaluations received, among which one deserves to be quoted: "I've never imagined that one day I would use a VCR to give a class on physical education. Now I understand that video tapes can be used in any discipline, we have only to look at it with attentive eyes." Our own attentive eyes noticed that at the end of the second stage, after following the presentation of a number of classes, many teachers were taking note of the strategies which were used there in order to apply them to their own future classes. Some of them, whose background had been built over 30 years of teaching practice, talked to us about their fear that technology would eventually take their place. There were many smiles and some tears from those who were experiencing a stage of professional growth and needed to leave behind many fears and insecurity.

Conclusion

The answers which appeared during the workshop just described suggest one path to be followed in order to allow technology to take part in the educational reality of efficient work: to train the teachers. The answers obtained by our workshop did reaffirm the idea that for an effective use of technology in the school an efficient teacher is necessary. Sometimes the teacher must be rescued, hidden as he/she might be behind his/her fear of the new and the fear of daring. We can proudly claim that in our workshop we have rescued many, but that is just the first step in the process of legitimating the School TV Project in Paraná state. There is still a lot to research on the ways to integrate more and more the professionals in education into the TV Escola in order to create significant and lasting realities in the partnership between technology and education.

Participant Interaction Models and Roles in a Computer Supported Collaborative Learning (CSCL) Environment: A Malaysian Case Study

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Abstract: Three models of participant interactions in a web based instruction course were identified among a diverse group of seven adult learners in this paper. The three models were named the cyclical model, the hierarchical model, and the parallel model. The cyclical model depicts the interactions of the computer, instructor and the learner as in a cycle, the hierarchical model views the instructor and the computer as the participants in a level higher than the learner, whereas the parallel model sees the learner and the instructor progressing parallel to one another mediated by the computer. The roles of the participants in the CSCL class as perceived by the learners are also discussed.

Introduction

Since Lev Vygotsky's introduction of the "Zone of Proximal Development" (ZPD) (1962) continuum, it has been advocated that social interactions can act as scaffolding in the construction of knowledge. Based upon this Vygotskian view of learning as social phenomena and experience, Ryder (1994) states that new knowledge is constructed by learners as they engage in dialogue. In the late eighties, there was an effort to individualize learning processes and hence the solo learner model was prevalent in the CSCL studies (Lehtinen, Hakkarainen, Lipponen, Rahikainen & Munkkonen, 1999). However this gave rise to the concern that social interaction in the CSCL environment was being omitted. The present trend in ICT is far removed from this original situation. Current theories on knowledge building emphasize the socially distributed nature of cognition especially in the CSCL environment. Distributed cognition is believed to be a process in which individual cognition is extended and stretched to accomplish and achieve something that an individual would be unable to achieve alone. According to Norman (1993), cognitive processes can also be distributed between humans and machines. Distributed cognition as stated by Salomon (1993) can form systems consisting of the individual learner, peers, instructors and cognitive tools. Cognitive tools apparently reduce cognitive processing load (Pea, 1994). Salomon (1995) envisions the computer as a trigger for a chain reaction and therefore the computer must be allowed to serve in the way it serves best that is enhancing learning from mere recitation to exploration, manipulation and creation. Crook (1994) made a distinction between interacting around and through computers. Interacting "around" computers means that computers can be considered as tools that encourage face to face communication between participants in a CSCL environment. Interacting "through" computers according to Crook (1994) means the use of networks such as the Local Area Network, the Wide Area Network, and the Internet, which has various mediating tools such as the e-mail. The e-mail for example can be used as an asynchronous or a synchronous communication tool. Koschmann, Feltovich, Myers and Barrows (1995), say that interactions in the ordinary classrooms are synchronous and sequential. According to Agostinho (1997), an example of "flexible interactivity" in a CSCL environment is, *"...how one group is able to review and participate in the dialogue of the other group. Also a member of one group can join the discussion of another group or send a message to a member in another group without disturbing the flow of discourse. The facilitators meanwhile can monitor the entire process...(p.6)"*. The scenario described would be a hard act to follow in the traditional classroom. Brna (1998) highlighted four different collaborative models in the CSCL environment that have different goals. They are (i) whether collaboration involves synchronous effort of a task or whether is the task divided into various parts and each handled by different collaborators, (ii) whether collaboration is a state or the process, (iii) whether collaboration is seen as a means to achieve some learning goal or whether the collaboration is in itself the end goal, and (iv) whether the participants in the collaboration state or process are aware of the existence of the formal contractual relationship (p.1). Laurillard (1993) in her conversational framework model put forward eight primary workflow actions that occur between the instructor, the learner and the interactive medium (the computer), which are, (i) instructor describes conception to be learned, (ii) learner describes the conception, (iii) instructor redescribes the conception, (iv) learner redescribes conception, (v) instructor sets up micro-world activities, (vi) learner interacts with the micro-world activities, system provides feedback, and (viii) learner modifies actions based on feedback. Lehtinen et al. (1999) reiterate that social interaction between participants makes certain that each other's viewpoints are considered. This in turn develops the participants' metacognitive skills, as they become aware of their own knowledge.

Another important factor to consider is that, in an ever-dynamic CSCL environment, the interactions among participants and their roles are beginning to take on new and unique patterns. Lerner (1997) concludes that because of the introduction of technology, the learner's role has shifted from "being taught" to "learning" and the instructor's role from that of an "expert" to one of "collaborator" and "guide". Javid (2000) calls teachers as "coaches" and "facilitators". Strommen and Lincoln (1992) say that the teacher assumes roles such as "project manager" and "tutor" and becomes part of the team and not the heart of the classroom. In spite of an enormous amount of research on the interactions and roles of participants in a CSCL environment, Sims (1997) cautions us by saying that the dynamics of communication between the learner, instructor and the cognitive tool are as yet not fully understood. However it is clear from research that interactions between humans and machines take place at a physical as well at a cognitive level in a CSCL environment. Also the roles that participants assume are much more varied and complex in these learning environments. Cerratto and Belisle (1995) say, *"With the functionalities afforded by new networked technologies, there is now the potential for students to share their learning experiences with each other and also interact more dynamically with their tutors." (p.1).* Just who is the tutor and who is the learner in a CSCL environment? This paper explores models of participant interactions that surfaced and the roles of each participant in a Course-On-Line, Masters of Instructional Technology Programme in the University of Malaya.

The KOL Course, Sample and Data

The Course-On-Line or *Kursus-On-Line* (KOL) ran for 14 weeks, that is one Semester. The course content focus was the integration of information technology in instruction. The instructor (also the author), used the University of Malaya's template ***(http://mdc.um.edu.my:88/mdc/mainmenu.nsf)*** for all KOL courses which can be classified as the Content and Support Model if based upon Mason's (1998) models of existing on-line courses. The instructor was directed to teach basic skills of word processing, presentation graphics, databases and how to use these skills in their training sessions. The problem that faced the instructor was that the seven adult learners were from professions that were profoundly different and transfer of knowledge efficiently in a direct manner to such a diverse audience was difficult. Hence, although the course content was planned and executed as wanted by the administration, the issues of learning theories and human-computer interaction was introduced by the instructor to provide a more wholesome view. The KOL was a class based upon synchronous as well as asynchronous interactions and deep cognitive engagement. Assessment was authentic. Class participation was emphasized and presentations were essential and assessed. In addition, the learners were asked to prepare a Glossary of terms learnt throughout the course as well as to keep a personal journal, which was assessed. The author wanted to identify and describe how adult learners perceived the dynamic interactions that were occurring during the 14 weeks of class and how these interactions affected participant roles. The discussion in this paper emerged from data acquired from the instructor's observations and conversations with the learners, which was kept as a personal journal. Data was also taken from the learners' journals.

Models of Participant Interactions: Perceptions of Learners

The prevalent interactions in the KOL class were perceived in different ways by the 7 adult learners. These ideas were revealed during one of the conversations with the learners in week 11, when they were requested to draw how they visualized the interactions that were going on between the various participants in the room. Each learner had constructed his or her owns conceptions and will be discussed in turn.

Case 1: Han

Han, from the Ministry of Education drew an interesting general cycle of interaction model (Figure 1). The interaction between the learner and the computer and between the learner and the instructor was intense. This interaction was mainly in verbal form in the classes and also via e-mail at other times. In his Week 1 journal entry

Han states, *"... I guess most of us including the lecturer have somehow benefited from the discussions"*. In Han's view, the interaction between the instructor and the computer apparently is not as intense and involved mainly input of course materials on the web.

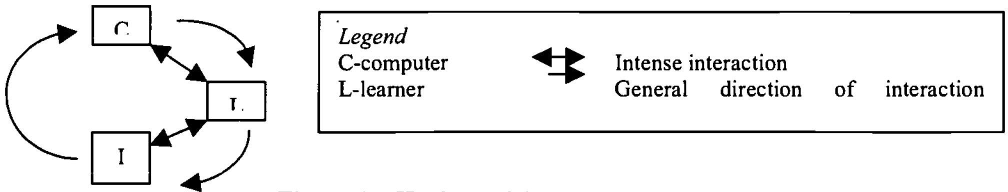

Figure 1: Han's Model

Case 2: Sham

Sham's (from the electronics field) perception is shown in Figure 2. Although her general idea was generally cyclical, the learners had various phases (1 to 4) of interaction with the computer. Phase 1 was interacting with the computer, to read, explore and understand the content provided. This was followed by phase 2 where she interacted with the computer in writing, thinking and rewriting the presentation that she had to prepare each week. At this phase she is also interacting with other members of her group via the email. Phase 3 she says was the most enjoyable as she and the computer added graphics and colour to make her presentations interesting. The last phase (phase 4) was during the weekly class discussions. Here she drew a sub cycle to show intensive interaction, between her, her peers, the instructor and the cognitive tool (the computer).

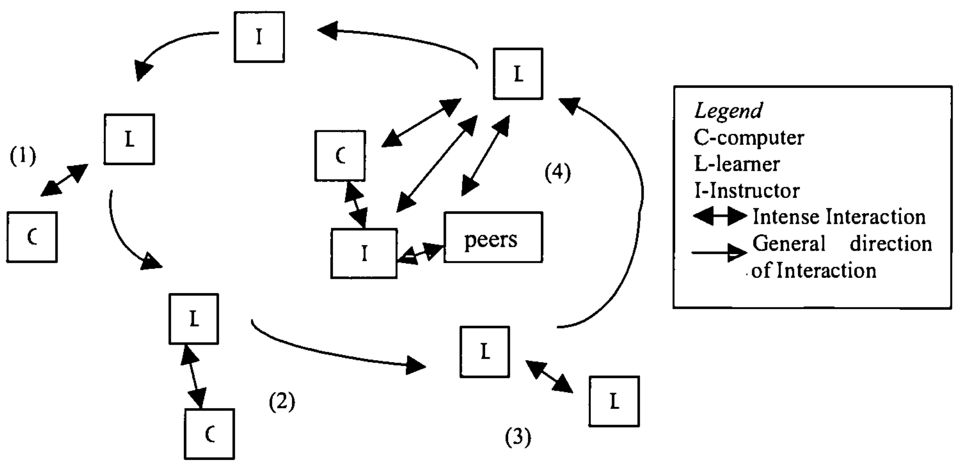

Figure 2: Sham's Model

Cases 3, 4 and 5: Dura, Afie and Una

These three learners' models although interviewed separately, were exactly the same as shown in Figure 3. Una was involved in human resource development and Dura and Afie were involved in the preparation of courseware for instruction with no prior experience with learning theories or human-computer interaction. According to them there was very straightforward intense interactivity between all three participants in a cyclical manner. Once again the vehicle of communication was verbal (one-to-one and group discussions) and via the e-mail.

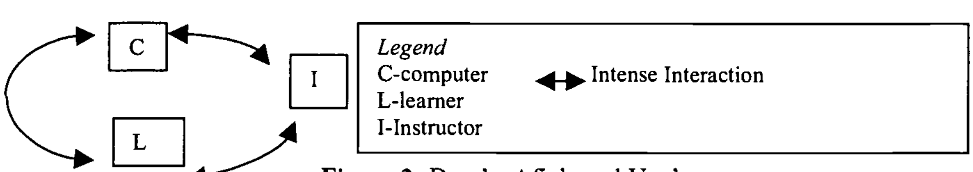

Figure 3: Dura's, Afie's and Una's Model

Case 6: Yang

Yang was involved in IT training such as word processing, presentation graphics and such, with no background in learning and instructional processes. Her model is shown in Figure 4.

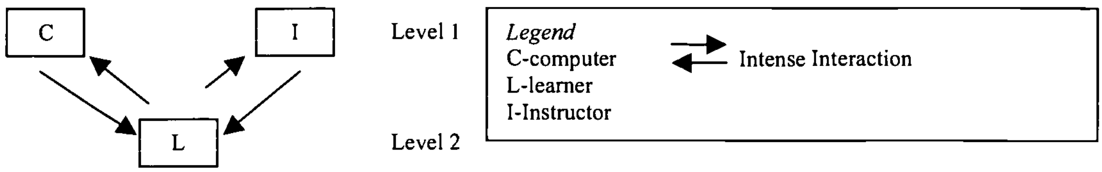

Figure 4: Yang's Model

Yang's idea was that there were two levels. Level one saw the instructor and the computer as equals. The learner was in level two. The interaction between the computer and the learner was one of receiving information and preparing presentations. Whereas the learner interacted through conversations and e-mail with the instructor and learnt through the feedback received. Strangely, according to Yang the interaction between the instructor and the computer was not apparent.

Case 7: Nas

Nas was from the Malaysian national automobile industry. His idea of a parallel model was unique (Figure 5).

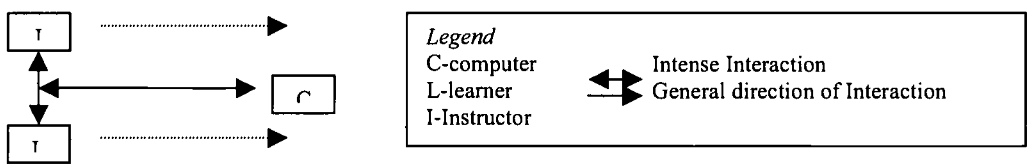

Figure 5: Nas's Model

Nas felt that the instructor and learner interaction progressed on parallel roads in the teaching-learning process. The computer was the mediating factor in this instructor-learner interaction.

The interaction models described above can be grouped into three main classes, namely cyclical, hierarchical and parallel. The Cyclical Model (Cases 1,2,3,4, and 5) has four important characteristics namely (i) there exists a general cyclical interactivity between the three main participants in a CSCL environment as shown in Cases 1,2, 3, 4 and 5, (ii) generally there seems to be more intense interactivity between the learner and the instructor, between the learner and the computer when compared with the instructor and the computer (Case 1), (iii) the interactivity between learner and computer seems to take place in phases (Case 2), and (iv) during class discussions and presentations, there occurs intense interactivity (high cognitive engagement) between learner and instructor, between learner and computer, between instructor and computer, between learner and peers, between peers and instructor and between instructor and peers (Case 2). The Hierarchical Model (Case 6) portrayed a more traditional setting. Yang gave equal importance to the computer and the instructor and both were placed at a higher level than the learner. When questioned as to why she perceived the participant interactions as such she said, *"The computer to me presented the content. You gave the human communication necessary. Without the instructor, the learner cannot be motivated"*. Hence the hierarchy in her eyes. The interactivity between the instructor and learner and between the learner and computer is evident. Interactivity between the instructor and the computer was apparently not perceived at all, perhaps because the instructor puts up the learning materials on the web before the start of the class to be accessed later by the students. The Parallel Model (Case 7) portrays the instructor and the learner being partners on the same path of constructing knowledge. It was a total opposite of the Hierarchical Model by Yang. Nas in his journal entry wrote, *"The inputs derived from the students would help the facilitator to enhance her knowledge and understand the student needs and expectation. The instructor is there, but did not make herself prominent. Learning was dynamic. Learners learnt from the instructor and vice versa. It has been an enriching experience for both."* Heath's (1997), stated that Computer Mediated Communication calls for a collaborative and group-oriented approach which encourages discussion, opinion sharing, reflection and debate. This kind of human-human communication is prominent in all three models perceived by the learners in this study.

Instructor, Learner and Computer roles in the KOL, CSCL Environment: Perceptions of learners.

Although conventional labels for the instructor such as *"facilitator" and "guide"* were given, several novel labels also emerged. Han described the instructor's role as one of *"provider of opportunities and democracy"*. He felt that the opportunities provided gave him freedom (sometimes too much he says) and control over his own learning. He also states that another role of the instructor was one of an *"authentic assessor"*. He says in his Week 2 entry, *"...In class tonight everyone took turns playing roles of recaller and listener."* When asked why "recaller", he explained that as presentations and discussions were taking place he had to recall what he had read and understood. Sham labeled the instructor as a *"disseminator of information"*, *"a model for constructivism"*, besides being a *"stimulator"*. Her perception was that the instructor placed large amounts of information via the net every week. Then by example lead them to how they can construct knowledge from the vast amount of information given. The encouragement given in class stimulated her to construct as deep a knowledge as possible. She writes in her journal, *"...she (the instructor) listened intently to our discussions and wrote down all the key points picked up from the presentations on the board. This later was constructed into the gist of the debate that went on."* Nas's labels were *"provider of guidance"*, *"a mediator"*, and *"social negotiator"*. When probed further apparently these roles assumed by the instructor made Nas feel comfortable and free, which triggered his intrinsic motivation. Yang also called the instructor *"a motivator"*. Dura's journal entries reflect a colourful picture of a journey. She wrote, *"...is the navigator, the others and I are sailors and we are going to cruise the tide together"*. Afie felt that the instructor was a *"key"*. When asked to explain he said, *"As a key to unleash creativity and communication"*. Una who was nearby agreed and said, *"My fear to try has been unlocked"*. Una in his journal also stated, *"Instead of telling us about the subject matter, we were given a situation and asked to reflect and discuss the pros and cons"*. Afie also felt that the instructor at times was like a *"host of a show"*. This was because the instructor had to facilitate and direct questions to the *"panel of experts"* (the learners) in the class. All the labels given to the instructor reflected similar thoughts found in Lerner (1997) and Javid (2000). The current ideas predominant about distributed and shared cognition between the instructor and learners also seemed to be implied here. The learners also felt that they were given a lot of control over their own learning. The instructor apparently stayed in the background, while stepping in at crucial times to steer the class.

Han described the computer as his *"late night companion"* who helped him to finish his presentations and assignments. Dura called her computer *"a friend"* with whom she interacts constantly. Sham labeled the computer as her *"assistant"*. It helps me to remember better". Afie said, *"the computer helps me to simplify things"*. Yang said, *"the computer presented content"*. She went on to say the computer *"made things flexible"*. All the learners called themselves *"readers"*, *"analysts"*, *"creators"*, *"sharers"*, *"critics"*, *sailors*, and *"collaborators"*. Clearly the above ideas discloses once again that the computer is a cognitive tool that essentially helps to intensify human-human interaction, as the presentation and direct transfer of information from the instructor to the learner becomes secondary and the construction and creation of knowledge utmost.

Conclusion

As the CSCL environment continues to evolve, the actors are as chameleons that adapt to roles to gain the utmost from the environment. Riel (1994) has rightly said that the role of the teacher would shift from being the prime source of knowledge to that of expertise in learning. He said, *"A good teacher should be an expert learner, who can facilitate students' learning and information seeking"*. Bannon (1989) stated that the computer besides being a tool, could also be a medium, which mediates collaboration with individuals. As a conclusion it can be said that this case study has uncovered some insights into how a diverse group of adult learners perceived interactions between participants in a CSCL environment and how they utilized this dynamic interaction to construct and create knowledge out of a colossal amount of information.

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Gender and Online Discussions: Similarities or Differences?

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Abstract: The study examined how female and male graduate students (n = 13) participated in the discussions in a web-based course by analyzing the interactions of a mixed gender group in both online chats and threaded discussions. The discussions were drawn from 4 different weeks over the semester. The purpose was to discover whether differences by gender in terms of types of substantive (that is, directly related to the topic) and non-substantive (not directly related to the content) messages existed. In addition, students were surveyed about their computer and Internet skills and their attitudes toward the course. Results indicated that overall students' discussions included the 2 main categories of substantive and non-substantive. Both males and females had the greatest amounts in the responding and reacting (2 of the substantive types) overall. Results were mixed in terms of any differences between gender in terms of the 2 main categories over the four weeks. In terms, of the non-substantive types, females tended to make slightly greater numbers of chatting and supportive comments than males. Comparing male and female discussion leaders, the female showed greater amounts in those same 2 non-substantive types than did the male leader. It appears that any differences in male and female messages are diminished when looking at substantive remarks in online discussions.

Introduction

A number of universities and colleges are adding or converting traditional courses and programs to online learning environments. These WBI courses require not only a different design and delivery of the instruction, but also a different form of engagement on the part of students with the course materials, other students, and the instructor. These learning environments require not only active, but interactive participation through the interchange of ideas with all participants (Davidson-Shivers, Muilenburg, & Tanner, (In press, 2000; Davidson-Shivers & Rasmussen, 1999).

This interchange of ideas occurs mainly through online chats or threaded discussions. The computer-mediated communication (CMC) literature documents the dynamics of online discussions by various forms of communication patterns, processes, and purposes (Walther, Anderson, & Park, 1994; William & Merideth, 1996; Piburn & Middleton, 1998; Wojahn; 1994; Jeong, 1996; McCormick & McCormick, 1992; McConnell, 1997; Sherry, 1999; Hara, Bonk, & Angel, in press; Davidson-Shivers, Muilenburg & Tanner, 2000). Wojahn's (1994) and McConnell's (1997) studies focused on gender differences in communication patterns in online discussions. For instance, Wojhan (1994) compared the adult communication patterns by gender using a bulletin-board communication format; she found that the length of communication patterns of men and women was very similar. McConnell (1997) when comparing patterns of men and women in mixed gender groups found that men tended to talk more and longest in computer conferencing, but that women may be less disadvantaged in conversations in online than in face-to-face. Davidson-Shivers, et al. (2000) observed contrary findings in that men in a majority-male group made dramatically less statements in online discussions in a web-based instructional course when compared to the women in a majority-female group.

The original study of Davidson-Shivers et al. examined the interactions in chats as compared to threaded discussions in a web-based course. Students were randomly assigned to small group for comparison over a two-week period resulting in a majority male and a majority female group. The results indicated that the majority male group, tended to have fewer comments in the substantive categories of reacting and responding in both the chat and the threaded discussion in comparison to the majority female group. In addition, the majority male group also had a lesser amount of chatting and supportive comments compared to the majority female group. These findings are similar to face-to-face conversations within same gender groups (Tannen, 1990; Wojahn, 1994; McConnell, 1997). Were these findings unique to the situation and particular members of the groups? This unanticipated finding lead to further investigation as to whether there remained these differences in the online discussions when students were in a mixed gender group setting within the same course..

Purpose of the Study

The purpose of the study was to ascertain whether the mixed group sessions would substantiate the initial findings of the Davidson-Shivers, et. al. study. To gain a better understanding of the dynamics of gender in both online chats and threaded discussions in mixed group, 4 different weeks (fifth, seventh, tenth and fifteenth) from throughout the semester time frame were analyzed. The coding scheme that was used relates more to classroom activities than to communication types (as in Wojahn's and McConnell's coding schemes). The specific question was there a difference in the types of and amounts of comments made by males and females in mixed gender group discussion?

Methods

Participants

Participants in the study were graduate students (n = 13) in a required course for their degree programs of study from a southeastern regional university in the USA. Approximately two-thirds of the students were female. Based on the survey results, the majority of students reported that they had computer experience with some having less experience with the Internet and WWW. Participation in the discussions was a course requirement. Confidentiality of information was maintained by having surveys collected and coded by someone other than the instructor and the analysis of the discussions occurred after final grades were posted.

Course content, organization, and requirements

The course was an introductory course on trends and issues in instructional design. The course was organized by weekly topics with assignments and questions being posted to its website. Two or three questions were given with directions on how to post (either chat or threaded discussion) answers and replies. Students had a week to respond to any listserv question(s) and were also required to reply at least twice to other students' responses during the week. Typically one additional question was scheduled for an hour and a half chat during the week. Chats were large group (whole class) in which most students were able to attend. Students were also assigned particular readings as preparation for discussing the weekly topic. They were also encouraged to draw on their own experiences, knowledge and skills. Both threaded discussion and chat could be copied and all of the chats were distributed to all members of the class. After the fifth week of the term, students were assigned as discussion leaders to facilitate the weekly discussions in both chats and threaded discussions with guidance from the instructor. The instructor participated directly in the online chats; however, less so when another student was the discussion leader. With the threaded discussions, she added her comments to a summary at the end of the week rather than commenting during the week.

Procedures

The following procedures occurred for gathering the data.

- Transcripts of the discussions for 4 different weeks were then coded using a coding scheme developed by the Davidson-Shivers et al (1999) based on the work of Piburn and Middleton (1998) and Williams and Meredith (1996). See Table 1 for the coding scheme. There were two threaded discussion questions and once chat for each of the four weeks; all of these discussions were whole class rather than students being divided into small groups.

- The researchers were trained to use the coding scheme and then coded each discussion transcript independently. The transcripts were coded by each completed statement/thought made rather than using a line-by-line method. The coding and analyses of the discussions did not occur until after the final course grades were posted. Complete sentences, incomplete sentences, and short phrases were considered as a statement if a new or different thought was presented within them. Incomplete sentences or short phrases were often used within the chat due to the speed and interactive nature of this format.

- Discrepancies encountered in the coding were resolved by review and discussion of the statement and the researchers coming to consensus.

Table 1
Types of Discussion Participation Coding Scheme

SUBSTANTIVE ***Structure Types:*** ***Messages that relate to the discussion content or topic.***			
Code #	**Code Name**	**Definition**	**Example**
1	Structuring	Statements that initiate a discussion and focus attention on the topic of the discussion. These statements are often made by the discussion leader or instructor	"Today we are going to discuss . . ." or "Well with only a few minutes left, I want us to conclude by . . ."
2	Soliciting	Any content-related question, command or request which attempts to solicit a response or draw attention to something	"How would you make IT attractive to . . .?" or "How long does it take to implement a change in . . .?"
3	Responding	A statement in direct response to a solicitation (i.e. answers to questions, commands, or requests). Generally these are the first response to the initial statements by the discussion leader or a direct response to a question by another student about the topic.	"From the assigned readings, I believe that the ID is a solution . . . for educational system restructuring. However, the main burden for the restructuring is that . . ." or "I think ownership is an internal motivation, if they think they are part of the design and it is their product, they can make instruction have a significant positive impact on . . ."
4	Reacting	A reaction to either a structuring statement or to another person's comments, but not a direct response to the question.	"Your earlier statement got me to thinking about . . ." or "You said. . . I think important ingredients to helping employees, teachers, etc. adjust to new technology would be . . ."
NONSUBSTANTIVE ***Structure Types:*** ***Messages that do not relate to the discussion topic or content.***			
5	Procedural	Scheduling information, announcements, logistics, listserv membership procedures, etc.	"The final paper is due on . . . OR The assignment can be sent via email
6	Technical	Computer-related questions, content, suggestions of how to do something, not	"some of you have experienced some difficulty recently in

		related to the topic directly.	getting email back from the listserv. . ." OR "How do I copy and paste the chat?"
7	Chatting	Personal statements, jokes, introductions, greetings to one, etc. to individuals or the group	"How was your weekend?" OR "What is the matter with my typing tonight!"
8	Uncodable	Statements that consist of too little information or unreadable to be coded meaningfully.	Typographical errors were the majority of the uncodable responses
9	Supportive	Statements that although similar to chatting, there is an underlying positive reinforcement to the comment! *Note:* This category was added when researchers met about their coded transcripts.	"You always give such a well written answer! I enjoy reading your ideas and thoughts." or "lol. . . cool idea!"

Source: Davidson-Shivers, Muilenburg, & Tanner, (In press, 1999). Adapted from Piburn & Middleton (1998); Williams & Meredith (1996).

Data Sources

Survey

Data were gathered by a questionnaire distributed three times to the group. The survey asked students to report their capabilities using technology, web-based technology in particular, experience with the discipline, and other demographic data. They were also asked to critique the course as it progressed through the term in terms of technical difficulties, interest in topics, preferences to types of activities, instructional strategies used, and amount of work that this course in this format involved.

Coded Transcripts

The weekly units included two threaded discussions and one chat. The coding scheme used two main categories of substantive, messages that related directly to the content or topic at hand and non-substantive, messages that did not relate to the discussion topic. Every statement or sentence was coded using one of these 9 subcategories. (See above Table 1.) Both types of online discussions were coded for the types of statements per week and then averaged due to the disproportionate number of females to males in the course. The results are discussed are as follows.

Discussion of Results

The analysis showed that participants' comments were made in all substantive and non-substantive categories in the chats and the threaded discussion, except that there were no uncodable statements in the threaded discussions and a few in the chat transcripts. (Note: Due to lack of space, the tables of results that will be provided in the paper presentation were omitted in this proposal.) Students overall provided more substantive statements either by responding to a question or reacting to another's statements or comments than any of the other seven types. Since part of the course grade was based on their substantive participation, it is not surprising that reacting and responding would be high in frequency. In terms of the non-substantive category, chatting and supportive comments were greater than any of the other types for the total group.

When reviewing the substantive comments by gender, the findings are mixed in terms of amount of statements by week. In terms of the responding and reacting types of statements, the average number is greater for male students than females in the threaded discussions in week 5, but it was reversed in week 15. For Week 7 and 10, the average number of responding and reacting statements by gender was equivalent. The average frequency of responding and reacting statements during the weekly chats were fairly even with the exception of week 7 in which the females showed a greater number of those two types of statements. In comparing these results with the previous study by Davidson-Shivers et. al., it appears that online discussions of either types may be equalizers in communication patterns by genders as Wojahn (1994) findings suggest when groups are made up of mixed gender.

With the non-substantive category of chatting, the statements in the was relatively low by comparison to and fairly even between genders for all 4 weeks in the threaded discussions. However, for the weekly chats, the chatting was low and even in amounts during the first 2 weeks, but increased as the semester progressed with it nearly tripling during week 15 of class for all students. During the last two weeks, the female students provided on average more chatting remarks than males in the online chats.

The average amount of supportive comments in the threaded discussions across weeks was even in number by gender with the exception of week 7 with a greater amount of supportive comments being made on average by the female students. In terms of the supportive comments made during the weekly chats, the average amount was even during weeks the first 3 weeks and the last week again showed the females providing greater amounts. For the online chat student discussion leaders, statements within these two non-substantive categories varied by gender. Both female discussion leaders (weeks 7 and 15) provided both chatting and supportive statements during the online chat whereas the male discussion leader (week 10) only provided chatting statements. The increase in non-substantive comments by students may be due to their becoming comfortable with web-based formats and with each other. However, it should be noted that some, but not all, of these students had on-campus courses (face-to-face) with each other that may have also helped them to become acquainted. The increase in amount of supportive statements by the female students may be indicative of a tendency for this gender to provide supportive comments to each other (Tannen, 1990) or acknowledge points made by each other (Wojahn, 1994). McConnell (1997) also suggests that men tend to support conversations at the end whereas women tend support conversations throughout the dialogue. This phenomenon may have held true for these students in online discussions as well.

Summary

Use of online discussions provides a direct and interactive environment in which students communicate with each other. Examining factors that influence these discussions are critical to effective participation in web-based instruction. Although the observations in the study by Davidson-Shivers et. al., suggest that there may be differences between genders in online chats and threaded discussions, those difference might be explained by the type of group (same gender) that were used. In this investigation, examining the discussion statements of the same participants but in a mixed gender group, the differences appeared to be diminished in the four weeks that were examined. These graduate students reacted and responded to the topic at hand, chitchatted, and made supportive comments to each other were, for the most part, equivalent in type and amount of statements. As suggested by McConnell and Wojahn, perhaps females are less disadvantaged in online discussions than in face-to-face meetings after all. However, further study in the exploration of communication patterns in online dialogue is needed. The type of group—mixed- or same- gender—may make a difference in the types and amounts of communications between and within gender. In addition, further investigations of the discussion patterns with use of whole class and small groups need to occur as well. Finally, examination of communication patterns of children and adolescents by gender also need to be examined. All of these factors can affect the interactions of students in online discussions and ultimately, the success of web-based instruction.

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FOR THE FEAR OF BEING WRONG: GROUP DYNAMICS IN CYBERSPACE

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Abstract: This paper describes the experience of conducting postgraduate students in an online seminar as part of an experiential, reflective course in interpersonal communication. It identifies some of the opportunities and challenges that online learning offer. Among these are the impact of technology, issues of participation, and patterns of communication. We conclude that critical reflection on experience is a difficult skill to acquire, even for people used to being taught in an interactive, participatory environment.

For the past 14 years part of an M.Ed. programme in "Communications, Education and Technology" has been taught experientially, with an emphasis on students' experiences and their reflections on them. Tutorless reflection groups are a central element of each session and students are required to maintain a reflective learning journal. As far as possible the focus has been real world – exploring the patterns of communications within the group, rather than on sterile exercises. Recently, students requested that we provide opportunities for online discussion in line with changes in practice. This paper describes some of that experience. Like many postgraduate students returning to study after a number of years, they come with expectations of a passive student role and expectations of having to meet well structured, tutor-imposed deadlines. Accordingly, the first semester can be a culture-shock as students struggle to move from dependence on the tutor to interdependence on one another. Among the demands on them is they have to learn how to learn from each others' experiences and knowledge. They also have to appreciate different patterns of communication arising from different cultures. There was little or no experience of using computers and none had taken part in an online conference previously.

Findings

There was not a great deal of activity in the conference as a whole, and none at all in two key areas which we hoped students would take advantage of: bibliographical data and reflections on the experience. There are a number of measures of engagement in cyberspace, from hits on the server to the number of words written. Clearly there are more qualitative measures, but these (for example discourse analysis) are beyond the scope of this short paper. Of the six non-participants, four were men and two were women. The activists – as measured by the number of contributions – were nearly all women. Rupert was the exception. He contributed the 3rd highest number of words through only two contributions. His statements, however, were well-formed and at a high end of the "spectrum of seriousness" (Davis & Holt, 1998: 321), perhaps influenced by his work as a journalist for a national newspaper. There are three themes we would like to analyse further: the impact of technology; issues of participation; and patterns of communication among those who did take an active part.

The impact of technology

The students were introduced to the software during the induction week of their programme. Students were therefore considered to be familiar with access and other features of the platform. Despite our beliefs, some still were not confident about how to gain access to the conference site. Nevertheless, in the post course evaluation session, Charles, whose only contribution was to ask for help, commented that the use of online conferencing should be included in the course and it might be useful to conduct the reflection groups online. This is, in our experience, not untypical. The nature of the course unit, and the learning that arises from it, develops insight and autonomy and moves students towards higher levels of interdependence. Charles's recognition of the value of online discussion was a product of more mature thinking arising from his reflections on his and others' learning.

A part time student was unable to access the conference as she did not have a computer at home or work and felt excluded from the experience. Part-time students can suffer from not having quite the same face to face (f2f) access to tutorial support or technology during the working day. In Nigel's case, this meant that he did not attend the initial training session and he did not find the written instructions to be adequate. He did, however, persevere as he was keen to experiment in anticipation of setting similar conferences with his own students. He seemed to be very concerned with the fact that having missed the training session, he needed more skills or a "better" handout. We cannot clearly identify whether this was an accurate self-assessment, or a mask to cover a lack of confidence that he was unaware of.

Participation

In the face to face classroom, lack of participation can be put down to shyness, apathy, personality or cultural style. Online there may be other issues that cannot be resolved by checking other cues or asking directly for a contribution. Students can simply choose not to participate and their absence can absolve them of any responsibility to the community. They are not physically present to witness others' frustration or irritation. One student commented in the evaluation that she was frustrated because people ignored her online. Interestingly, in the face to face classroom, she was quiet: online she was extremely "noisy".

Patterns of communication

The first thread, initiated by Sue (tutor), was an invitation/exhortation to participate. Through deliberate choice, this was to be Sue's only contribution to the discussion – leaving the space clear for the students to develop their own lines of research, discussion and reflection. Similarly, Mike (tutor), was not intending to take an active part, but did make more interventions by responding to direct questions. Thread two (Carole), who had found Nigel's misdirected contributions on two occasions inside other topic areas. Despite Nigel's earlier misgivings, he actually found help. Thread three (Mike) shared the view that quiet members of class – possibly more reflective students – could become more active online. Thread four was misplaced during Nigel's efforts to gain access to the site. Thread five (Carole) explored some of her difficulties of accessing the material and then went on to invite contributions from her fellow students. This generated a lively discussion among three of the group, all of whom shared feelings of empowerment online in contrast to the f2f classroom environment. Jackie, a late entrant into the discussion, initiated thread six and she clearly felt the need to make a strong statement: a manifesto, rather than an opening in a dialogue. While accepting that the scope for cyber learning was great, for example people can talk to one another across distance and time, that they can learn at their own pace, that written text can be translated, that responses can be thoughtful and, "that the expertise of a few can reach a huge number of people" she also pointed to some of the disadvantages: access to technology; social isolation; lack of social interaction; the potential for undetected misunderstanding. Thread seven (Margaret) became a dialogue between her and Mike. That other students did not join in is of interest but difficult to explain. There were indications from the evaluation and from the number of hits on the server that there was more silent activity than writing. This is not untypical nor unexpected, but written contributions here were considerably lower than other evidence has led us to expect. One reason for this may be the emphasis on the use of emails in all the other course units in the degree. "Because we meet every day we don't feel the need to communicate through facilitate.com we use emails, it's easier" (Jackie). Thread eight gave the address of the paper site, ten was a discussion about problems associated with getting to it and nine involved Carole asking questions of the process and Mike's response to them.

Conclusion

Critical reflection on experience is a difficult skill to acquire, even for people used to an interactive, participatory environment. In an online environment, we expected similar difficulties and barriers to effective participation and reflective thought. Not all students participated and it is difficult, in the absence of other evidence, to understand the nature of their experience of this part of the course unit. Among the confirmatory evidence was the strong suggestion that students who, in the f2f environment, would be quiet observers, became active participants and intense followers of the argument and unfolding debate. For example Helen made the most contributions, the most hits on the server and wrote more words than anyone else. There was evidence to highlight the responsibility that students took for one another's learning, illustrated by Nigel's success despite his self-proclaimed lack of skills in using the conference platform. In the end, he found the help he needed to start to use the medium and in doing so, made a contribution to others. There were difficulties for part time students and their access to training and technology; time constraints, levels of active participation, the potential threatening nature of the mode of communication and varying levels of understanding of the task.

This course unit intends to provide every one with the opportunity to communicate in a variety of different ways, some of which they may find uncomfortable and threatening. Computer conferencing is almost certainly an example of one of these. Although we would not wish students to feel excessively uncomfortable, we would want the course to represent real life interactions with all its complexity.

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Combining Instructionist and Constructionist Learning in a Virtual Biotech Lab

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Abstract: The functional and didactical design of a virtual learning environment depends on the underlying learning theory. We discuss a virtual biotech lab as a special kind of virtual learning environment from an instructionist and a constructionist viewpoint. The virtual biotech lab introduced in this paper is an application of CoopLab, an object-oriented framework for the development of cooperative virtual labs. The virtual lab supports instructionist as well as constructionist learning and allows a combination of both approaches.

1. Introduction

Laboratory education in natural sciences is time consuming and expensive. Equipment and educational staff of a laboratory is limited and in a lot of cases not sufficient for the number of students that demand a lab course. Unexperienced students have to repeat parts of an experiment. Each mistake and a new trial produces more costs and often toxical waste. The costs for lab courses in natural sciences represent a great expense factor for universities and research institutes.

Not only material restrictions obstruct the offering of real world labs but also restrictions in the number of available tutors who have to assist the students in doing the practical experiments. Some of the students need more assistance than others, but individual assistance is nearly impossible during a practical lab course with a number of students of ten or more.

With virtual laboratories some of these restrictions can be addressed: A virtual laboratory is a graphic environment that gives the user the impression of a workbench, which is similar to a real one. Applets enable the user to perform typical biotech experiments in an analog way to a real world lab.

The background of this paper is an internal research project at GMD-IPSI dealing with software engineering, computer-supported cooperative learning (CSCL) and practical biotech knowledge. The project goal is to develop a software framework in order to simplify the implementation of such virtual laboratories. The framework is called CoopLab because an important aspect of the framework is to enable cooperative learning in the virtual laboratory environment. However, this functionality is still under development in the current state of the project.

The target group of the biotech applications built on the framework (i.e. the virtual labs) are students in molecular biology and trainees in genetic engineering, who want to prepare themselves for the practical work in real world labs. We want to stress that the virtual labs, which can be created using the framework do *not* intend to replace real world labs. A virtual lab created by using the CoopLab framework represents an additional workbench with the aim to improve the practical and theoretical preparation of the users and to reduce some of the restrictions of real world lab courses, which are mentioned above.

CoopLab is implemented in Java (based on JDK 1.1), but we are currently moving to Java 2. Java is becoming a prominent programming environment for the design and implementation of nearly all kinds of frameworks.

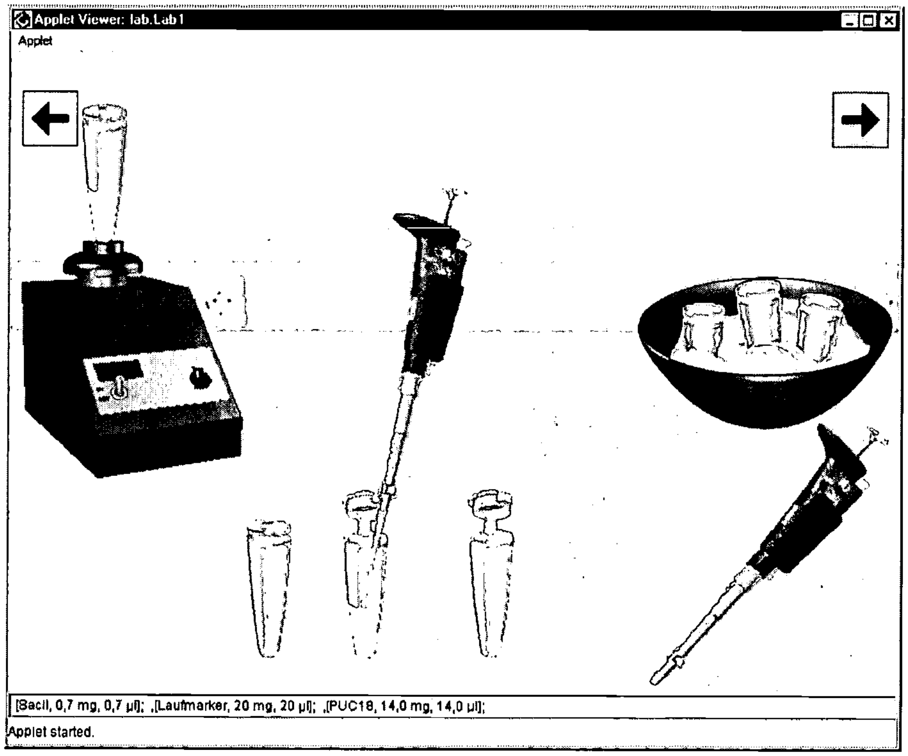

Figure 1: Screenshot of a virtual lab workbench

2. Application Domains

CoopLab applications are supposed to simulate real world lab experiences. So far the application domain has proven its power for the development of biotech labs, although it could also be used for other domains. The work in such a biotech lab is comparable to the work in a common chemical laboratory. To simplify it, you can say that the student in a real world biotech lab handles chemical fluids and organic material (like living cells, bacteria or plant cells) to fulfill a number of proposed tasks like DNA analysis, cloning or production of proteins etcetera.

A common practical experiment is the restriction analysis of bacteria DNA: Doing this, the user must prepare the DNA for an analysis by applying various chemicals in combination with special enzymes to the cell DNA, which has to be analyzed (see next paragraph).

Normally you cannot recognize any results with your own eyes, but instead you must use detection tools and machines, wich are applied to the DNA or the containing tubes.

2.1. A Sample Biotech Experiment

As a prototypical application the biotech experiment *Plasmid Restriction Analysis* is chosen. A step-by-step overview of the experiment *Plasmid Restriction Analysis* is given here with an emphasis on common elements, which are found in many biotech experiments. For more information about genetic engineering see (Watson et al. 1992).

During this sample experiment the DNA of bacterial plasmids is treated with special enzymes (called restriction enzymes). This treatment leads to a splitting of the plasmid-DNA into different fragments. With the so-called gel electrophoresis the fragments are compared with an already known standard DNA-fingerprint (mostly the so-called λ-standard). That makes it possible to find out the length of the newly generated plasmid fragments.

The following tasks are summarized in order to provide a clue of the typical working steps in a biotech experiment:

1. Pipet plasmid-DNA into the micro tube with the enzymes and the puffer and shake it shortly with a vortexer.
2. Spread the mixtures of enzymes and DNA together with the λ-standard on a prepared agarose gel.
3. Put the gel into the electrophoresis chamber and start the electrophoresis by switching on the voltage generator.
4. When the electrophoresis is finished, switch it off and put the gel onto an UV-light screen.
5. Take a photo of the observable DNA bands and interpret the results.

The user of the CoopLab application, which is built for doing this experiment, can execute the five steps in a customized way: With the help of mouse events like clicking or dragging, the user can touch, move and combine tools, devices and tubes on the screen, which are similar in appearance, behaviour and usage to the corresponding elements of a real world lab.

The tasks that the user has to fulfill, can be presented in form of a step-by-step protocol list. This protocol can be integrated into the software e.g., as a checkbox-list or alternatively appended as a printed handbook. A typical task would be "Pippet 0.7 µl of the enzyme SacII into the micro tube with the plasmid-DNA." or "Put the gel onto the UV-light.". Each single operation can be performed with help of the computer mouse and, in cases of alphanumerical inputs, the keyboard. After a successful experiment the user gets an adequate feedback: This can be a text output like "The experiment Plasmid Restriction Analysis is finished." in combination with a visual illustration of the experiment goal.

3. Instructionism and Constructionism in a Virtual Lab

In theories on the use of computers in education two main approaches can be differentiated: The 'instructivist' and the 'constructivist' approach (Greeno 1991, p.3).

A focus of instructionism is to increase the efficiency of learning. All actions of the computer aim at transmitting knowledge to the student. By applying this approach the learner is regarded as "the passive recipient of instruction" (Reeves 1993).

In contrast, constructionism regards learning as a process in which the learner actively constructs his or her knowledge by interacting with the subject-matter. The role of the computer is to support such kind of active learning by providing an appropriate learning environment.

What do these approaches mean for the design of virtual labs? From an instructionist viewpoint virtual labs have to support the execution of a linear sequence of steps, which lead to the learning goal. Students are prompted to press the right button, to perform the right interactions or to enter the correct value in order to proceed to the next step. A virtual lab based on this approach would control the student's actions and gives feedback on their correctness. There is little space for the student to deviate from the correct way.

An implementation of the constructionist approach can be found in situated learning (Brown et al. 1989), (Lave & Wengler 1991). According to (Herrington & Standen 2000) an environment for situated learning should fulfill the following criteria:

- authentic context: The context in which the knowledge is learned should resemble the context in which it is normally used.
- authentic activities: The activities performed in the learning environment should resemble real-life activities with respect to the complexity and structure.
- access to expert performances: The student should be able to learn from expert solutions.
- multiple roles and perspectives: The environment should enable students to look at a problem from different viewpoints in order to get a more realistic model of the subject-matter.
- reflection: Reflection on the learning should be supported by providing authentic contexts and non-linear navigation through the whole virtual environment.
- collaborative construction of knowledge: The environment should support collaboration between students.
- articulation: The students should be supported in learning to speak the special language of the discipline.
- coaching and scaffolding: The teacher should be able to provide support for the students, e.g., provide hints and structure the learning activities.
- authentic assessment: The assessment should be seamlessly integrated with the activity.

Remember that in our didactic approach virtual biotech labs serve the purpose of helping students to prepare for real world labs. In the virtual biotech lab students learn about:

- the functionality and behaviour each tool in the real world lab provides,

- the experimental setup for the real world lab, and
- the procedures they will need to follow the tutor's instructions in the real world lab

In order to meet the criteria for situated learning environments our virtual lab environment provides graphical representations of the tools and objects used in a real world lab. These representations can directly be manipulated by the student using mouse and keyboard devices. By arranging these representations the user is allowed to construct arbitrary experimental setups. A workbench is provided in the virtual lab, which serves as a common frame for a set of tools. All objects can interact with each other on such a workbench, while each object has a certain state and can change its state according to user input resp. interactions with other objects. Thus procedures consisting of multiple steps can be performcd in the virtual lab. With these features a virtual lab can provide the authentic context, authentic activities, and articulation. Furthermore reflection on the learning process is stimulated through the authentic context as well as the free navigation through the lab environment.

As stated in the introduction the cooperative learning support will become a central aspect of the CoopLab framework, so that collaborative construction of knowledge and reflection, coaching and scaffolding can be supported in the virtual lab. These criteria fall into the category of the so-called *distributed contructionism*, which extends constructionism by focusing specifically on situations in which more than one person is involved (see Resnick 1996).

The provision of multiple roles and perspectives on the subject-matter as well as expert performances can be achieved through external material and data or - in the collaborative usage - by co-learners and tutors. Due to its solely preparative nature the assessment is of less importance in our virtual biotech lab.

4. Related Work

There are several web-based software systems for the training of natural science lab courses available as described in (Hampel et al. 1998) or in available web courses like in (Physics 2000 lab). But both systems miss the power of offering complete virtual environments that are functionally equivalent to real world experiences. Moreover, they provide only a restricted degree of freedom with respect to the user interactions.

Two ongoing projects are more comparable to CoopLab: *GenLab* (Boles et al. 1998), a project conducted by the OFFIS research institute in Oldenburg and *ViSel* (Giegerich & Lorenz 1998), a project conducted by the University of Bielefeld. They also use multimedia technologies to build up a virtual learning environment, but do not aim at integrating any CSCL-features. ViSel is implemented as a Toolbook application, whereas GenLab is implemented with Macromedia Director.

Similar virtual labs are also developed as part of the *Biology Labs On-Line* (Bell 2000) project, which is conducted by the California State University in Chico (USA). These virtual labs provide simulations covering the subjects of evolution, genetics, protein translation, demography and some more topics. They provide Java-based applets, which help to understand and learn the different topics more easily. But in contrast to CoopLab applications, they do *not* offer a virtual lab environment, which gives the user the impression of workbenches analog to a real world lab. They provide a fixed experimental setup whereas in our virtual labs the experimental setup can be constructed and/or modified by the user.

5. Conclusions and Future Work

In this paper we described a constructionist approach as an enhancement of instructionism in virtual laboratory environments. We discussed learning in virtual laboratories from an instructionist and a constructionist viewpoint and related them to virtual biotech laboratories developed as an application of the CoopLab framework. Virtual labs based on the CoopLab framework have the capabilities to meet the requirements of constructionist learning environments. A comparison to related work unveiled the specific potential of CoopLab applications to support constructionist learning.

As already mentioned above, it is a future goal to support collaborative learning in a virtual lab. This could be realized by combining the CoopLab framework with DyCE, a Java framework for the development of modular groupware (Tietze & Steinmetz 2000). In a collaborative virtual lab its state can be made persistent on a server. Different users can log into a collaborative virtual lab and share the same data ("lab-sharing"). If they log into a lab at the same time, they can additionally communicate, work and learn simultaneously. The virtual lab provides awareness of the other students' presence and activities in the lab.

Using this technology, a tutor can enter the virtual lab and provide support, e.g., by answering questions, explaining tools, demonstrating experimental setups, or performing lab procedures. Similar to this, many more CSCL scenarios are possible. Such scenarios are even closer to the experience of a real world lab than a single user application.

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DyCE framework:
http://ipsi.gmd.de/concert/projects/dyce

Physics 2000 lab:
http://www.colorado.edu/physics/2000/index.pl

Flexibility, Efficiency and Enrichment in WWW-Based Learning Environments?

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Abstract: The use of Web-based systems in education is emerging rapidly. It seems that the web offers a large potential for (higher) education, although not many positive effects can be found yet. What is the potential of a Web-based system? In this article gives an overview of what Web-based systems are, how they are being used and what potential they have. The possibilities of Web-based systems, used as an integrated tool for courses, are discussed making use of the experiences of the TeleTOP project at the University of Twente in the Netherlands. The TeleTOP Web-based system enables instructors to add more flexibility, efficiency and enrichment into their courses, which will be demonstrated with some interesting examples.

The potential of WWW based systems

For some time now the use of WWW-based system is increasing rapidly in (higher) education institutions. (Collis & V/d Wende, 1999; Veen et al, 1999). It seems that the use of these systems has an enormous allurement, many projects have been set-up to build and/or implement Web-based course support systems. But what are Web-based course support systems? There are many sorts of learning systems which can be used through the WWW and many classifications have been made. For example Berge (1995) and Collins (1995) indicate a set of instructional modes comprising the overall complex of computer-mediated communication (CMC) technology: mentoring, project-based instruction, lecturing, information retrieval, chat, peer reviewing, tutorials, simulations and drills. Collis (1999) refers to five main purposes of using *teleware* (the whole set of tools, resources, and instruments that support learning-related communication-based processes): (1) publication and dissemination of information; (2) structured communications; (3) collaboration; (4) information and resources handling and (5) support for course delivery. Robson (1999) devides 5 sorts of tools: Computer-mediated communication; Navigational tools; Course management; Assessment and Authoring tools. Teles (1993) analyzed Web-based support of cognitive apprenticeship by features that embody a variety of methods (e.g., sequencing, scaffolding, exploration, reflection) in online-apprenticeship or *tele-apprenticeship* activities.

A lot of Web-based systems have been built to make all kinds of learning (-organisation, -communication, -materials, -support, etc.) possible. Landon (1999) has made an impressive, but rather technical, overview of over 60 available systems. But how are Web-based learning systems used? Mioduser (2000) looked at 500 cases to search for what the web was really used for. He found that most educational WWW-sites support cognitive processes such as retrieving information or rote learning and higher learning skills as inference processes, problem-solving and decision-making were much less present. Within the 500 cases less than 3% supported any real form of collaborative learning. "Only a few sites included feedback, either automatic (16.3%) or human (5.5%)" (pp 19). The researchers conclude that the potential of the new pedagogical forms are emerging out of unique features of the technology but are still far from being implemented in most educational Web sites. The same conclusions are found in a smaller research of case studies. Van der Veen et al (2000) reported that the reasons mentioned for using the Web environments within the cases that have been evaluated are mostly not didactical but are aiming at flexibility for students. The students however report limited added value. Veen et al (1999) found in a national research that most institutions in the Netherlands initiated ICT in their organisations with motives relating to educational innovation in a broad sense rather than attempting to raise levels of effectiveness and efficiency.

It seems that much is being done, but the results are still minor. The research of Russell (1999) subscribes this. In his meta-research "The No Significant Difference Phenomenon" he found that less than 10% of all papers reported any significant positive results of using ICT in education. Is there a potential, but we have not yet put our hand on it? In the next section the experiences of the TeleTOP project at the University of Twente demonstrate that it takes time to accomplish something, but that the promise of Web-based systems can be fulfilled.

A Web-based course support system; *TeleTOP*

At our University of Twente in the Netherlands we have national and international reputation in the field of Information and Communication technology (ICT) and learning. In stead of the term ICT we rather use the term *Telematics*, which stands for the branch of computer science involving the combination of information and communication technologies in particular, related to the Internet and the World Wide Web (WWW). Also the application of telematics applications to the teaching and learning process, what we call "Tele-learning" (Collis, 1998), has a high priority. Tele-learning, in our definition, does not necessarily imply distance education, but instead emphasises the increased flexibility, efficiency and enrichment that can come to the teaching and learning process through the combination of the new possibilities offered by the WWW and new ways of teaching and learning.

In 1997 the Faculty of Educational Science and Technology initiated the TeleTOP Project. The overall goal of the TeleTOP initiative was to stimulate the innovative and appropriate use of the WWW for learning purposes within the faculty in order to make the educational delivery more efficient, more enriched, and more flexible (Collis, 1996). The TeleTOP system was build upon a powerful database (Lotus Notes) and to be used by everybody in the Faculty of Educational Science and Technology; it was made to be WWW-based (for both students as well as instructors) and it was made accessible through an ordinary Web-browser everywhere in the world. The TeleTOP system became a very easy to use system and it allowed to a certain extent fit with the instructional practices of an on-campus University and extent these to distance students as well. It also did engage change to new didactics. The starting-point was that WWW-based learning environments should not replace existing teaching and learning, but should add to them.

The main question within the TeleTOP project was and still is: what (added) value can there be? In the beginning of the project we focussed on three main points: flexibility, efficiency and enrichment (Collis, 1996). With regards to flexibility in telematics we distinguished: flexibility in location, in programme, in types of interactions and in forms of communication. Flexibility was a main issue, as a new group of students should be able to follow all courses within the curriculum. A partly distance variant was made available for these new students. The distance students within the program visited the university every other Friday, and were able to take courses in the same pace as the on-campus students. Also on-campus students are now able to choose this variant of courses, so the offer became more flexible.

Now that a lot of study material is available in course environments it became much easier for instructors to set-up a new course environment for a specific group. This “flexibility in programme” was being realised at our faculty within the Masters programme. The Masters programme has its core set of courses, but already two new programmes (the HRD programme and Telematics Applications in Education and Training) have been set-up with less effort compared to the situation that a system as TeleTOP was not available. Figure 1 shows how earlier used course material easily can be re-used in new course environments.

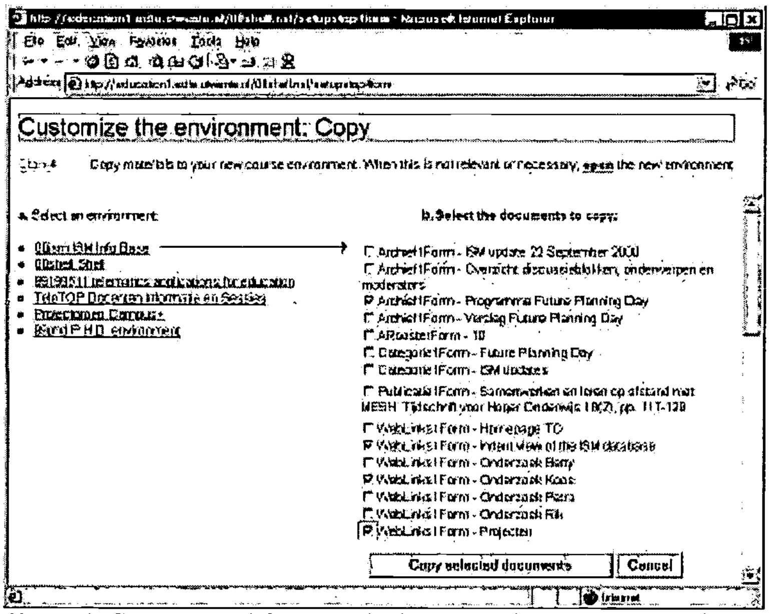

Figure 1. Course materials can easily be re-used in new course environments.

This interface is for the instructor, no technical support is necessary, and it is fully Web-based. The re-use of materials is also a good example of efficiency.

Another type of efficiency is the way instructors are dealing with the different students within one course environment. As mentioned, on-campus as well as distance students can take a course. All students start at the same point (date) and preferably will finish their course at a set date. This gives the instructor two advantages; he can focus on his teaching in the time that has been allocated for teaching, (it takes instructors a lot of time and effort to help students who want attention after a course is done), and the instructor is able to set-up one environment in which he can teach several groups of students, so he can re-use course materials. See for example figure 2, a screen dump of the roster in a course for 2 groups.

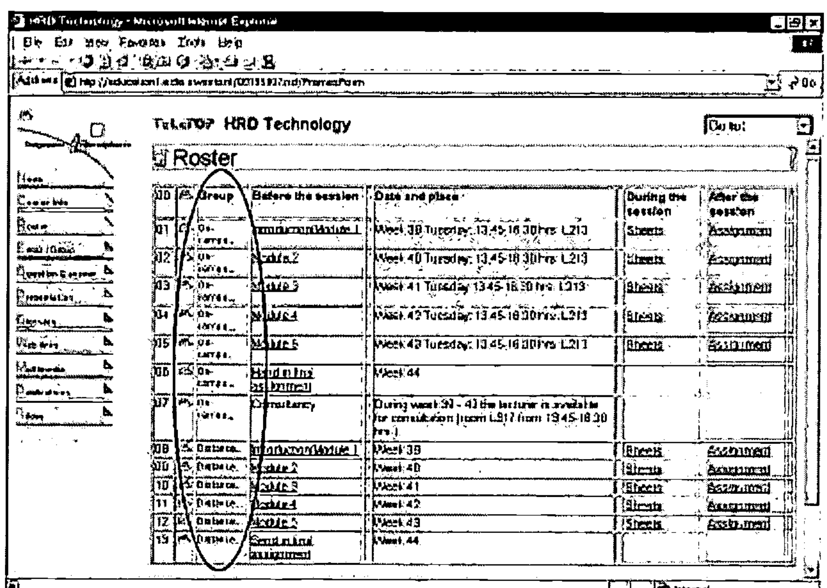

Figure 2: The roster in a course, set-up for 2 students groups.

Most of the flexibility and efficiency aspects are implemented in the past two years. Interesting is to see were we are at with regards to the enrichment which has been identified as another powerful added value of

Telematics in education. First, what sort of enrichment can be distinguished? Enrichment can occur in " educational materials (i.e. Web-links to papers, multi-media, actualities, etc), in pedagogy and/or learning styles and in better insights of relations and links between courses.

The use of possible enrichment in educational materials and pedagogy and/or learning styles proceeds not as fast as the efficiency and flexibility possibilities. Fullan (1991) notes that a major change in an institute takes 5 years, so it seems natural that new ways of teaching and learning with the use of additional resources and new media takes time. To encourage this it is important to show instructors possibilities and options so that these can be integrated within the courses.

For the second year a survey was set up to look at how "rich" the telematics were used, in particular with regards to assignments and feedback. Table 1 is derived from Peters and de Boer (2000) and shows what sort of assignments and feedback were used within 27 courses.

Activities	**Feedback**	Personal or group feedback	Model-answer	Student peer evaluation	No Web-feedback	Computer feedback	
Group activities	Search for information	2		1			**3**
	Cases	1	1				**2**
	Role-play		2				**2**
	Report	1					**1**
	Product	2		1	3		**6**
Indiviual activities	Related to theory (to be studied)	6			2		**8**
	Search for information	3					**3**
	Cases	2					**2**
	Skills	1			3		**4**
	Quiz					1	**1**
		18	**2**	**2**	**8**	**1**	**31**

Table 1: Variety in assignments in 27 TeleTOP courses (4 courses had more than one sort of assignment)

A map with this overview and an interesting collection of "good practices" examples of the use of telematics within our faculty was created (De Boer & Manuhuwah, 2000). There is variety of assignments through the courses, but much more is possible. The types of feedback do seem very alike; most instructors only gave personal feedback to the assignments. We organised workshops where instructors were invited to listen and discuss about the other and new possibilities. All of the support-materials (i.e. the good practice examples) were also made available through the web, and instructors were able to look at the examples at their own place, in their own time. It would be interesting to see whether the courses would contain more variety in assignments and feedback next year.

Another type of enrichment that can be supported by telematics would be enrichment of learning materials. An important philosophy within our education programme is the active learning strategy (Simons, 1999). As a consequence, students in the courses are invited not only to study passively, but also to find and/or create new learning materials. These can be resources that are located on the web, but can also be the writing of articles about certain topics that can be used by the instructor in the courses, as well as in other courses. An example of how telematics can support this is shown in figure 3.

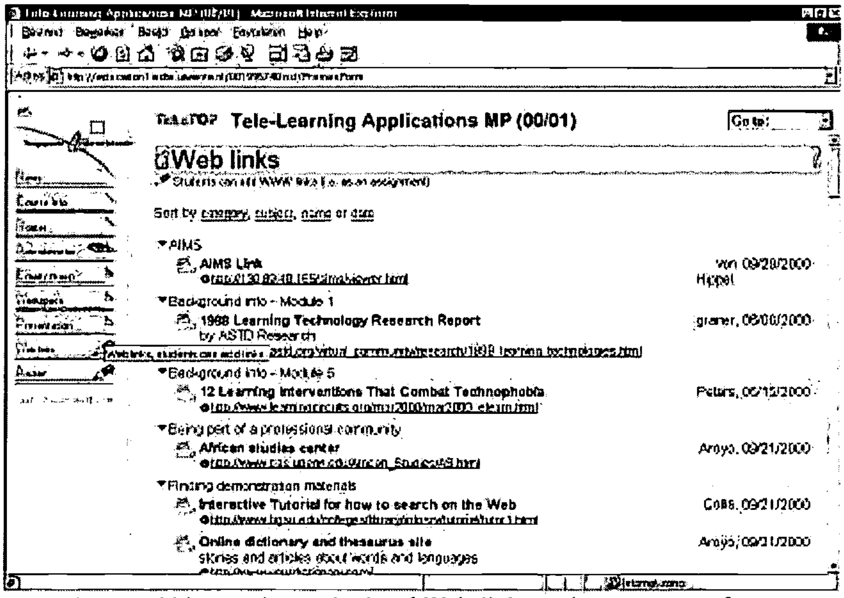

Figure 3: Students are able to add interesting and related Web-links to the resources of a course environment.

Conclusion and Discussion

Russell (1999) states that less than 10% of all papers reported any significant positive results of using ICT in education. So should we stop? Isn't there a potential?

We believe, and think we are proving, there is a large potential, but it certainly takes time to effectuate this. Good tools and good strategies with customised support should be effective and all cohorts could benefit form this. Students have several options to take a course: i.e. students have flexibility in time, place, but also in learning style (i.e. teacher guided, or self-regulated). Instructors are able to communicate more targeted and directly with all their students. Instructors have a way to see each other's materials en can easily share resources. More interaction is possible. Also new ways of learning are possible, instructors could use the active and participating student involvement approach, where not only the instructor contributes to the learning environments with new related and actual materials, but students contribute as well. Students should also be able to be reflective and look at their own and each other's work.

The main success indicators could well be the quality of the Web-based learning support system, as well as the (educational) support related to this. This support could be human, via support systems, or a combination. Further research shouldbe done to answer these questions more specifically.

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ESCUELA: A Platform Which Assists the Work of the Teacher and Supports the Learning of the Student

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This article present the prototype of a working platform, which incorporates technological innovations to be use in schools interested in promoting a modification of the pedagogical-didactic paradigm, integrating environments of work suitable to different necessities and situations of learning.

VIDEO SUPPORTED WEB LEARNING

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Distance education is emerging in many aspects of university education. Lecture broadcasts, delivery of course material and on-line tutor support are becoming standard applications of ICT in education. But especially in technical studies another important capacity of such technology in education is also to enable remote classroom and laboratory work.

We present a part of our results and experiences from technology supported distance education, especially when using video communication as an add-on. We first outline our implementation of the video supported web lecturing. It consists of indexed video stream, presentation slides and text subtitles. Then the remote laboratory examples with real-time video support is described. This distance experiment includes remote student work via WWW, handling of the laboratory process in real time and monitoring of the whole activity using a video camera.

The common denominator of the two examples is video streaming over Internet. It is not an absolute necessity in any case, but it is our finding that the learning outcome and acceptance by students is greatly enhanced in both applications when video is part of the user interface to the lecture or experiment.

A REVIEW OF WEB-BASED LEARNING SYSTEMS FOR PROGRAMMING

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Abstract

We provides a review of web-based interactive programming environments which facilitate learning programming concepts. The main focus is to categorize web-based programming systems into classes according to their pedagogical approaches and provide a brief review of individual systems. The paper is intended to give a survey of available systems and a discussion of the differences and the commonality of the tools.

Introduction

Traditionally, computer-based learning systems have been built and deployed using static media, such as disks and CD-ROMs. Currently, client-server systems can be deployed with increased access and availability. With the web, it has become much easier to distribute educational material widely. Also, with such implementation of learning environments, enhancing contents is simple, and users' needs are quickly addressed. There is a wealth of learning resources available on the web. However, not much is available to guide the user and assist in determining the appropriateness of a particular system for a certain situation or need. This paper is the result of an extensive search for available web-based instructional systems that can be used for learning programming. The goal is to organize these systems with respect to their functionality and usefulness for the learner and to provide a concise evaluation of their suitability for their learning objectives.

There is a need to organize and classify the systems into different groups based upon a set of identifiable and distinguishable characteristics. The intent in providing this categorization of these instructional systems is to offer web users - ranging from those who are just learning programming to those who are already experienced programmers - a 'guidebook' to available systems that will most likely match their educational needs. The classification of the systems fell into the educational software categories of *drill and practice systems*, *tutorial systems*, and *simulations* (Pienaar, 1997). Of the systems reviewed, each one is distinctly aligned with one of the three categories, allowing for slight overlap in common capabilities. A classification of the systems into the three categories of drill and practice systems, tutorial systems, and simulation systems is provided, along with a review of each system; in addition to URLs, references to published papers are included, were appropriate. A discussion on the distinguishing patterns and the commonality of systems reviewed is then given.

Classifications and Review

We have arrived at a classification for instructional systems that fall into the following three categories: drill and practice systems, tutorial systems, and simulation systems.

Drill and Practice Systems

Within the broad family of instructional learning systems, a subset categorized as drill and practice systems constitute the category of systems designed to provide users with practice for already defined skills. Drill and practice systems serve to reinforce learning that has taken place external to the system. In most cases, they can be used to supplement external instruction, or to refresh the learner's knowledge. Drill and practice systems include capabilities to provide immediate feedback, and usually some form of corrective action. Skills taught elsewhere are reinforced. Next, we discuss the drill and practice systems we reviewed, along with a brief description and the web URL where the systems can be accessed.

LISPTUTOR (Villamil, 1995) is a web-based tool that teaches the basics of the LISP programming language. It was developed as a student project at Tulane University, Louisiana. The LISPTUTOR provides a free-format interface for the user through the use of its 'teacher board', which is a picture of a blackboard with the various LISP concepts that, when clicked, bring the user to a page where the subtopics/feature concepts are presented. The interface provided by the teacher's board presents all the various concepts that are being taught, and the student has the option of deciding what to learn. The concepts covered range from data structures, input and output, control structures, recursion, basic arithmetic operations, and sets, with a comprehensive graded test that covers all the concepts and provides feedback. The LISPTUTOR can be found at the URL: http://www.cs.tulane.edu/www/Villamil/lisp/lisp1.html#text

This C Programming tool (Brown, 1984-1999) is an online introduction to the C programming language. It consists of a collection of web documents that are organized into chapters and subchapters. The concepts covered begin with variable declaration, arithmetic and relation operators, programming constructs, and end with dynamic memory allocation, pointers to functions, and compile options. Interspersed between chapters are optional interactive multiple-choice tests, which provide immediate feedback to each selection made by the user during his test. The feedback given takes the form of a one or two sentence response to the user's selection in a popup window. The C Programming Course can be accessed at the URL: http://www.cit.ac.nz/smac/cprogram/default.htm.

The RIT CS Course Exercises (RIT, 1999) consist of two online exams developed by the computer science department at Rochester Institute of Technology in New York. The exams were created to supplement the course lectures for its CS1 course and C++ courses. There are two exams: one covering the aspects of the Eiffel programming language, the other the C++ programming language. The organizational structure for both exams is similar. Each is broken into several high-level exercise areas, with each exercise area containing a collection of sub-lessons. Depending on the exercise area chosen, sub-lessons may be tackled in any order, or must be done in a sequential fashion. Both these exams can be accessed at the URL: http://www.cs.rit.edu/exercises.html

The TTT (Topic, Task and Test) Online Learning System (Chopping, 1996) is an online course covering the fundamentals of structured programming using the C++ programming language. It presents an introduction to the basics of C++ program structure, syntax, control structures, and functions. The TTT learning system's course is organized into several sections, each of which contains a group of topics covering a particular C++ programming concept. Each topic is a web document containing three sections (the three T's). The TTT Online Learning System can be accessed at the following URL: http://clio.mit.csu.edu.au/TTT/

Lovelace (Wheeler, 1996) is an online interactive course on the Ada programming language. Lovelace's instructional material is broken into a set of lessons, which are further broken down into sections. Each section presents some instructional content along with sample code. The sections end with a single-question quiz to reinforce the user's remembrance of the material. Lovelace also contains a separate Java section describing to the user how to create Java programs using the Ada 95 programming language. Sample programs and reference links are provided. The Lovelace tutorial can be accessed at the URL: http://www.adahome.com/Tutorials/Lovelace/lovelace.htm

Tutorial Systems

Tutorial systems comprise the largest category of instructional learning systems. Unlike drill and practice systems which supplement learning that has already taken place externally, tutorial systems are concerned with the teaching of new concepts, and providing capabilities to aid the learner in retaining what has been learned. Good tutorials attempt to deepen the level of processing of the instruction by providing different strategies to recall prior knowledge, making the instruction as relevant and meaningful as possible, and including aids for incorporating old with new information. Next, we discuss the tutorial systems we reviewed, along with a brief description and web URL where the systems can be accessed.

ELM-ART (ELM research group, 1997) is a web-based LISP tutoring system that integrates the features of electronic textbooks, learning environments, and intelligent tutoring systems. It was developed at the University of Trier in Germany. ELM-ART (Episodic Learner Model – Adaptive Remote Tutor) is based on ELM-PE (Weber & Specht, 1997), which is an on-site, platform-dependent intelligent learning environment featuring example-based programming, intelligent analysis of students' problem solutions, and advanced testing and debugging facilities. ELM-ART can be accessed at the following URL: http://www.psychologie.uni-trier.de:8000/elmart

ADIS (Warendorf & Tan, 1997) was developed at the Nanyang Technological University in Singapore as a teaching aid for a beginning course in Data Structures. ADIS is integrated with a graphical user interface that can display data structures pictorially on the web browser, as well as allow the student to graphically manipulate the data structures created. Through interacting with ADIS, students learn basic algorithms (insertion, deletion, etc.) of data structures visually. ADIS can be configured either as a standalone application, or, as discussed here, a client server/application with the parent canvas residing on a central server, and students access the ADIS Intelligent Tutoring System as clients. ADIS can be accessed at the URL: http://www-jime.open.ac.uk/98/adis/adis.html

Opsis (Michail, 1999) is a Java applet designed to teach binary search tree algorithms. By visually manipulating abstract tree fragments and/or single nodes, the learner is able to actually implement various binary tree algorithms such as binary tree search, binary tree insertion, binary tree deletion, and AVL balanced binary trees. Opsis adopts a state-based model for representing a program. By specifying the possible transitions from one state to another via manipulation of abstract objects in a visual manner, the user creates the algorithm. All states in Opsis are abstract states - which is an abstract visual diagram that represents a set of possible concrete states. In Opsis, abstract states are identical only if their respective visual diagrams match identically in appearance. The Opsis Homepage is located at the following URL: http://www.cs.washington.edu/homes/amir/Opsis.html/

The IBM Java Software Group offers a family of free online courses covering different aspects of the Java programming language and development environment. The courses make extensive use of IBM's Bamba, Macromedia Shockwave, and IBM's Hot Audio multimedia products to stream audio and video content as complements to its text lessons. Each course is presented in a slideshow format with an accompanied audio soundtrack. The courses begin with an audio/video clip introduction by the instructor, who outlines to the user the purpose and goal of the course, and the knowledge the user should expect to acquire after taking the course. The courseware are accessible from the URL: http://www.software.ibm.com/developer/education/java/online-courses.html

The SQL Tutorial is a web-based tutoring environment for the Structured Query Language, and incorporates with lessons the use of its online SQL interpreter and database where tables can be created and modified the user. This tutorial is meant to be an introductory course in SQL. It covers the concepts of the Select Statement, Table Creation, Row Updates and Deletion, and Table Deletion, in that particular order. The tutorial is arranged in a linear fashion, with the user being presented with the concept of the Select statement, and moving forward. Concepts are presented in the following format on each HTML concept page. The system can be accessed at the URL: http://torresoft.netmegs.com/

The Webmonkey HTML Teaching Tool teaches the user the basic concepts of using the HTML language to develop a webpage. It covers the basic html tags in a series of non-sequential lessons. The user is presented with a page listing all the available concepts available to be learned. Each concept corresponds to a lesson on one of the basic html tags taught by Webmonkey and can be accessed by clicking on its hypertext link. The Webmonkey HTML Teaching Tool can be accessed at the URL: http://www.hotwired.com/webmonkey/teachingtool/index.html

SOLVEIT (Deek, 1998) is an integrated environment designed for users to learn problem solving and program development while operating within a software engineering framework. Developed at the New Jersey Institute of Technology, SOLEVIT (an acronym for *Specification Oriented Language in Visual Environment for Instruction Translation*) is based on Deek's *Dual Common Model for Problem Solving and Program Development.* This dual common model represents the integration of a cognitive model for problem solving with the tasks involved in program development, and is the foundation of SOLVEIT. Consistent with the model, the SOLVEIT environment involves six stages: problem formulation, solution planning, solution design, solution translation, solution testing, and solution delivery. The SOLVEIT environment is available from the URL: http://www.cis.njit.edu/~fadi/research/solveit/solveit.htm

The Java Tutorial (Camione & Walrath, 1996) is an online guide to writing programs in the Java language. The tutorial is organized into a series of 'trails' - programming lessons grouped together based on topic. Trails can intersect where they share the same lesson. The Java Tutorial assumes the user already has some programming experience, and does not cover the syntax of the Java programming language; rather, it's trail lessons cover topics such as techniques and concepts useful for developing standalone Java programs or applets, tools required for creating graphical user interfaces, information about the Java development environment, and differences between Java and C/C++. The Java Tutorial can be accessed at the URL: http://sunsite.utk.edu/java/docs/tutorial/

The ACT-R Tutorial (ACT Group, 1998), developed at the Carnegie Mellon University, is an interactive web-based tutorial to teach the user about the ACT-R environment. The ACT group (1998) is concerned with the theory and architecture of cognition. The goal of this research is to understand how people acquire and organize knowledge and produce intelligent behavior. ACT-R is a theory that attempts to explain human cognition by developing a model of the knowledge structures that underlie that cognition. This model takes the form of a computer simulation that is capable of performing and learning from the same tasks worked on by human subjects in laboratories. Users programming in the ACT-R programming environment use declarative and procedural knowledge structures and production rules as building blocks towards the development of complex ACT-R models. The ACT-R Tutorial can be accessed at the URL: http://128.2.248.58/inter/Welcome.html.

The LOGO Tutor and Programming Environment (Golze, Chau, Hirsche, 1997/1998) is a tutorial on the LOGO graphics programming language and an introduction to computer programming. Through the use of simple commands, the user can manipulate a little turtle on the graphics screen in order to draw and paint shapes, and event provide animation. The LOGO tutorial is presented as ten lessons that cover all the important aspects of programming in the LOGO language. The lessons are based upon the previous ones, and the user is encouraged to tackle them in that order. The LOGO Tutorial website can be accessed at the URL: http://library.advanced.org/18446/eindex.shtml

Simulations

Simulations cover the family of instructional systems that approximate, replicate, or emulate the features of some task, setting, or context. The majority of CAI simulations relating to the teaching of programming concepts or programming languages employ software visualization techniques such as graphics and animation to describe a program or its underlying algorithm. The level of user interactivity during the simulation varies from system to system. Next, we discuss the simulation systems we reviewed, along with a brief description and web URL where the systems can be accessed.

The Interactive Data Structures Visualizations System (Arc & Feldman, 1997) was developed at the George Washington University School of Engineering and Applied Science and designed for use by CS2 students to further their understanding of data structures. The system covers CS2 level data structures and algorithms for graphs, trees, and sorting. The system is organized into three main sections: Graphs, Trees, and Sorting, with each section broken into subtopics. Navigation through the system is unguided and open. The user clicks on the sidebar for the hyperlinked subtopic interested in learning. The Interactive Data Structures Visualizations can be accessed at the URL: http://tangle.seas.gwu.edu/~jarc/idsv/

Jeliot (AAPS, University of Helsinki, 1997) is an interactive algorithm animation environment for animating user algorithms. It was produced by the AAPS (Animation Aided Problem Solving) research group and was developed jointly by AAPS members along with CS students in the Department of Computer Science at the University of Helsinki. The name Jeliot is shorthand for Java-Eliot, where Eliot is the non-web-based predecessor of Jeliot. Using Jeliot, the user can produce animations for algorithms written in EJava, a programming language nearly identical to the Java(tm) language, but with new animation data types along with some restrictions. The Jeliot Interactive Algorithm Animation Environment can be accessed at the URL: http://www.cs.helsinki.fi/research/aaps/Jeliot/

The Java Sorting Algorithm Page (Mitra & SUNY Brockport, 1997) was developed at the Computer Science Department of SUNY Brockport, and consists of a collection of applets for illustrating the operation of various commonly studied sorting algorithms. The Java Sorting Algorithm Page can be accessed at the URL: http://www.cs.brockport.edu/cs/javasort.html

JAWAA (Pierson & Rodger, 1996; 1998) is a command language for creating animations of data structures and algorithms and displaying them with a Java-enabled web browser. JAWAA was developed Duke University and implemented in Java. The JAWAA applet provides an interface for reading animation scripts developed by users to display their animations over the web. The JAWAA home page includes a collection of algorithm and data structure animations such as those illustrating depth first search, LR(1) parsing, and circular graphs. The JAWAA home page can be accessed at the URL: http://www.cs.duke.edu/~wcp/JAWAA.html

The Java Algorithm Library (JAL) Animator (Silicon Graphics Inc., 1996) consists of a suite of algorithm animations that operate on elements in an array. The algorithm animations are broken into four classes: Inspection, Modification, Sorting, and Numeric algorithms, each which apply some action to a range of elements in the array. The JAL Animator interface is a Java applet which offers the user some control for setting up the animation. The JAL Animator can be accessed at the URL: http://reality.sgi.com/austern/java/demo/demo.html

The Generalized Algorithm Illustration through Graphical Software (GAIGS) Home Page (Naps, et. al., 1999) is maintained by the Computer Science Department at Lawrence University, and contains a collection of viewable algorithm animations. The GAIGS Home Page is currently still under development with new algorithm visualizations to be added. It can be accessed at the following URL: http://gaigs.cmsc.lawrence.edu/cmsc34/AVClient.html

JSamba (Duskis, Dey, Lambada Project, Hartley, Wagner, 1999) is a Java version of the Samba algorithm animation system developed by the Graphics, Visualization and Usability (GVU, 1998) Center at Georgia Tech. JSamba runs as an applet on the web and is, in essence, an interactive animation interpreter that reads ASCII commands entered in by the user and performs the corresponding animation actions. JSamba can be accessed at the URL: http://www.cc.gatech.edu/gvu/softviz/algoanim/jsamba/.

Analysis

All the drill and practice systems examined exhibited strong competency in informing users about the goals and learning objectives of their respective systems, as well as providing methods to elicit user performance. The capabilities relating to the presentation of instructional material were also strong, which is worthy noting, as most traditional drill and practice systems focus on the reinforcement of existing knowledge, and not instruction of new knowledge. Feedback capabilities amongst all the systems in the drill and practice category were notably weak, which can be attributed to the fact that most of the exercises used to elicit user performance take the form of multiple-choice questions. Questions in such a format, in practice, offer the system little opportunity to truly providing evaluative feedback on the user's entry. It is interesting to note also that the drill and practice systems provided the least focus, of all the three system categories, toward incorporating the use of devices to gain user attention.

The majority of the tutorial systems employed successful techniques to gain user attention. Their success in informing the user of the system's goals and learning objectives was varied, however, with some systems faring better than others. Almost all exhibited strong capability in presenting the instructional content to the user, as should be expected in tutorial systems. However, the majority of the tutorial systems performed poorly in their ability to stimulate the user's recall of prior knowledge, although a significant amount did provide good learning guidance to users for new instructional material.

The simulation systems, like the tutorial systems, also successfully incorporated techniques to motivate users and engage their attention. The majority of the simulator systems offered adequate support in informing the users of the system's rules and objectives, as well as presenting users with the stimulus instructional material. However, only approximately half of the simulator systems provided any form of learning guidance to supplement its instruction content.

It is interesting to note that all the reviewed systems from all three categories shared a lack of any definitive support in the area of assessing user performance. In order to provide for some worthwhile assessment, systems need to include facilities to record the users' activities throughout the training session, take note of where much of the users' time is spent, record their performance on lesson exams and tasks, and ultimately examining all this data and being able to construct an informative user model or profile. All the reviewed systems were deficient in this regard, with some systems only providing partial support for the stated facilities.

In general, almost all the systems were successful at informing the users about the their goals and objectives, and presenting them with stimulus instructional material. Facilities to stimulate recall of prior knowledge prior to reception of new instruction was poor in all systems, with drill and practice systems providing a surprisingly stronger showing of support than the other two types of systems.

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Use of Video Mediated Instruction in Teaching American Heart Association Emergency Cardiac Care Training Courses

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Abstract: This paper provides a historical look at American Heart Association training regiments and their movement towards video mediated instruction in 2001. A discussion of problems associated with previous training methods are identified. Following this is rational for movement to a standardized training program facilitated through video training with instructors as facilitators rather than lecturers.

History

In the past 35 years, since the introduction of modern techniques in cardiopulmonary resuscitation (CPR), there have been dramatic advances in emergency cardiac care (ECC) of victims in profound circulatory collapse and/or cardiac arrest (American Heart Association, 1992). The 1966 National Academy of Sciences- National Research Council (NAS-NRC) conference on CPR made recommendations for the training of medical, allied health, and other professionals in the use of external chest compression technique according to standards set forth by the American Heart Association (AHA) (National Academy of Sciences, 1966). During the mid 1960 and throughout the early 1970's strides were made to implement these recommendations via training materials and programs designed by the American Heart Association. In the 1973, the second national conference on CPR and ECC was held. Among the recommendations of this conference was the: (1) extension of CPR programs to the general public; (2) training in CPR and ECC in accordance with the AHA standards; (3) certification of competence at various levels of life support based upon a nationally standardized curricula that included written and performance tests (American Heart Association, 1992). Since 1973, five other national conferences have been held updating guidelines and recommendations for emergency cardiac care (1979, 1983, 1985, 1992, 2000). In each of these conferences, there was further support for educational efforts in training health care professionals and the lay pubic about cardiac symptoms and treatment.

Role of AHA in Education

The American Heart Association (AHA) has been involved in educating the public and health care professionals in emergency cardiac care for over 30 years. The development of training programs has involved the effort of national and international organizations in reviewing scientific data, developing guidelines, and translating guidelines into training programs for the lay public and health care professionals. In these efforts, it has been the role of the AHA to provide strictly educational programs and not to be a certifying body attesting to competency of health care professionals (American Heart Association, 1992).

Educational Training Programs

In training individuals about ECC, programs must be designed to motivated adults to learn CPR and to use these skills in situations as warranted by their training (American Heart Association, 1992). It has also been noted that retraining is an important issue for retention (Kaye, 1991; Mandel, 1982). Within 1 year of completing advanced ECC courses, health care provides have difficulty in recalling knowledge and performance skills (Kaye, 1989; Lownestein, 1981; Stross, 1983). The reason skill deterioration has been difficult to determine is because it is unclear as to whether the problems stem from problems with the training course or whether it is a retention issue (Kaye, 1989; Lownestein, 1981). Some of the factors identified with educational failure include, insufficient practice time and complexity/large amount of information covered (American Heart Association, 2000).

The traditional format of training has relied on lecture, skills demonstration, skills practice, and evaluation using skills checklists. In courses prior to 2000, with the exception of one particular training program (Heartsaver AED), the instructor was free to organize the course, timing, teaching method, and evaluation in a way that s/he preferred. This format was in essence "instructor-led." There were no criteria on how much time should be spend on specific topics and was highly individualized. Various studies evaluated these programs on instructor performance (Kaye, et al., 1991), post-course skill performance (Brennan & Braslow, 1995), and retention (Liberman, et al., 1999; Kaye & Mancini, 1986; Wilson, Brooks, & Tweed, 1983; Mancini & Kaye, 1985; Mandel & Cobb, 1982). In most of the studies, post-course skills performance and knowledge retention were low.

Kaye, et al. (1991) showed that instructors tend to spend too much time lecturing and allow for little time in skills practice. They identified a poor feedback mechanism portrayed by the instructors, with little assistance in providing correction of skills performance. Reliable between instructors in evaluation of skills are also low (Mancini & Kaye, 1985; Brennan, Braslow, Batcheller, & Kaye, 1996).

Numerous instructional methods have been introduced to try to improve student performance, including:

(1) Over-training (Tweed, Wilson, & Isfeld, 1980),
(2) Simplification of content,
(3) Videotaped instruction for initial training and reinforcement (Mandel & Cobb, 1987; Eisenberg, et al., 1995; Schluger, et al., 1987)
(4) Videotaped self-instruction with manikins (Braslow, et al., 1997; Todd, et al., 1998; Todd, et al., 1999)
(5) Use of "practice-after-watching" videotapes with instructor support (Aufderheide, Stapleton, Hazinski, & Cummings, 1998), and
(6) Use of audio prompts (Starr, 1998; Doherty, Damon, Hein, & Cummins, 1998; Strarr, 1997)

Retention

Resuscitation skills deteriorate at variable rates (Weaver, 1979). Various methods of training have been attempted to minimize this loss of knowledge. The American Heart Association (1992) believes to improve retention, (1) multiple step procedures must be simplified for easy recall, and (2) key factors that determine successful performance must be highlighted throughout the training course. In dealing with issues of training and retention, flexible models of education have been encouraged. One example is the American Heart Association's advocating the use of public service announcements and videotaped training.

To increase retention, attempts have been made to simplify the content. Braslow, et al. (1997) study showed that a student focusing on a single task (1- rescuer adult CPR) after watching a 34- minute video retained more information and skills that did a student who learned multiple topics in a 4-hour training course. Additional studies with audio prompts (Doherty, Damon, Hein, & Cummins, 1998; Strarr, 1997) have also been useful in simplifying CPR training. Similar techniques to simplify content have been used successfully in Advanced Cardiac Life Support (ACLS) training (Kaye, Dubin, & Rallis, 1988).

Video Training

In efforts to maintaining a truly national training program, the AHA, in its 2000 conference update, has moved to using video-mediated instruction in all their training programs. The used of video instruction is not new, as the use of this method of instruction has been implemented in training the lay public in CPR since 1995. The training of health care provides has been primarily lecture based, moving to a more interaction case-based system in the mid-1990's. The variations in instructional skills of trainers across the nation, and the concerns about provider skill retention have prompted the AHA to develop small video segments to be played by the instructor throughout the training course. This would ensure that all providers learn the skills and techniques in a similar manner, as well as ensure that the important factors associated with techniques are outlined. In addition, the use of video-mediated instruction provides visualizations that are difficult to depict in a classroom environment. Recent research (Kaye,

1995) has shown that video-based instruction is effective for teaching the lay public CPR and has better retention rates than standard instructor-led training programs.

However, the use of video without an instructor has not been found to be as beneficial as programs with instructor involvement. Video self-instruction is an effective method, as are other techniques, to teach initial cognitive and psychomotor skills, however most these people tend not to retain their skills for long (American Heart Association, 2000). The only exception is Darcup, Doering, Moser, and Evangelista (1998) study, were they found respectable retention rates in highly motivated individuals who review and practiced their skills. However, for those who do not practice or review, low retention rates are inevitable. Studies have also found retention rates lower in the less educated, elderly, and male population when using self-instruction. Moser, Dracup, Guzy, Taylor, and Breu (1990) found that instructor-led sessions were more effective.

Result of these studies yielded varying formats of video-based instruction including: (1) passive watching, (2) learn/practice while watching, and (3) learn/practice after watching.

Passive Watching

The passive watching technique is useful for conveying information but does not involve any psychomotor training. This method may be motivational and students report "feeling more comfortable" after the video viewing (American Heart Association, 2000). This method has resulted in poor initial and long-term outcomes (Schluger, Hayes, Turino, Fishman, & Fox, 1987).

Learn/Practice while Watching Technique

The learn/practice while watching technique is a self-lead video sessions including a manikin for psychomotor performance. This method has been heavily studied with positive outcomes, but lacks and instructor to provide feedback or answer student questions.

Learn/Practice after Watching Technique

The learn/practice after watching technique is where the student watches a video segment, the instructor demonstrates critical actions, and student performs skills as demonstrated on the video. This method requires a trained/certified instructor to provide feedback and ensures students correctly perform the skills before moving forward. The video sessions provide for standardized training, thereby ensuring consistent training throughout the country. These videos are tightly scripted thereby limiting instructor variation, which has been a problem in ensuring that the same message is sent to all students throughout the United States. The goals of the videotapes are to improve consistency of information while maximizing skills practice time (American Heart Association, 2000).

Conclusion

According to the American Heart Association, video-based instruction offers many benefits including: (1) consistency of content, (2) less time needed for instruction demonstration, (3) more time for skills practice, and (4) a shift from a teacher-centered to a student-centered learning environment. The videos are beneficial in showing various angles when demonstrating skills and provide a focus on the most important aspects of the training. Video mediated instruction has a potential to motivate students by presenting real-life case scenarios or reenactments. As well, video serves as a visually stimulating educational tool.

The new courseware for these training programs were to be released during December 2000, however was delayed in production. Do to this delay; an impact study was not completed at time of this writing. Long-term data analysis evaluating students' perceptions of this training medium as well as retention studies will be started this summer.

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TOETS : development of a computer assisted assessment system

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In this session we will present the results of a project to develop a comprehensive and flexible computer assisted assessment system. This system, called TOETS, delivers an item bank, an item editor, an test editor, a management tool and of course a student assessment tool. All these tools are internet based and are using the TCP-IP protocol to connect to a database on a TOETS-server. The re-use of items and complete assessments within new items or assessments and cooperation between instructors on items and assessments are very important characteristics of this software. Central issues during the development were also the ease of use, an intuitive graphical interface and flexibility. All kinds of multimedia (sound, pictures, video, animations) can be integrated in the items and in the feedback.

TOETS : development of a computer assisted assessment system

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Abstract: TOETS is a comprehensive and flexible computer assisted assessment system that delivers an item bank, an item editor, an test editor, a management tool and of course a student assessment tool. All these tools are internet based and are using the TCP-IP protocol to connect to a database on a TOETS-server. The re-use of items and complete assessments within new items or assessments and cooperation between instructors on items and assessments are very important characteristics of this software. Central issues during the development were also the ease of use, an intuitive graphical interface and flexibility. All kinds of multimedia (sound, pictures, video, animations) can be integrated in the items and in the feedback.

Development and implementation?

TOETS had its origin in an institution-wide questionnaire on the needs of the innovation of our education. Within the whole group of teachers and instructors assessment was found to be the hottest item. Instructors of both our institutions were asking for training, support and tools to improve quality of assessment. That was in 1998.

Today, three years later, three projects have already been worked on. The original goals and project options have been profoundly changed. The first project aimed at making 'assessment'-templates within existing programs like MS Word and Authorware. Now TOETS is an independent program written in C++ with an extensive and internet-based open source database. Ready for implementation...

Recently the University of Louvain decided to implement a campus-wide computer assisted assessment system. An advisory committee decided to attain a product of a private company. This decision to 'outsource' CAA had noting to do with the quality of our or other products. The development and support of a CAA-system within the university itself was too risky...

A comprehensive and flexible CAA-system

TOETS is a comprehensive and flexible computer assisted assessment system.
TOETS is Internet based. However it does not make use of a browser like Internet Explorer or Netscape. TOETS has its own interface allow users (students, instructors and system administrators) to interact with the TOETS database

on a server on the Internet. TOETS uses the TCP-IP protocol that is the Internet protocol. The choice for building a TOETS interface that did not work in a browser was made for reasons of flexibility (a broader variation of interactions is possible) and security.

TOETS contains a big and highly structured open source database.

TOETS has a modular architecture. Within each of the three modules all functions and features of importance for a specific user group are integrated. The three modules of TOETS are: instructor, student and management..

The management module

TOETS is installed on a server on the Internet. It can be used by one institution by a co-operation of several institutions. In both cases TOETS needs a system administrator. His function is to manage users, groups, organisational units, educational units, and courses.

The instructors module

If one wants to make tests available to students on the Internet, the first thing one needs are items, a lot of good items. An item has many multimedia components and properties: question, answer, distracters, scores, pictures, sounds, video, comments and feedback, hints, links to external resources, etc. At this moment only multiple choice is available. Instructors can insert one or more multimedia components (picture, sound, video) on all levels: on the question level, on the answer and distracter level, on the general or answer specific feedback level. It also possible to add meta-information on items... (difficulty, course, description, author, date of last modification,...).

A group of items form a test. Instructors can add and modify tests. They are able to change lay-out, preferences and options of tests (the colour, background, feedback on/off, timeline on/off, free or fixed navigation through the test, etcetera). Each test consists out of one or more blocks of items, their preferences and options (see above). TOETS has the possibility to build user defined or system defined item blocks (a selection of items in a certain order). In a user defined item block the instructor selects the items and chooses the order of the items in the block, using the search and browse tool. In a system defined item block the instructor selects a combination of criteria and rules. The system (TOETS) then picks out, at random, items based on the rules and criteria. It is possible to do this only once in advance at the instance of the instructor (resulting in an identical test for all users). But it is also possible that the selection of items from the item bank is made (based on the instructor-defined criteria) at the very moment that a particular student wants to do his or her test (resulting in a different test for all students).

Very powerful tools of TOETS are the block rules and block navigations. At the end of each block instructors can set rules and connect them with navigations. TOETS holds a score for the test as a whole but also for each block or group of blocks that were defined in an test. In one or more rules (e.g. "if the score on block 1 is less than 50 %") instructors can directly navigate students to another block or to the end of the test (navigation). This system of blocks (and groups of blocks) gives the instructors a very flexible way to build student centred tests.

When a test is ready instructors can decide for which students (or group of students (see management-module)) a test was published. It is also possible to specify a period in which the test is available. We call this a session.

Tools to analyse and report results are under construction. We are working on tools to analyse items (difficulty, mean score, number of times the test was run,...), to analyse tests and sessions (difficulty, scores, mean score, highest score, lowest score, standard deviation,...), to report the results of individual students (and groups of students) on an test or a session (difficulty, scores, mean, highest score, lowest score, standard deviation,...), to calculate item-test correlation (discrimination), A-values (attractiveness of distracters),etc...

The student module

The function of the student module is quite straightforward. To let students choose a test that was made available for them (see management module) for this period (a session). To let students do a test. To give students feedback. To create the possibility to interact with (send email to) the instructor if there are problems while doing a test.

Teaching OOT Using a Framework and Both Direct and Net-based Tutoring

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Abstract: We report on experience from teaching OO project courses to undergraduate students. Before they can successfully tackle projects they have to climb a rather steep qualification ladder: pick up a working knowledge of some OO language, learn and practice OOA and OOD, and get used to advanced ideas like patterns and frameworks. In order to relieve this heavy burden somewhat, we provide an object-oriented application framework as a common base for the projects. That way, the students are given an architecture, which they have to adapt to their specific task instead of doing all the design on their own. We also believe that this policy closely resembles the way beginners are integrated into on-going projects in practice. We briefly describe the Java framework we use and then concentrate on the organizational issues involved.

Introduction

Education in object-oriented (OO) technologies has become a core part of any modern education in software engineering. A well-known problem with education in this field is the relatively long period of time that is required to get accustomed to "OO thinking":

- First, learn to solve problems by building small communities of interacting objects. People with a strong background in classical structured-procedural programming may first have to unlearn their previous algorithm-centered approach.
- Second, adopt the habit of reusing existing classes instead of inventing new ones. This requires you to know where to look for reusable components.
- Third, start to think flexibly about the organization of the software development process. Beginners have to be taught the importance of a formal software life cycle and of a proper requirements analysis (see e.g. Wilkinson 1995, Wirfs-Brock, Wilkerson & Wiener 1990 and Rumbaugh, Booch & Jacobson 1997).
- The most advanced concepts we teach to our novices are patterns and frameworks (see Gamma, Helm, Johnson & Vlissides 1994, Froehlich, Hoover, Liu & Sorenson 1998). *Patterns* describe concepts of proven solutions for recurring problems: when, where and how to apply them. *Frameworks* are application skeletons that can be turned into complete applications by providing parameters and/or subclasses of the framework's generic classes.

Here, we describe our current approach, which we have found very useful and which might be applied similarly by other organizations as well. This approach was developed jointly between Dresden University of Technology and the University of the Federal Armed Forces in Munich, and is applied at both universities. The central idea of our approach is to first provide a rapid and dense education covering all topics mentioned above in an introductory course, which immediately precedes the project course. The project course where student teams are assigned individual tasks requires extensive practical work based on a given object-oriented application framework. This provides valuable experience for programming assignments and advanced courses in the postgraduate phase of their studies.

A strong motivation for putting so much emphasis on using a framework stems from the following observation: In academic as well as industrial settings beginners will often join projects that are already well in progress. Finding out enough about the project's structure to be able to do your job is similar to learning how to apply a framework. Experience with this activity is likely to be reusable to some extent also in a non-object-oriented context. A practical course based on one common framework even offers some more advantages:

- For the organizers it is easy to define a number of similar projects and to scale the projects' complexity from moderate to reasonably hard. Since they are based on the same framework, all the different tasks are still comparable.
- For the students it is simpler to extend the application architecture predefined by the framework than to design it for each application from scratch. Also, the framework provides many domain-specific components that can be used "off the shelf".
- Beginners get a chance to learn good design by example: Frameworks by definition are designed for change. Therefore, they typically exhibit patterns that increase flexibility.

The rest of this paper is organized as follows. First we briefly describe the domain, components, adaptation interface and documentation of our `SalesPoint` framework. The next section outlines the project organization: our aims, the persons involved, the timetable and, most important, our tutoring concept. The final section gives some statistics and recent experience.

The Framework

Our `SalesPoint` framework supports the development of point of sale simulations ranging from simple vending machines to big department stores. Typical applications include an exchange office where you can obtain foreign currency as well as a post office offering stamps and a well-defined set of services. The simulations comprise both business with customers (selling, buying, or renting goods) and administrative tasks (like accounting, refilling the stores, removing slow-moving articles, and putting new kinds of items on sale). All applications from the `SalesPoint` domain share the following characteristics: There is one single *shop* where *customers* are served at a number of *counters* (or *SalesPoints*, in our terminology). At each counter there is a queue of customers. Every counter offers articles from some fixed *catalog*. For each article, the catalog has an entry giving its name, price, and other relevant properties. A *stock* is a bag of articles from the catalog. Examples of stocks are: the goods on an order form, the articles contained in a vending machine, in the shelves of a store, or in a customer's shopping basket. *Money* fits into this terminology as a special case: Here the catalog is called a *currency*. It describes the set of valid bank notes and coins and their values. The contents of a personal purse or those of a cash register are called *money bags*. `SalesPoint` customers have *data baskets*, which may contain a number of goods chosen by the customer. Thus data baskets closely resemble the shopping baskets carried around by real customers in real shops. The contents of a data basket represent the state of a customer's current shopping *transaction*. Like other transactions, data baskets can be *committed* (e.g. when the goods are paid for and taken out of the shop) or *rolled back* (i.e. the goods are restored to the shelves they came from).

All `SalesPoint` applications have similar organizational and GUI requirements. Accordingly, the `SalesPoint` framework supports the development of point of sale simulations by providing (among other things) similar GUIs built from the same components including generic form and menu classes for user interaction. A shop is represented by a main window, which contains a set of subwindows, one for each customer at the currently visible counter. Tabular form components are available for presenting catalogs and stocks. The common organizational part comprises *base classes* for catalogs, stocks, currencies, and money bags, *persistency management* (on request the state of the simulation can be stored in a file to be restored again later), *user management* (allowing users with possibly different capabilities to be created), *time management* (for controlling the simulation time), *transaction support* including rollback, and a *logging mechanism*.

On a more technical level, framework users expect their framework's software to be *robust* and *flexible*. Among the robustness features of the `SalesPoint` Java implementation that require no activity on the part of the application developers (and thus might even go unnoticed by them) are: `SalesPoint` data structures are *thread safe*, i.e.

they can be accessed concurrently from different threads. `SalesPoint` guarantees the *referential integrity* of catalogs and stocks, i.e. you cannot add an item to a stock if there is no matching catalog item in the corresponding catalog. And you cannot simply remove a catalog item without first removing all corresponding items from all stocks based on this catalog. These properties are implemented using suitable Java *Event* and *Listener* objects. In order to make the `SalesPoint` framework flexible suitable design patterns were applied, e.g. the *Factory Method* pattern for creating stocks and the *Bridge* pattern for choosing between different time management implementations.

Like other frameworks, `SalesPoint` is adapted to its users' needs in several ways: first, by supplying specialized subclasses; e.g. menu sheets are easily adapted using Java's *inner classes*; second, by providing *hook methods*; e.g. the presentation of tables is adapted with hook methods: redefining the method *compare (x,y)* that compares table rows one can impose any sorting order one wishes; third, by providing *parameters*; e.g. when creating a new stock object one of the constructor's parameters describes which catalog to use, another chooses one of the algorithms for building stocks with a given value.

The `SalesPoint` on-line documentation consists of *three complementary descriptions*: a top-down *introduction* to the purpose, architecture and components of the framework, a *javadoc*-generated detailed documentation of all the framework's classes and methods including all the predefined adaptation interfaces, and a *tutorial* describing in a line-by-line fashion how the framework can be used for building a typical application: the simulation of a Fast Food Restaurant.

For more details on the introductory course and the framework see (Demuth, Hussmann, Schmitz, Zschaler 1998) and (Demuth, Hussmann, Schmitz, Zschaler 2000a). On the (English) `SalesPoint` homepage (Demuth, Hussmann, Schmitz, Zschaler 2000b) all the material for using the framework (code and on-line documentation) is accessible.

Organization

The project course organization, which we describe in the following, is very similar at both universities. A few differences come from varying conditions: the large number of students that participate in the project course every year in Dresden; two semesters (Dresden) versus three terms (Munich) per year; and students living on campus in Munich.

Aims

For the majority of students, the project course is the first hands-on experience in software engineering. Prior to that, they were taught (among other things) structured programming and verification techniques, sorting algorithms and data structures including hash tables and AVL trees. Programming tasks were defined precisely, small to moderate in size and typically could be solved by one person in a few days. In order to succeed with their projects students now have to develop a number of new ("soft" and auxiliary) skills:

- They have to learn to work in teams: assume different roles (team leader, developer, etc), communicate in a professional way within the team and with customers, and work systematically for a period of three months following some given method and a plan made by themselves.
- They have to find out what their task is: In contrast to the programming tasks they were given before the project definition is rather sketchy. It is the students' job to find out what to do and to negotiate with their "customers".
- They have to present their work: Both oral and WWW presentations are required. The presentations are aimed at either customers or consultants and thus differ very much in the level of abstraction and amount of technical detail.
- They have to acquire a working knowledge of the tools they need: In addition to some Java IDE they need a CASE tool and some HTML and FTP background as required to set up their own small WWW site.

During the project course a written process outline, guidance by the tutors and feedback from the presentations are available. With this background, the students are expected to develop the soft skills mainly by themselves.

Persons Involved

The students are asked to form teams of five or six persons each and to adopt a *chief programmer team* organization, i.e. to assign chief, assistant, secretary and developers' roles to the team members. The resulting teams are coached by senior students who in turn are supervised by the project course leader. The senior students work as tutors: They are both consultants for the younger students and clients for the software project. Technical questions and requests for framework correction or extension are handled by senior students who have participated in the framework development.

The situation resembles that of a start-up software company specialized in some domain (as represented by the framework). The company's technical staff consists of a technical director, four or five experienced developers (one of whom is responsible for the framework) and a bunch of 50 to 150 beginners who are to be "trained on the job". To avoid disaster, some strict discipline and a lot of communication is required:

- Teams have to adhere to a predefined timetable (see below). Otherwise, management cannot guarantee that projects will be completed in time.
- Development has to be founded on the framework. Beginners tend to do everything from scratch and "reinvent the wheel" many times. Only by using the framework they will contribute to the company's know-how and produce solutions that can be maintained easily.
- Guidance by management (i.e. the tutors) is impossible unless progress is documented extensively all the time. The company's work process description therefore lists what kind of documents have to be produced in which phase.

Teams that will not stick to these rules are excluded from the project course.

Timetable

A rather rigid timetable is prescribed for project work. Once or twice during each phase, results (documents, programs) have to be presented to the tutors. Final delivery includes a formal oral presentation per team where the main results including the working program have to be shown and questions to be answered. The timetable is as follows (The number of weeks per phase is given for Dresden/Munich. A Dresden semester has approximately 13 weeks, a Munich term only 11 weeks.):

Getting Started	... 3/3 weeks
OO Analysis	... 2/2 weeks
OO Design and Prototyping	... 2/2 weeks
Implementation and Test	... 3/2 weeks
Maintenance	... 3/2 weeks

Table 1: Project timetables

Alternatively, incremental development with several development cycles is allowed. This approach is adopted by most teams. In the *Start* phase students establish their teamwork organization, obtain and install the development and documentation tool sets as well as the `SalesPoint` framework software and documentation. During this phase the students also have to study the framework and its tutorial. We experiment with different approaches to learning the framework. For example, each Munich student has to implement the same and rather simple `SalesPoint` application at the beginning of the project course. This takes time (3 weeks), but it helps the students to develop their main application much faster than when learning the framework in parallel with the software development. In the *Analysis* phase, students first identify the use cases of the system to be built. CRC card sessions are then used to elaborate corresponding scenarios in order to better understand the dynamic behavior and the classes of the target system with their responsibilities. OO modeling has to be documented in UML notation (Rumbaugh, Booch & Jacobson 1997) using static, use case, state and sequence diagrams. In the *Design* phase, suitable framework components are identified for implementing this model. The model is adapted accordingly and a first prototype can be built. The *Implementation and Test* phase is devoted to growing and testing the prototype. The *Maintenance* phase includes the removal of bugs and satisfying some minor clients' wishes. The latter serves as a test whether the design is clean enough to allow for easy modification.

Net-Based and Direct Tutoring

All information is distributed via *WWW*: the framework, its documentation, the tutorial, and the project specifications. Using *email* help can be obtained all the time from the tutors, the frameworks specialists, from system administrators, and from the course manager. Framework bugs and requests for new framework features can be entered into a *web-based list*. A public *electronic calendar* is kept for booking presentation dates and rooms. Some teams even install their own private *electronic chat-rooms* and *bulletin boards* for communication within teams. All these communication channels are used rather heavily indicating that without net technology this kind of course might not be possible - or at least take much more time for all persons involved.

The students are required to present their solutions on HTML pages. For this purpose, each team is given an account on one of the institute's web servers. *Student team web sites* are the most important prerequisite for net-based tutoring: therefore, the students are required to publish their results as early as possible and to update them on a daily basis. That way, the tutors and the course manager can asynchronously observe student progress all the time. This allows for instant (email) feedback and thus helps to avoid mistakes and too much time spent taking wrong turns. For beginners this kind of continuous guidance is very important.

However, net-based tutoring alone does not suffice: In difficult situations, inexperienced developers cannot be expected to even state their problems precisely. Some find it difficult to overcome the psychological barrier of asking an anonymous consultant for help. To get them started, tools and ways to work with the documentation have to be shown them directly. Although student web sites are really helpful, not all mistakes show up there. And sometimes it is easier to give feedback when meeting in person.

At the end of every phase (Dresden) or every week (Munich) students have to present their progress orally. In a short *presentation* of 15-30 minutes at most the teams demonstrate the latest version of their prototypes; each developer explains his or her contribution showing documentation and code fragments, and answering questions from the tutors or course managers, respectively. This is a way of ensuring that all team members actively take part in the development. Also, frequent presentations result in a more regular style of working. In the final presentation, we also collect student feedback for improving the course organization.

Evolving the Framework-Based Project Course

Since winter 1997/98 when we first taught the framework-based project course we have improved both the used framework and the project organization every year (Demuth, Hussmann, Schmitz & Zschaler 1998). A major step was taken in winter 1999 (Munich) and summer 2000 (Dresden), when we upgraded successfully to version 2.0 of the framework.

The overall results of the previous project courses are very encouraging. In Munich, there were no dropouts so far. This is probably due to the fact that in Munich almost the same number of tutors are employed as in Dresden while the student numbers are much smaller. Another advantage is that Munich students are paid by the armed forces and live on campus. The table below specifies the number of teams and the total number of students for each project course up to now.

	Dresden Winter 97/98	Munich Winter 98	Dresden Winter 98/99	Dresden Summer 99	Munich Winter 99	Dresden Summer 2000	Munich Winter 2000
Success rate	90 %	100 %	91 %	70 %	100 %	88 %	100 %
Teams	22	6	25	2	7	21	9
Students	116	32	120	7	42	115	54

Table 2: Project success rates

During the whole process we had a lot of feedback: from the tutors, some students' questions, many intermediate documents, final presentations with discussions and the detailed questionnaires we requested from the students. We learned that:

- studying the framework took more time than we had expected (about 25 % of the whole effort); in retrospect we feel this justified since it covers a good deal of what would otherwise have been part of the design phase; students rated the tutorial and the on-line support rather high;
- the time table was realistic, given the students' tendency to postpone work towards the end; on an average, the students spent about 10 to 12 hours per week on their projects; some additional time was needed to catch up on missing OO and Java knowledge from the introductory course;
- students generally liked the tasks they were given; some teams even tried to find out *real* clients' requirements by doing field studies; a growing number of students, however, would prefer to develop *real* applications instead of just simulations; students rated their own achievements rather high; for them, team work experience was novel and important;
- in the tutors' opinion, most students performed rather well, but there still seemed to be some who had hacked their way without a true appreciation of OO technology; on the positive side, the framework proved practicable and accommodated all kinds of students' approaches: everyone felt they had learnt a lot.

In the summer 2000 (Dresden) project course another 20 students were sent to a software company to do "real" projects there. Typically, more successful students applied for the external projects. The four teams were coached by a former university colleague. On an average, they spent as much time on their projects as the framework-based teams, but produced twice as much code. Also, they liked their projects very much.

So why not send all the students to industry instead of doing in-house projects? There are several problems: First of all it is difficult to find enough software companies where beginners are systematically trained as opposed to being misused as cheap code hackers. Today, short-term profit appears to rank higher than long-sighted investments in education. Because of the diversity of projects and companies it is difficult to offer equal opportunities to students; also, the organization and necessary quality control would probably bind at least as many university resources as the framework-based course.

On the other hand, our approach should carry over easily to frameworks in other domains and there provide the same advantages for beginners: *realistic professional activity* is simulated and *guidance in the form of a framework* is offered.

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PERIGRAMMA – A System for the Support of People with Cognitive or Movement Impairments Working in Secretarial Positions

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Abstract In spite of the growing interest in interaction design, there remains a large user population that needs special interest; users with special needs. These users can dramatically benefit from software that better responds to their interaction needs, not mentioning the fact that designing software that takes into account the special needs of such users makes software more easy to use for everybody. In this paper we present PERIGRAMMA, a system designed to offer an integrated environment for the support of people with movement or cognitive impairments who offer secretarial support in a modern office environment. The system is currently in tits final stage of implementation and offers an easily accessible environment of four applications: a word processor, an e-mail client, a calendar and a web publisher.

Introduction

Arguments typically leveling against designing for user with disabilities include the claims that costs are too high, and the benefits serve too small a market. (Glinert & York 1992). The traditional view of people "having a disability" or "not having a disability" is overly simplistic. All users have a range of capabilities that vary across many dimensions depending on the user and his or her life stage, task and environment. People may experience sudden temporary or permanent changes in capabilities at any time in their lives. If a computer user falls and breaks a wrist, he will spend several weeks or more with much the same keyboard capabilities as many people with spinal cord injuries or missing limbs. In fact, a significant number of user requirements for people with disabilities apply to almost any user, given the right circumstance or task context. (Newell & Cairns 1993).

The system addresses primarily people with movement impairments and people with light cognitive impairments offering secretarial support in the environment of a modern office. Word processor, E-Mail Client and Calendar ranked first as the applications used most often in a survey on fully capable people offering analogous services. In addition, we decided to implement the web publishing application in an effort to offer such people the opportunity to easily circulate their documents and diminish in this way the factor of social isolation they face in their everyday life.

By the term "movement impairment" we are referring to disabilities that affect the ability to move, manipulate objects and interact with the physical world (e.g. spinal cord injuries, degenerative nerve diseases, stroke, missing limbs and repetitive stress injuries). Cognitive impairments on the other hand range from dyslexia to difficulties remembering, solving problems, or perceiving sensory information to problems comprehending and using language.

Several applications have been developed for the disabled at a commercial or research level. Applications such as Writing with Symbols[1] address people with cognitive impairments. The teacher or parent builds an on-

[1] Writing with Symbols 2000. Available at http://www.mayerjohnson.com/software/Wws.html.

screen selection window(s) and places the vocabulary in it. The student then writes by clicking on items in the selection window(s). As items are chosen, each selection puts text, or text and pictures, into a writing area above. Multiple on-screen selection windows can be linked together to provide a large vocabulary of pictures. Set ups and writing files may then be saved for later use.

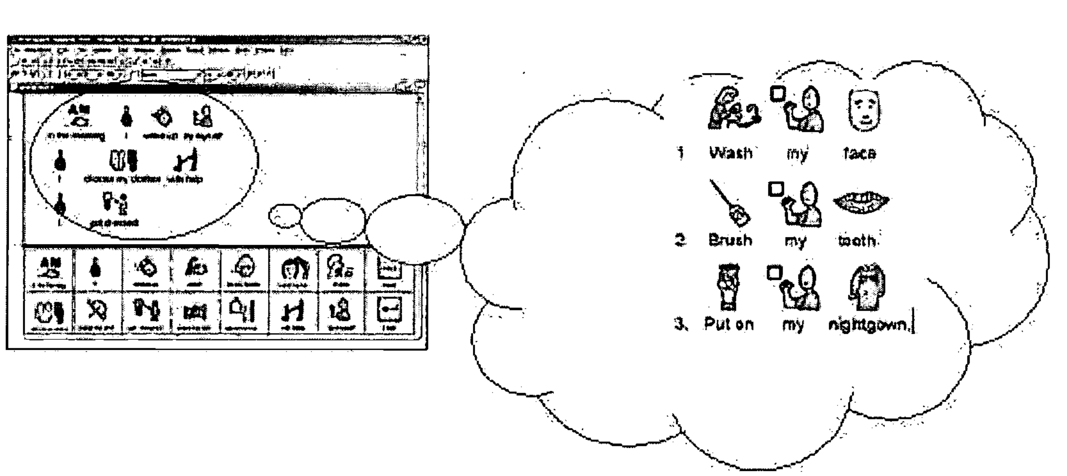

Figure 1. Writing with Symbols

Special Learning Food for Thought[1] introduces the vocabulary of Food and engages learners in activities that challenge and stimulate them at their own level of thinking. It helps them learn and develop skills in language, counting, choice making, matching, identification, vocabulary and visual and auditory discrimination (Figure 2).

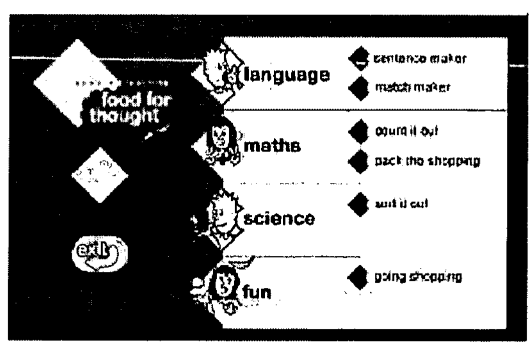

Figure 2. Learning Food for Thought

GRAFIS (Stephanidis 1999) supports the typical word processing functionality, through a simple interface, accessible through conventional as well as alternative input-output devices. The basic characteristics of the interface are: (a) a clear separation between the 'text-input' and 'function' areas, and (b) elimination of overlapping objects on the screen through the grouping of functions in alternative functional areas. In addition to text input (in Greek and English), manipulation and formatting, GRAFIS features a simplified interface for

[1] Special Learning Food for Thought. Available at http://www.edbydesign.com/ebdsw/fft.html.

storing, retrieving and otherwise managing document files. The user is supported by an extensive on-line help system, which describes the interface and guides the user in the completion of common word processing tasks. GRAFIS also supports saving and loading documents in Rich-Text Format (RTF), thus allowing users to share and exchange documents with their able-bodied counterparts employing mainstream word processors. Several other software applications are available for disabled, focusing on case-specific specialities (Sirmakessis 2000).

Design Considerations

In our effort to address as big a percentage of population as possible, we distinguish two main levels of difficulty (novice and expert) in a total of three distinct user profiles, summing up to 6 instances of the system. Each instance is differentiated by the kind and the degree of special needs to be covered and the assistive technologies to be integrated. More specifically, we designed two versions of the system for people with movement impairments and one additional version for people with light cognitive disabilities (see Table 1). Each one of these versions required a different approach as we had to deal with different interaction scenarios (input devices) and screen layout.

Movement Impairments		**Cognitive Impairments**
Profile 1	**Profile 2**	**Profile 3**
✓ Interaction through switches ✓ On-screen keyboard ✓ Scanning ✓ Buttons with graphics and tool-tips, no captions	✓ Mouse interaction ✓ On-screen keyboard ✓ Buttons with graphics and tool-tips, no captions	✓ Mouse interaction ✓ Buttons with graphics and captions

Table 1. Supported profiles based on the user needs (two levels of movement impairments and one level of light cognitive impairment)

People with heavy movement impairments that cannot have control neither over the mouse nor the keyboard, but can use some kind of switch have access to the system via a combined use of an on-screen keyboard and the scanning technique. The system supports three different layouts of the keyboard (QWERTY, horizontal grouping and vertical grouping layout).

The scanning technique is based on two actions: NEXT and SELECT. Action NEXT moves the user to a dialog's next step (steps vary depending on the interaction control encountered by the scanner). Action SELECT is interpreted as the user's wish to actually interact with the control currently activated (optically highlighted) by the scanner. For instance, if the currently highlighted object is a button, NEXT will move on and highlight the object next to this button, while SELECT will activate the button and result in executing the button's operation.

This user profile has posed some very interesting questions on the subject of screen layout, as it is of crucial importance to insure that all buttons and interactive objects are placed and grouped in an ergonomic way, limiting the time required to select and activate any given control (on a most commonly used basis).

People that can use the custom mouse device but not the keyboard, can fully interact with the system via the mouse and an on-screen keyboard activated by the mouse. In this case, no scanning is required. This profile was the easiest –in comparison- to handle, as it was closer to our notion of a usable and ergonomic interaction.

People with cognitive impairments raised serious issues to consider on the design of the user interface, the exact captioning of buttons, the metaphors adapted in the design of the graphics, the presentation of error messages and system messages in general, the learnability and memorability of controls and tasks, as well as the overall design and implementation of the help system.

Architecture and Functionalities

The Word Processor offers the custom set of text editing, formatting and management of text files. The format of the created documents is .rtf so that they are compatible and recognizable by all commercial software. The user is also offered the capability to import a picture, find/replace a word, print-preview the current document and also save it in html format so that it can be published on the web using the web publishing application of the system.
The E-mail Client supports both POP 3 and IMAP and offers the capability to send/receive, forward and reply to messages, manage mail attachments and interact with the Address Book in order to locate the e-mail address of a recipient or update the Address Book with the e-mail address of the sender in the message currently selected.
The Calendar provides a view of the current month so that the user can locate the day of interest and a daily view of the recorded events. For each event a reminder can be set with the option of an accompanying sound. With every new event entry a check is performed that informs the user of a potential overlapping with a prior entry. A set of secondary calendar applications is also under development, which shall be supported in the expert version of the system: Tasks, Notes, and Address Book (in fact it is the entity mentioned in the E-mail Client, which is updated and accessed by both applications). All the system's individual applications can communicate with one another via the clipboard. A high level representation of the system is depicted in Figure 3.

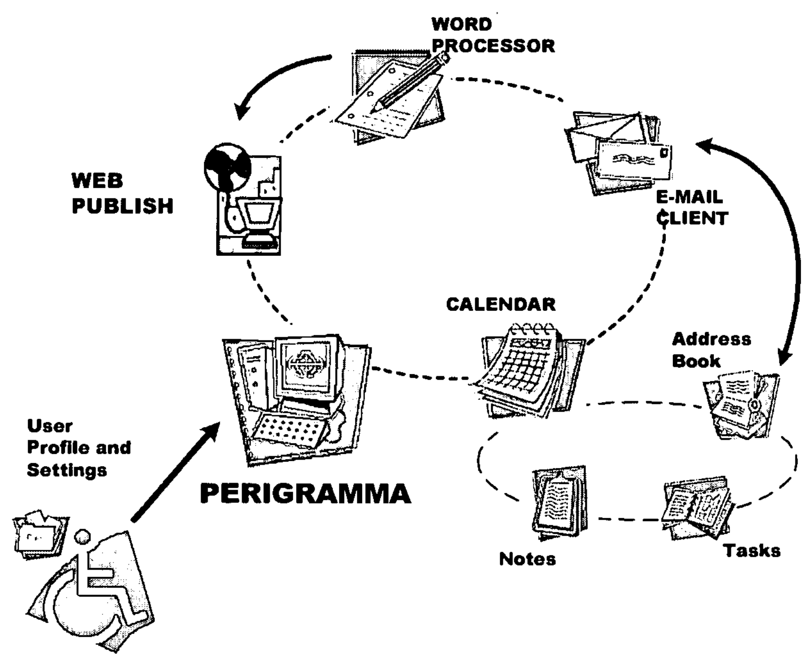

Figure 3. High-level structure of the system

One fundamental feature of the applications that comprise the system is that they have basic functionality, which is common to all of them. This raised the necessity to adopt an architectural model, which takes advantage of this fact not only in the development phase of the system but also during its operation as far as performance is concerned. The model, which is adopted and best fits the above-mentioned system is called component oriented.

According to the component oriented model the applications of the system are broken down to their structural components. The structural components are responsible for the fulfillment of the operational specifications of the system. It is obvious that each structural component implements a set of operabilities. Each structural component must provide access to its operabilities, so as they can be used by the application. This access is obtained through interfaces. Each structural component may provide one or more interfaces. Each interface provides access to a group of operational or conceptual interrelated operabilities. The access is performed either through method invocations relevant to the requested operability or by accessing publicly known properties. It is not necessary to use all the interfaces that a structural component exposes. Each application may use only those interfaces, which provide the needed operability.
The following figure depicts the relations between the applications and the interfaces of the structural components.

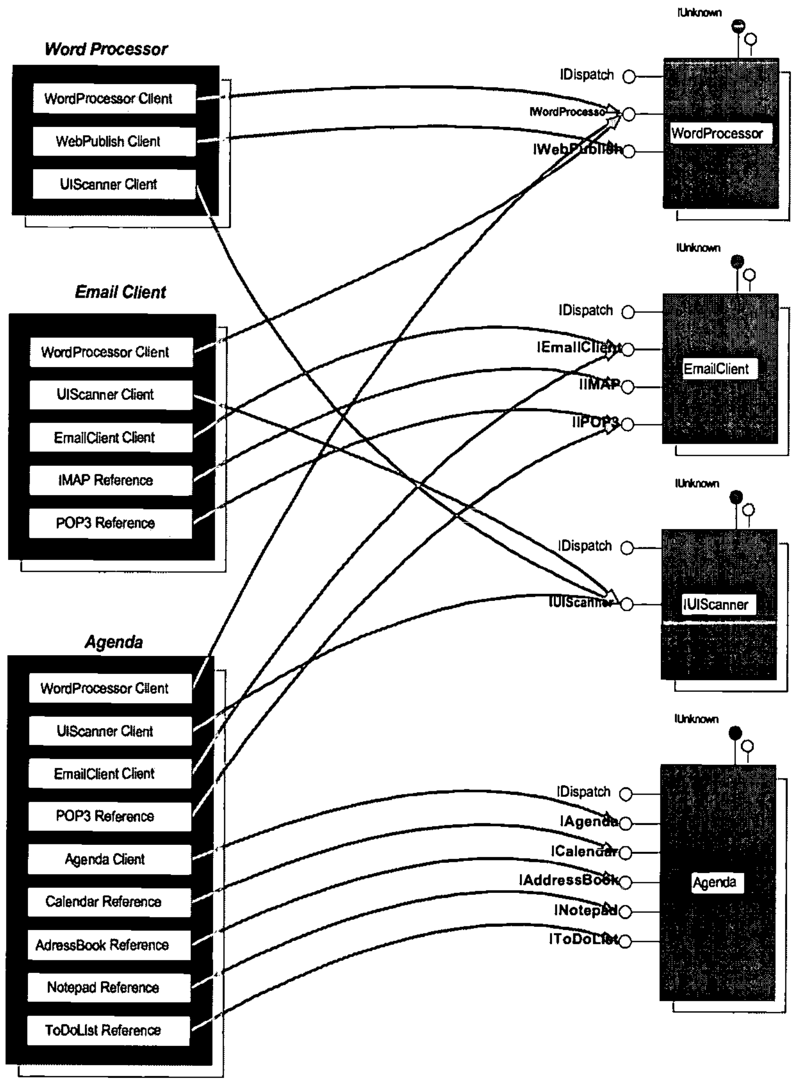

Figure 4. System's component model

The system comprises four main applications. Each one offers a complete set of functionalities that overbalances those identified as typical secretarial needs. As refers to the functionalities that should be left out from the novice version of all applications, the help and guidance from scientists that work with people with

special needs and particularly people with cognitive problems was necessary. Certain options from the word processor and the e-mail client were left out, while in the case of the Calendar, the secondary applications were considered too complex for comprehending and using in the novice version of the system.
At the point of installation, there will be two options regarding the kind of the user's special needs (whether there are cognitive or movement impairments) and in the case that movement impairments are selected, there will be an extra dialog about whether or not the user needs to interact through some kind of switch (in which case the scanner must be activated). In addition, either "Novice" or "Expert" must be set according to the level of user's prior experience with the system and with computers.
An option "settings" available at all times will allow the user to change the system's level of difficulty (novice or expert), fill in and alter data required by the e-mail client and the web publishing application (FTP server, login, password, directory, mail server, etc.) as well as the size of buttons and the size and type of fonts, the number of days a message stays in the trash before being permanently deleted, sound activation/deactivation, etc.

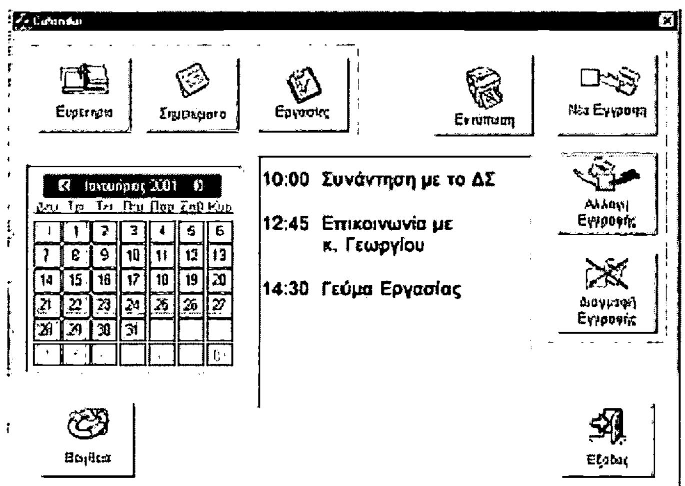

Figure 5. The main screen of Calendar with daily entries presented in the white frame. The system interface is in Greek but the user can enter English as well.

Conclusions and Future Work

PERIGRAMMA is an integrated office environment for people with movement and light cognitive impairments. This environment offers significant potential for increasing their social inclusion. It can be used to fully support teleworking, since through a common environment; one can prepare a document, send it to someone else by e-mail or publish it for generalized access on the web. Moreover, since the interface is designed in a simplified manner and tasks in the profile version are easy and straightforward to execute, the system could be used by inexperienced fully capable users and children.
We have already planned a series of evaluation sessions for the two target groups using a "think aloud" procedure and lab observation. We intend to continue evaluation and system redesign, as feedback from the actual target group in this case is irreplaceable. Our future directions include the further extension of the system so as to expand and foster the needs of more categories of special needs (e.g. low vision problems is our next working hypothesis). In addition, our efforts will focus on extending the degree of system customization to a user's specific preferences, as well as an English version of the system.

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Improving Motivation by Flexible Course Organization: Case Study on Telecommunicatios Education

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Abstract: This paper proposes a simple method for improving student motivation, which is based on the following principle: the pedagogical strategy to be followed by the teacher must be flexible and fit to a specific student profile. The fundamental role of multimedia and Internet are discussed. We report the application of the new methodology to an undergraduate course at the Faculty of Electrical and Computer Engineering (FEEC) of Campinas State University (UNICAMP)-Brazil.

Introduction

Motivation of students in classroom plays a key role for any academic course. In our local context, State University of Campinas (UNICAMP) has organized in 1998 an internal meeting in order to develop undergraduate teaching. However, to our knowledge, it seems that few works of the engineering education literature are devoted to the crucial problem of student motivation. For example, according to the proceedings of the last international engineering education meeting (ICECE 99), only 10% of the articles have made explicit reference to the issue.

In this paper, we introduce a new strategy for motivating students. Our proposition is simple: professor must change his/her traditional behaviour towards the course organization. As a consequence, undergraduate courses pedagogy should be based on the following three-step procedure: pointing out problems, looking for problem causes, proposing effective solutions.

New Strategy and Case Study

Firstly, it is necessary to realize the problems of the course to be taught by means of extensive discussions with previous lecturers, students and also the administrative staff. After getting a complete picture of the problems from several viewpoints, it is then possible to propose preliminar solutions. Then, based on these solutions and on the characteristics of the current students, it is possible to propose a coherent pedagogical strategy to overcome previous problems, as well as to match the course goals to the current students needs and expectations.

Of course, there are several problems to be tackled, however in this article we are convinced that two issues deserve special attention: the order of the topics to be studied and use of several different pedagogical tools. In fact, based on the principle that each student has a personal learning process (Pintrich 95), current pedagogical research strongly motivates the use of different tools: transparencies, informatics, practical experimentation, visits outside the classroom, group work, etc. According to a recent research, computers and INTERNET represent an important element in the daily life of UNICAMP students, before their arrival at the university. As a consequence, multimedia and WEB-based resources should be used in courses, so that students will feel "at home".

In the following, we discuss the application of the new strategy to the undergraduate course on waveguides of FEEC/UNICAMP. This course, which will be abbreviated by EE753, comprise 64 hours (4 hours per week), and it has been taught during the period March-July/2000. Firstly, the following problems have been pointed out after discussions with the academic community.

(P1) It is difficult to understand and to work with Maxwell's equations.
(P2) Links between theory and practical situations or applications should be provided.
(P3) The subject is lengthy and there are few relationships with courses of other fields (electronics, control).

Based on the previous discussions and on the profile of the students, the following guidelines have been set up.
- Emphasis on microwave circuit design for telecommunications applications.
- Review on Maxwell's equations and soft transition from circuit to wave theory.
- Illustration of transmission line concepts and exercises based on software tools provided in the website of the University of Utah, as well as by the well-known microwave package PUFF.
- Analysis and visualization of 3-D electromagnetic fields, as well as microwave devices design, by means of 3-D-plot software and by multivariable function packages.

Results

In (Destro et al. 2000), we discussed the evaluation of student motivation and a new method for assessing it has been proposed. This method is based on taking note of all interactions (doubts, remarks, discussions) between students and the lecturer, classifiying them according to some criteria and estimating some motivation indexes, which characterize the motivation level of the class. The first three columns of (Tab. 1) present experimental bounds of these motivation indexes. For further details, see (Destro et al. 2000). The last column of (Tab. 1) (in the right side) present results achieved by means of the new pedagogical proposition. Clearly, (Tab. 1) points out that all motivation indices of EE753 are much more closer to the well-motivated class, which characterizes the good performance of the proposed strategy, as well as the great improvement associated with the use of information-technology resources.

Bounds for student motivation indexes (Destro et al. 2000)			Results for EE753
Index	Low-motivated course	Well-motivated course	
CDR	$30x10^{-3}$	$46.7x10^{-3}$	$59.5x10^{-3}$
QR	$20x10^{-3}$	$80x10^{-3}$	$128.6x10^{-3}$
RR	$5x10^{-3}$	$126.7x10^{-3}$	$95.24x10^{-3}$
DR	$1x10^{-3}$	$180x10^{-3}$	$113.3x10^{-3}$
ML	$9x10^{-3}$	$131.4x10^{-3}$	$109.8x10^{-3}$

Table 1: Theoretical bounds for student motivation indexes and current results

VII. CONCLUSION

In this paper, a new pedagogical method for improving student motivation has been proposed. A case study on telecommunications education has been presented, attesting good results of the proposed strategy. Concerning multimedia and INTERNET resources, experimentation pointed out that they represent fundamental tools for concept visualization and simple circuit designs, specially in the context of complex tridimensional electric and magnetic fields. Current work involves the search for other INTERNET/multimedia resources, as well as new pedagogical tools based on a multidisciplinary approach.

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Crossing Boundaries: An Integrative Architecture for Campus-Wide Digital Libraries in Research Universities

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Abstract: This paper examines the creation of robust digital libraries and information systems using a campus-wide architectural model through two means: 1) an analysis of selected Digital Library Federation members and 2) an examination of the University of Tennessee as a case study for developing a model which crosses boundaries of departments, colleges, museums, libraries, and research centers. The goal of such a model is to advance the integration of digital scholarly resources and services for teaching and research.

Introduction

Although many universities have developed so-called "digital libraries" few have truly integrated digital resources campus-wide. Barriers to such development rest more with campus organizational, political or boundary crossing issues than with technical issues. Using an analysis of selected research libraries, and the University of Tennessee as an emerging example, the paper reviews strategies for overcoming barriers and establishing powerful systems of deploying digital content and service. The paper also examines potential issues and next steps for federating multiple "digital libraries" on a national and international level.

The Current Context of Digital Libraries and Universities

Digital libraries of one form or another exist in nearly every modern research university today. However, the content of the so-called "digital library" is as diverse as each institution. In almost every case the term "digital libraries" refers to both "born digital," commercially available digital resources, and re-formatted digital content administered or controlled by the university library. Digital services such as electronic reserves, virtual reference, and web-based tutorials are sometimes included in research libraries' articulation of their digital library. The emergence of an identifiable digital library by name is a relatively recent phenomena with leadership coming from associations like the Digital Library Federation (DLF). The DLF is a consortium of libraries and related agencies that are pioneering in the use of electronic-information technologies to extend their collections and services. Through its members, the DLF provides leadership for libraries broadly by identifying standards and "best practices" for digital collections and network access, coordinating leading-edge research-and-development in libraries' use of electronic-information technology, and helping start projects and services that libraries need but cannot develop individually (http://www.clir.org/diglib/.

Common Characteristics of Digital Libraries in the DLF

DLF members share some common attributes related to their digital library efforts:

- A name or identity has been established for an institution's digital library initiative.
- The "content" of most institutions' digital libraries is administered by the library rather than integrating resources found elsewhere on campus.
- Most institutions do not appear to have a robust search engine designed specifically for cross campus searching of digital (including multimedia) scholarly resources.

- Organization and staffing models of digital library initiatives vary tremendously ranging from establishing a department, using a committee model, and/or deploying existing staff from across the library system to population digital library initiatives in an integrative way.

University of Tennessee: A Case Study of Emerging Initiatives

The University of Tennessee is a comprehensive public "Carnegie I" research institution with land grant status. The UT Libraries is also a founding member of the Digital Libraries Federation and is active, both in the Libraries and elsewhere on campus, in developing digital library capability along with the underlying infrastructure needed to deploy scholarly resources in the digital environment. A unique aspect of the University is the rapidly emerging boundary-crossing activities between the Libraries, the Office of Research and Information Resources, the School of Information Sciences, and and a number of Colleges/academic departments. The UT Libraries has been at the forefront of several digital intiatives noted below:

Content

- **Unique digital collections**. The UT Libraries (led by the University of Georgia) were awarded a second **IMLS** grant to scan 1,000 original documents and visual images relating to the Native American population of the Southeastern United States (http://aztec.lib.utk.edu/~di/). Other digital collection projects include digitized photographs related to the Great Smokies region.
- **Commercial e-resources.** UT is expanding its suite of full-text journals, e-books, and electronic databases.
- The UT Libraries play an active role in the campus **ETD** (electronic thesis and dissertations) project.
- The UT Libraries are playing a leadership role in implementing **the Tennessee Electronic Library** (TEL), a state-wide digital library collection.

Services

- **Digital Media Services** (DMS) department. The primary objective of DMS is to serve as a production facility for faculty to digitize a wide range of materials for courses. It will also be used to help the Libraries explore scholarly publishing with faculty, departments, and research centers.
- **A next generation media services department** (formerly audio-visual) with electronic text and imaging capabilities is being implemented for image archiving as well as multimedia image creation. **Electronic reserves** and **Web-based tutorials** have been implemented.
- A **research data services department** is being implemented.
- A working group has been established to develop a **virtual reference services** capability.

Infrastructure

- UT is a founding member of the Digital Library Federation and is now part of the initial testing for the **Open Archives Initiative metadata harvesting project** supported by the Mellon Foundation.
- **Wireless technology** has been installed in the UT Hodges Library as part of a campus-wiring upgrade project called Volnet.
- Interlibrary Services implemented **the ILLIAD system** providing electronic access to patrons to track their requests. Additionally, material is sent electronically whenever possible to the user's desktop.
- ASERL (Association of Southeastern Research Libraries) is moving forward with the **virtual electronic library catalog, Kudzu**, which will provide access to the rich resources of the large research libraries in the Southeast including digital library collections.

Next Steps for Integrative Digital Architecture

The ability to identify and link to existing campus-based digital archives, collections, databases, and other kinds of research materials is an important next step in the Tennessee digital initiative work. On a broader basis more work needs to be done at the DLF and other consortial levels to allow for identification and access of digital scholarly resources across institutions and disciplines.

Digital Image Deployment: Production and "Studio" Models for Research Libraries

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Abstract: This paper examines the creation of production and "studio" models for digital image deployment for teaching, learning, and creation of multimedia scholarship. Two new services being developed at the University of Tennessee will be examined including the Digital Media Service, a production facility for course material preparation, and a "new AV center" embracing a studio concept for multimedia access and production.

Introduction

The deployment of multimedia digital materials, including images to support teaching and learning, is an important need at research universities. The ability to integrate discipline-appropriate and robust digital content for course WebPages and scale production of such content at large campus such as the University of Tennessee was a major driver for the Digital Media Service (DMS). The need to provide a space for a wide variety of digital creation activities for course assignments and research was the motivating force in overhauling the UT Libraries' Audio Visual Department. These collaborative digital initiatives provide service to the entire campus.

Digital Media Service: A Production Model

The Digital Media Service (DMS) came out of an interdisciplinary working group appointed by the UT Office of Research and Information Technology and the Libraries. Its primary goal is to digitize and store instructional materials for faculty from all Colleges with the ability to convert all formats into digital media. Faculty will be referred to appropriate staff for copy permission, instructional technology needs (Web page development and training), and identification of course-appropriate resource materials from the library and elsewhere. In the future it is hoped that the service would be able to provide digitization for grants and contracts, for department needs that are not course-related, and for electronic scholarly publishing production.

The DMS is a true partnership between the Libraries and the Office of Research and Information Technology (ORIT) reporting jointly to the respective heads of both entities. It will be funded and staffed by ORIT with a library point person and a jointly populated steering committee providing day-to-day operational guidance. A larger interdisciplinary advisory committee with faculty users will commence after the service is underway to provide strategic direction (including representatives from the School of Information Sciences, College of Communication, the School of Broadcasting, early faculty adopters, and the various IT groups on campus). Staffing consists of a DMS coordinator, a digitization specialist, and student assistants. The permanent staff are supervised by the university's Customer Technology Support group. The facility is located in a high traffic area of the UT Hodges Library.

It is hoped that the DMS will be seen as THE central campus facility for course-related digital production, therefore alleviating the need for individual colleges and departments to maintain their own production facilities. It will also provide faculty with much needed support to integrate the use of digital resources into their courses through course Websites. Scaling production at a large campus (26,000 students) is now possible with a central facility.

The "Studio" Approach to Image Deployment: UT's New AV Services Unit

At about the same time the DMS was being created a new initiative began to modernize the University Libraries' Audio Visual Department. When Hodges Library opened in 1988 the AV Department was a state-of-the-art facility deploying film and video to individual carrels as well as to a number of viewing rooms located throughout the library. This capability enabled faculty from all over campus to show films and videos to classes as well as have students individually study materials in viewing carrels. Audio carrels were also built in the unit. While the group viewing rooms and traditional services of centralized AV deployment will still be continued there is a growing unmet need for digital multimedia collections, deployment, and application to teaching and research. Audio carrels could be eliminated to make room for new services in the facility originally built in 1987.

A "New AV Task Force" worked to define new services. Members also met with faculty from disciplines who currently use AV or would most likely use the multimedia services to support teaching and research. The group developed a plan for the implementation of new servicss:

- Add multimedia computers and high-end software for use by students or faculty
- Provide access to multimedia instructional programs
- Enable student production of multimedia assignments using text, images, video, audio, and/or a combination of these formats
- Provide group areas for multimedia production
- Provide group and individual instruction for users
- Provide technical support

New Services

Two major new services are also planned including collecting and archiving images for use in academic departments such as art, classics, anthropology, history, agriculture, etc. A number of commercial digital archives are being considered for purchase and digitizing locally held images is planned. An enhanced electronic text capability is also planned where e-text literary collections will be increased, and encoding capability and training will be added for students and faculty wishing to do text analysis.

The implementation of these capabilities will truly enable students and faculty to use the facility as a multimedia studio to, not only view and manipulate digital multimedia resources, but also to create multimedia "products," scholarly resources, and assignments. The facility is seen as a central studio supplementing specialized computer labs located in the Colleges. These labs are only open limited hours and are restricted in their use and do not always feature on-site assistance. As with the DMS the "New AV Department" will be a collaborative effort drawing on expertise found from throughout the campus to help build the collections, conduct training, and identify priority services. Staffing will come through reallocation of existing staff resources in the current AV Department and from other sources.

Summary

Implementation of the Digital Media Service and the "New AV Department" will provide the University of Tennessee with a much greater capacity to deploy resources based on images and other digital multimedia. Students and faculty will be able to integrate these resources into their teaching, learning, and research. Redundant and expensive services scattered throughout the campus will not be necessary. Issues remain including effective marketing of the new services, staff training, and relationship building to continue the collaborations at a high level.

Designing a Virtual Laboratory for an Online Course in Microelectronics

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Abstract: The paper presents the design, development and implementation of a virtual laboratory associated to an online course in Microelectronics within the EDIT Distance Learning Network (EDIT DLN). This way students from different Romanian universities have access to expensive computer hardware and software resources that are not available in their own universities by means of web-based interfaces of the needed simulation tools as well as to the expertise of the best experts in the field.

General Presentation of EDIT DLN

The EDIT DLN was setup within a project financed by the Romanian National Higher Education Funding Council for a period of three years and run by a consortium of four Romanian technical universities (University "Politehnica" of Bucharest, Technical University of Cluj, Technical University "Gh. Asachi" of Iasi and University of Craiova) and IBM Global Services, Education&Training, La Hulpe, Belgium (see Drondoe et al. 1998 and Voinea et al. 2000). The project main objectives were to assist the implementation of the distance learning methodologies and to setup an academic open and distance education network in the field of Microelectronics and Information Technology.

Course implementation

The pilot course entitled *Numerical Modeling of Carrier Transport in Semiconductor Devices* was derived from a "classic" postgraduate course given at University "Politehnica" of Bucharest and was implemented in LOTUS Learning Space 4.01 environment. The text-based course material was reorganized in a larger number of chapters in order to better keep trace of the students' assessment. The students must pass a preliminary test from the course prerequisite topics in order to be admitted. Furthermore, the access to a given chapter is granted only if the student passed the tests from the previous chapters. A maximum number of attempts to pass a test may be imposed by the tutor.

Laboratory implementation

Some chapters have laboratory work that in the first implementation stage was “classically” perform in our center in a face-to-face approach. The reason for doing this way was that the needed software run only on powerful RISC workstations that are not commonly found in Romania. In order to have a full online course we decided to design web-based interfaces for all the simulation tools used within the lab that will allow a student to launch remotely a job using a low cost Pentium based computer. As the jobs might run for periods of time between half hour to several hours depending the simulation tool and the computer load, we choose an asynchronous way of working, the results arriving as attachments to e-mail messages in the student mail box.

It is important to point out that these interfaces offer limited access to the simulation tools features as they are topic-oriented designed (Drondoe et al. 1999). This way the student can easy cope with the complexity of the simulators (keywords, physical models, numerical methods, etc.) and spend most of the time for the real work. Through the integrated communication system the student is encouraged to discuss the results together with others and can contact any other student or a tutor. In the same time each simulator has an extended help that offer on-line guidance when needed. For research purposes the students may have full online access to a specific simulation tool through special interfaces.

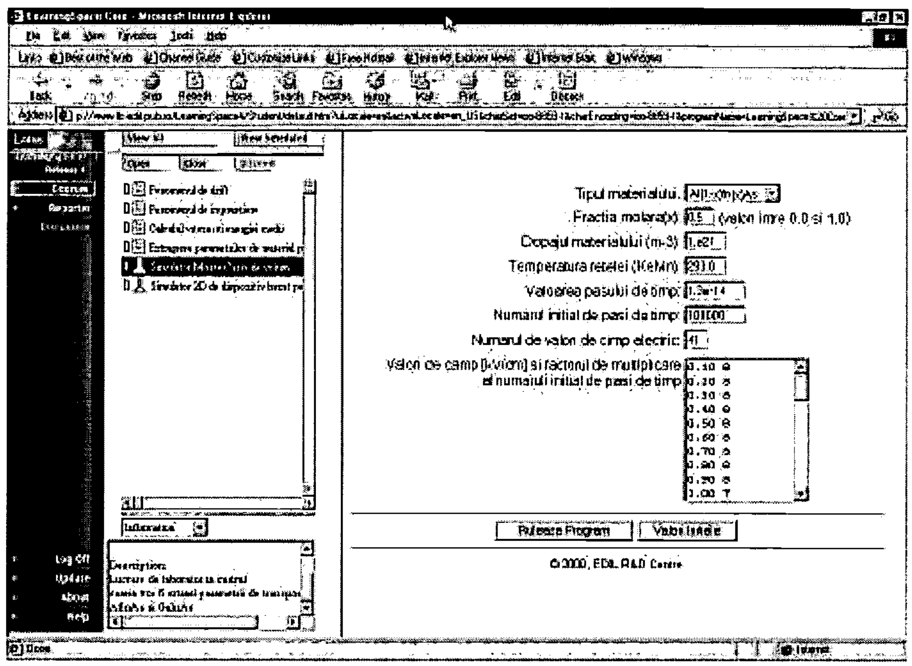

Figure 1: Screen snapshot of the WWW interface for a device simulation tool

Conclusions

A pilot implementation of virtual laboratory associated to a course in Microelectronics within the EDIT DLN has been presented. This way students from different Romanian universities have access to expensive computer hardware and software resources that are not available in their own universities by means of web-based interfaces of the needed simulation tools as well as to the expertise of the best experts in the field.

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Study of Thermal Phenomena in Junior High School
A New Technology - Based Learning Environment.

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Abstract: The use of the New Information Technologies in the laboratory of Natural Sciences leads to a satisfactory approach, by the students, to the scientific views in thermodynamics, when compared both to their original ideas, voiced during the labs, as well as the situation described in the international bibliography. Taking into account the current developments in the teaching of Physics, we designed and applied a program that studies thermal phenomena in the laboratory, through the use of MBL

Introduction.

The rapid scientific and technical developments, a defining characteristic of our time, call for a radical change in the content, as well as the method, of the teaching of Physics throughout all stages of education.

Even though there is almost a consensus among the teaching researchers, concerning the need to change the content and method of teaching Physics, there has been considerable argument about the direction of such change. However, most of them agree that the following goals have to be attained(1):

- That the students understand the basic concepts of Physics and their relation to the natural world, the activities of everyday life, as well as high-tech devices, so that the subject of Physics be widely accepted, rather than considered to be meant for future specialists.
- That there be a more active participation of the students in the process of learning.

Without a doubt, the attainment of the above goals can be simplified by incorporating the use of new technologies in the process of education, which can lead to the design of new educational tools, which, in turn, can allow students to collect, analyze, visualize, model and announce data, so as to understand Physics through their active participation(2).

Subject/problem.

Long-term studies in various countries have shown the lack of functional distinction of the concepts of heat and temperature (1) by the junior-high students, as well as the inability to understand the concept of thermal equilibrium (3) and the procedure of heat transfer by conduction (4,5). In general terms, most students believe that the temperature of objects depends on the material (6), and as a result, they do not acknowledge that the same object can have different temperatures. They do not acknowledge that different objects that come into thermal contact will eventually reach the same temperature. They cannot percept the concept of heat, as a form of transferred energy (5,7) and they confuse thermal conduction and temperature of materials (6).

The laboratory practice, which is supported by the New Technologies, can play an important role in the improvement of the teaching results, regarding the concepts of thermodynamics and thermal phenomena. In particular, the use of sensors for the taking of measurements (e.g. temperature) and their simultaneous display on the computer screen, in the form of a diagram, gives the possibility:

- To observe the change of temperature in more than one systems simultaneously.
- To focus the students' attention on the phenomenon, and relieve them of the "dull" process (as they perceive it) of taking measurements and creating the relevant diagrams.
- To detect the students' preconceptions as well as to develop Socratic dialogues between the teacher and the students during the experiment.

Design and procedure.

Taking into account the current developments in the teaching of Physics, we designed and applied a program that studies thermal phenomena in the laboratory, through the use of a computer, connected with sensors to the laboratory equipment. The program included 5 labs that referred to calorimetry, linear dilation, propagation of heat through conduction, thermal equilibrium and energy conservation. Three grammar schools in Athens were selected to be school units of application, so that the sample would represent the average Greek student. There was a total of about 250 participating students of ages 14-15, that created 10 groups, divided into experimental group and control group (5 groups each). The teams of the groups were selected in such a way that they were almost equally matched, the criterion being the average mark of the students last year in the subject of Physics.

The experimental application classes used various simple means – hotbeds, isolating containers etc., and worked in MBL environment, which disposed a computer, proper software, a printer, a projection screen, a video projector, sensors of force and temperature, as well as an interface for the sensors and the computers. In the experimental group, two additional teaching hours took place, so as to help the students become familiar with the software and the use of sensors. The current textbook was used, as well as a laboratory guide, with proper worksheets, and suitably configured labs. The students worked in groups, but the answers to the questions of the worksheets were given in individually.

At the original stage of the execution of the labs by use of multiple choice questions, the students were asked to predict the development of the variables displayed on the computer screen.

After the conclusion of the experiment, they had the possibility to compare directly some of their original predictions with the actual experiment data. The worksheets included both a quantitative processing of the data, as well as questions regarding the concepts and the laws under study by the students, which were helpful in many cases for the development of a Socratic dialogue with the professor.

The experiment's design for the control classes was based on the traditional lab equipment. All the activities provided in the textbook were realized, as well as the relevant labs from the experimental group. The students created and studied relevant diagrams in the lab, and they were also given filled-out diagrams, which were talked about in class.

The experimental and control classes operated equally in every school unit, on every aspect. The teachers were the same for both classes. Students in both classes worked under the supervision of two teachers and they filled in worksheets. The efficiency of each teaching intervention was evaluated through a questionnaire, common for both classes. (The filling in of the questionnaires was conducted a week after every laboratory experiment).

Results

Ten days after the completion of those labs, a test was given to the students, which consisted of multiple-choice question of an open type (where they were also asked to justify their answers) as well as the construction of a diagram. The results, which are presented suggestively, concern the dependence of the rate of heat transfer to the nature of the material, the concept of thermal equilibrium, the use of the relevant law to calculate the amount of heat transferred, and the application of the principle of conservation of energy during the heat transfer. According to the results: a) Although an equally big percentage of students (80% for the C.G. and 90% for the E.G.) acknowledges that heat transfer causes a rise of temperature, the experimental group surpasses the control group by 40% in correctly recognizing the diagrams that display the development of the phenomenon in two different materials; b) the experimental group surpasses the control group by 40% in constructing graphs that show the development of temperature by exchanging heat between two materials of different temperature, and by 30% in understanding the approach of the state of thermal equilibrium; c) the percentages of correct application of the relationship of heat calculation were 50% for the E.G and 35% for the C.G. The percentage of students connecting heat transfer with the conservation of energy, with correct justification, were low in both groups, but the E.G. was still leading by 12%.

Conclusions.

It comes forward, by the results of the above study, that the use of New Information Technologies in the laboratory of Natural Sciences leads to a satisfactory approach, by the students, to the scientific views in thermodynamics, when compared both to their original ideas, voiced during the experiment, as well as the situation described in the international bibliography. Furthermore, the use of the Environment of New Technology bolsters the ability of the students to describe, understand and predict the development of natural phenomena through diagrams. Similar conclusions can be drawn by the application of the ENT in another field of knowledge, on students of the same age [(8)]. Generalized use of the ENT in various cognitive fields and educational stages may become a substantial contribution to the confrontation of the problem of drawing the interest of students, as well as improving the effectiveness of the provided education in Natural Sciences.

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Are Experts Able to Predict Learner Problems During Usability Evaluations?

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Abstract: A number of approaches for expert-based evaluation of Instructional Multimedia have been proposed during the past few years. However, there is little evidence in the literature regarding how effective they are, especially in identifying real learner problems. In this paper we report an empirical study which assesses whether experts can predict the problems experienced by students. The evidence suggests that expert evaluators, although successful in predicting usability problems, still have difficulties identifying certain types of learner problems, such as comprehension and learning support. We conclude that expert evaluations do not eliminate the need for tests with actual learners, and suggest ways of improving their effectiveness.

Introduction

The usability of Instructional Multimedia (IMM) applications is vital for their success and for the satisfaction of their users, as the confusion resulting from using poorly designed programs can be particularly detrimental to learning performance. To avoid this, the evaluation of such software should assess how successful learners are at achieving learning tasks, and not just how effective and efficient they are while interacting with the application (Squires and McDougall, 1996). To measure the former, 'before' and 'after' knowledge tests are typically performed with learners (Draper et al, 1996). However, learner tests have been found to be expensive in terms of the time and effort required, and recruiting users can also be problematic (Dimitrova and Sutcliffe, 1999). Due to these problems, involving learners may not be feasible in many projects, and alternative evaluation methods need to be explored.

A number of expert-based methods for the evaluation of IMM have been proposed in the past few years, such as Interactive Multimedia Checklist (Barker and King, 1993) and Multimedia Taxonomy (Heller and Martin, 1999). However, there is little evidence in the literature regarding their effectiveness, especially in terms of identifying real learner problems. In a review of expert- and learner-based evaluations, Reiser and Kegelmann (1994) criticise the expert-based approaches for having poor reliability as the majority of them required evaluators to make subjective judgements. The authors also acknowledge that teachers and students rate software differently, however they do not explain the nature of these differences. Tergan (1998) also criticises checklist-based approaches for their inability to assess the instructional efficacy of the software. Although these reviews are useful, they do not provide empirical data to support the conclusions reached. The reviews also do not give details about the differences between expert and learner evaluations.

In this paper we report an empirical study which assesses the effectiveness of expert predictions using three different evaluation methods by asking the question whether experts can predict real learner problems. To address this, we compare the results produced by two types of expert - subject matter specialists and multimedia designers - to those from learner tests and discuss their similarities and differences in terms of the number and the type of problems predicted.

Study Design

The IMM Application

One section of a multimedia environment for learning Mathematics at university level was evaluated. The selected topic covers the principles of exponential functions and the three types of transformation of these functions – Scaling, Reflection and Translation. A series of 23 screens presents the Maths content in textual, graphical and animation formats. Interactive quiz-like tests are also provided, which enable the users to plot exponential graphs and test their knowledge of transforming them.

Learner Tests

Four students undertaking a course in Mathematics at City University London were involved in the learner tests. Before the experiment, pre-exposure knowledge tests were administered to establish students' prior knowledge of the material. Each student was then given four tasks to perform, which consisted of learning about the principles of exponential graphs and exploring the three different types of transformation. During the usability tests, the students were asked to think aloud while performing each task. After the students had completed the tasks, they were interviewed by the experimenter to determine their attitude towards different aspects of the application. The student sessions and the interviews were recorded on video. At the end, comprehension tests were administered to reveal the knowledge students gained while working with the software. The material covered by the students was divided into 20 knowledge propositions, of which the students were expected to have a reasonable level of comprehension after working with the application. Each proposition was tested in the post-exposure comprehension tests.

Expert Evaluations

Ten experts took part in the expert evaluations, including six multimedia designers (MMDs) with varying degree of design experience and four subject matter experts (SMEs), all of whom had significant knowledge in this area of Mathematics and experience in teaching it to students.

Each expert was asked to use one of three usability evaluation methods. The first method was Multimedia Taxonomy (MMT) (Heller & Martin, 1999), which represents a three-dimensional categorisation framework of multimedia issues, such as media types, their expression and contextual aspects like the target audience and the content. The taxonomy contains 120 cells, in each of which evaluators can ask questions regarding specific issues of media design. The second approach was Multimedia Cognitive Walkthrough (MMCW) (Faraday & Sutcliffe, 1997), which concentrates on cognitive aspects of multimedia presentations. It involves three steps of evaluation of the media design, the media combination and the media selection. Each step contains a set of guidelines against which the relevant presentation segments can be evaluated. Finally, the Interactive Multimedia Checklist (IMMC) (Barker and King, 1993) comprises twelve categories, such as engagement and interactivity, which embody essential principles of good design. The authors suggest 90 questions distributed amongst all categories, and experts are expected to answer the ones relevant to the application being evaluated. The MMT and the IMMC were used by two multimedia designers and two subject matter experts, whereas the MMCW was used by two multimedia designers, as recommended by the authors of the techniques. No subject matter experts used the MMCW because it concentrates on low-level multimedia design issues, and it would not be appropriate for such experts to use.

Results

Learner Tests Results

The video footage containing the student interactions, their verbal protocols and the post-exposure interviews was analysed to identify usability problems. Problems were identified using a set of nine criteria, such as 'the learner articulated a goal but cannot succeed in achieving it without external help from the experimenter' and 'the student expresses confusion while trying to achieve a task'. A total of 51 unique usability problems were found to match the criteria. The comprehension test results showed that students understood the concepts of Reflection and most of those of Translation. However, they had particular problems understanding the principles of Scaling, as well as some principles of Translation. In particular we found that the students had difficulties comprehending 13 of the 20 knowledge propositions. We defined comprehension difficulties as cases where at least two students did not grasp the essence of the knowledge proposition. Thus, as a result of all learner tests we found that the students encountered 64 problems in total, i.e. 51 usability and 13 comprehension problems.

Expert Evaluations Results

A total of 191 unique problems were identified by the experts. The total number of problems identified by each expert group is shown in Table 1. 27 problems were identified by both types of experts using the IMMC, and this number has been included in both totals given in columns 4 and 5.

Evaluation Method / Expert Type	Multimedia Taxonomy	MM Cognitive Walkthrough	Interactive MM Checklist	Total Number	Mean
Multimedia designers	43	34	69	**146**	**24.3**
Subject matter experts	32	-	40	**72**	**18**

Table 1: Number of problems predicted by each expert group

Analysis of the Evaluation Results

The main question to be answered was whether the experts were able to predict the problems experienced by the learners. Therefore, we compared the experts' predictions with the results from the learner tests. To be able to match the two problem sets, six matching rules were established. For instance, problems were matched if both problem statements described the same learner behaviour or if both described the same fault with the same design feature, although it may have been observed in a different page of the application. The results of the problem matching are depicted in Figure 1. As can be seen from the figure, only 28 of the 64 learner problems were predicted. It was found that in total 60 statements identified by the expert evaluators mapped onto 28 of the learner problems. In the following sections we discuss these results.

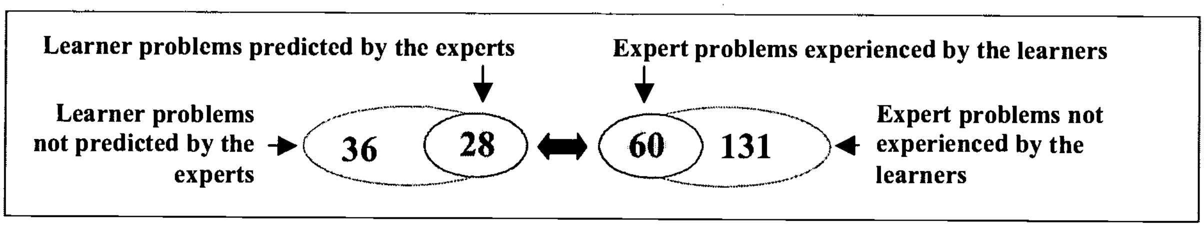


Figure 1: Similarities between learner and expert problem sets

Number of Correctly Predicted, Unidentified and Unobserved Problems

We first analyse the number of correctly predicted versus the number of unidentified learner problems. We then discuss the number of problems the experts predicted, which the students did not encounter in their interaction with the application.

Correctly Predicted Problems
From Figure 1 it can be seen that the experts predicted 28 of the 64 learner problems, or 44%. In particular, we found that 24 out of the 51 usability problems were identified by the experts, or 47%. However, the experts could predict problems with only 4 out of the 13 knowledge propositions which caused comprehension difficulties to the students, which is less than a third. The multimedia designers predicted more of the usability problems, whereas the subject matter experts identified more of the comprehension problems.

Unidentified Problems
The expert evaluations failed to predict certain problems that the students did encounter. We found that in total 36 of the 64 learner problems were not predicted by the experts, or 56%. In particular two thirds of the comprehension

difficulties and nearly half of the usability problems the students encountered were not predicted by the experts. The above results show that the experts had difficulty identifying potential comprehension problems, but they were more successful at predicting usability problems which the learners experienced.

Unobserved Problems
Apart from the 60 problems which were matched with the learner ones, the experts also found 131 other problems. We divided these into two categories – specialist problems and false alarms.

The *specialist problems* category includes 81 problems, which students cannot be expected to identify. These problems concern a variety of issues, such as the accuracy of the Maths equations and the notation used. We found that a significant proportion of the problems identified by the SMEs fell into this category (in total 60% of their predictions), whereas only 25% of all issues predicted by the MMDs were specialist ones.

False alarms are issues which experts identified as problematic but which did not cause problems to the learners either while interacting with the software or during the knowledge tests. We found 50 false alarms in total, which amounts to 26% of all expert predictions. Most of them were raised by the multimedia designers. One reason for this could be that the MMDs were more critical about the design of the application, pointing out minor issues which did not cause problems to the learners.

The analysis so far only provides information on the proportion of the learner problems predicted or not by the expert evaluators. The next part of the analysis aims to provide a more detailed review of the types of problems which the learners and the experts focused on during the evaluation of the IMM application.

Types of Problems Identified

From the analysis we found that although there are some similarities between the problems identified in the learner tests and the expert evaluations, each group paid attention to different aspects of the IMM application.

Types of learner problems the experts could predict
One area where the experts predicted all learner problems is *affordance*, which encompasses difficulties relating to students not being able to identify which part of the presentation affords certain actions or what action a particular button affords. An example of such problem is shown in Figure 2 (a), which illustrates that after reading the instruction circled the students had difficulty identifying where to click for the graph of 10^x. Both expert groups also detected some issues of *learner engagement*, i.e. how interesting and challenging (or not) the application was to the students.

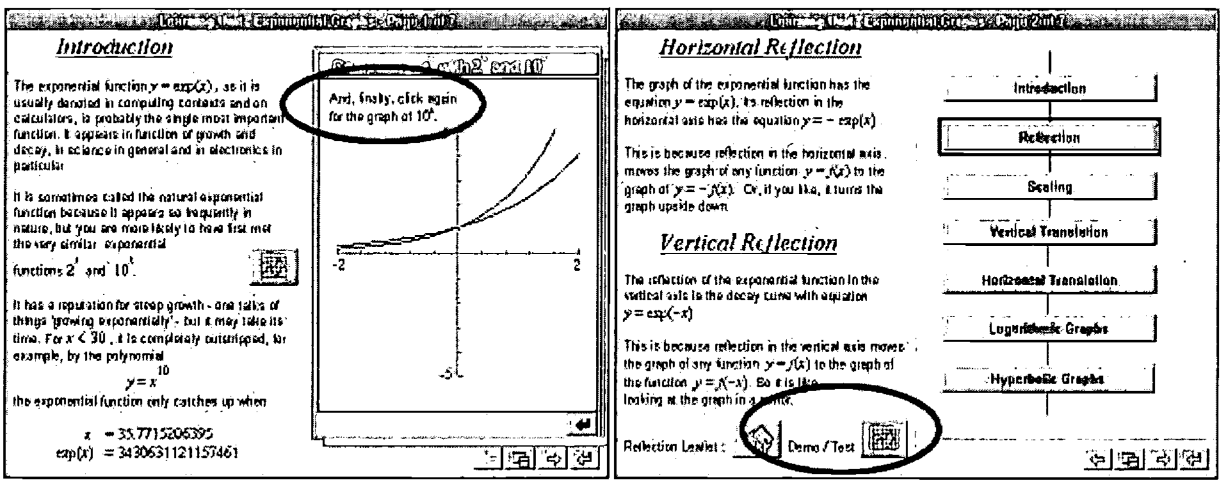
The multimedia designers also focused on problems with the *design and appearance of the media resources* used, such as the design of the graphics, graph lines, quality of the icons and the pop-up message boxes. This kind were also identified by the students. The experts further spotted some problems with *synchronising* time-varying media resources, such as animated text which changes too quickly for the students to read. The MMDs also identified some problems with the *navigation* within the application. Finally, mostly the SMEs, but also two of the MMDs, pointed out some areas in the presentation which they believed were not sufficiently clear, and the students actually had difficulties understanding these sections.

Types of learner problems the experts could not predict
On the other hand, a number of learner problems eluded the attention of the experts. These fall into three categories: *learning support, comprehension* and *missed interaction*.

Learning support problems deal with how much explanation of the material the students required. This greatly depends on the students' prior knowledge. Most students requested more help with Scaling and Translation, especially Scaling, since they had no previous knowledge of these concepts. Although before the evaluation sessions the experts were told to assume none or little prior knowledge of the subject matter, none of them could envisage where students may need further explanation of the material. Furthermore, none of the evaluation methods explicitly asked the evaluators to consider students' prior knowledge in order to identify such issues.

The *comprehension* problem category describes which parts of the material the students had problems understanding. Although the experts identified some areas of the material which could potentially cause such difficulties to students, they missed out a significant number of them. One factor found to influence the comprehension was the varying complexity of the Maths material. The higher the complexity of the material the greater the cognitive task requirements were on the students. Reflection was found to be the simplest concept, the principles of Translation were slightly more complex, and those of Scaling were the most complex of the three. The comprehension test results showed that all students grasped the concepts of Reflection, the majority of them got the Translation right as well, however most of them experienced difficulties with understanding Scaling. None of the evaluation methods suggests that the complexity of the material or the cognitive task requirements should be considered, and none of them correlates these aspects to how media resources could be used and designed to represent complex concepts in order to enable students to comprehend them easier.

Finally, *missed interactions* are situations where the students did not perform an interaction which is considered important for achieving their learning tasks. One such situation arose on the Horizontal Reflection screen, illustrated in Figure 2 (b), where a student skipped the test regarding Reflection, which would have helped them reflect on what they had learned about it. Such situations occurred predominantly because the learner's attention was not explicitly drawn to the important parts of the presentation. As can be seen from Figure 2 (b) the icon to start the test is placed at the bottom right-hand corner of the main presentation screen where the learner is not likely to look very often.



(a) An example of an *Affordance* problem (b) An example of a *Missed Interaction*

Figure 2: Sample screens from MathWise (NAG ©) illustrating learner problems

Types of problems the experts predicted but the students did not encounter

As mentioned earlier, the experts predicted a number of problems which the students did not experience, which we categorised as *specialist problems* and *false alarms*.

Specialist problems include pedagogical and instructional design issues, which fall into four categories. Firstly, many predicted problems concerned the accuracy and completeness of the Maths content and the notation used. Such problems were identified by the subject matter experts. For instance, two SMEs identified a mistake in one of the equations of Vertical Scaling. Secondly, issues regarding the adequacy of different monitoring and assessment techniques were identified. A third set of issues questioned whether different expert system facilities are required to support learners. Finally, the experts also made suggestions as to how the design of the application could be improved. Some of these specialist issues can potentially point to usability and learning problems. However, they were specified in a way that only revealed design faults, without identifying the likely effect of the faults on the learner's behaviour or performance.

In the *false alarms* category we include issues which experts identified as problematic but did not cause problems to the learners. Most false alarms were due to experts making wrong assumptions about students' sense of orientation within the application and the information presented, their control over the application and preferences regarding customisation of program settings. For example, one expert thought that students could lose a concept of where they are in the application, however when asked during the interviews none of the students reported experiencing such confusion. Such comments were made predominantly by the MMDs. The multimedia designers also commented on design faults which did not seem to bother the students. Perhaps because the students were so engaged in grasping the Maths material, they did not seem to notice presentation imperfections, such as some of the letters in the titles not being properly drawn. Such issues, however, are valid design considerations and can be useful for redesigning the application. Finally, the SMEs presupposed that learners' attention and concentration could not be maintained consistently, which was not the case with the students. However, the experimental nature of the evaluation could have caused the students to be more focused.

Conclusions

The results of the study presented in this paper show that the experts were successful at predicting a number of usability problems the students encountered. However, despite using formal usability evaluation methods, the evaluators did have difficulty predicting certain types of learner problems, particularly comprehension, learning support and attention to important information. One explanation of this is that the experts and the learners showed differences in focus. The subject matter experts emphasised matters of the content, the multimedia designers paid particular attention to the media and presentation design, media synchronisation and navigation, while the students were more concerned with how understandable the material was. Another critical issue that emerged from the study is that expert evaluators tend to uncover design and content faults, but rarely try to infer what consequences such faults may have on learners' behaviour and performance. Even when they did try to predict the effects on the learner, they often made wrong assumptions. The evaluation methods also did not support experts in making such predictions. The evidence presented above suggests that expert evaluations, although effective, do not eliminate the need for actual tests with learners.

The prediction rates of expert evaluations could be improved by training the experts in how to use learner data more effectively, so that they can make better assumptions about students' interaction with the IMM, and their behaviour and performance. Furthermore, more research is required into how the design of IMM should take into account relevant learner characteristics, such as their prior knowledge, metacognitive skills and personal motivations, and incorporate the findings into evaluation methods for use by experts. The existing usability evaluation methods also need to be enhanced to consider how the major factors contributing to effective IMM design - the learner, the subject matter content, the instructional approach adopted and the context of use – all relate to each other. This will provide a more integrated approach for evaluating the effectiveness of IMM.

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THE INTERNET AS A TOOL FOR A REVOLUTION IN EDUCATION IN AFRICA: A DREAM OR REALITY

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Abstract

In this paper, the author looks at how the Internet can help Africa develop educationally. The research also highlights the problems, which have caused the slow growth of Internet access in education in Africa. The author then suggests solutions to these problems in an effort to bring full Internet access to Africa as quickly as possible.

Keywords

Internet, Africa

1. Introduction

Before the Internet was introduced in Africa, (Osburn, 1999) observes that there was no other method capable of transmitting the same information and at the same time to both industrialised and developing countries. With the Internet, the people of Africa have, for the first time the opportunity to have access to the same information, and at the same time, as people in industrialised countries.

Other than giving Africans the same development opportunities as the industrialised world, the Internet is the fastest growing communication technology. According to (Molosi, 1999) it took 38 years for the radio to have 50 million listeners, 13 years for the television to reach the same mark and only 4 years for the Internet to cross the same line. By the end of 1998, more than 100 million people were Internet users. With the ability to grow so rapidly, one wonders why more people in Africa have not been able to gain access to the Internet, and have not been able to use it as an educational tool.

As the use of the Internet continues to grow, this will have profound implications for African countries. According to (Africa on the Internet, 2000), there are fears that if Africa does not 'connect fast enough' the growth of the Internet will only accelerate marginalisation of the African continent. As the pace of growth accelerates even more, the gap between those who are linked up and those who are not grows larger. These dangers and fears are real and should not be underestimated. Lamenting them will not stop the growth of information technology. Instead, Africa's civil society, governments and entrepreneurs need to be challenged to take advantage of the information technology revolution now gripping the rest of the world and bring the Internet to Africa.

2. Problems Causing Africa's slow Growth in Internet access

Internet access in Africa has slowly improved over the years, but many people in the continent are still unaware of the Internet and those who may be aware of its existence don't know how it may be of benefit to them. There are several reasons why Africa's Internet infrastructure has remained so fragile, therefore slowing down the rate at which people are able to access the Internet.

2.1 Interference of state-owned PTCs

According to (Adam, 1993), the state-owned Posts and Telecommunications Corporations (PTCs) involvement and approval is usually required to proceed with networking plans in the area of telecommunications in most African countries. Because, in most cases, the PTCs have rigid policies and poor management and computing capabilities, the need for approval by the PTC to proceed with any networking plans frequently hinders the progress of networking in Africa.

(Adam, 1993) further observes that in most cases these PTCs claim to be the national networking institutions. This creates confusion because these PTCs now "go beyond service provision to becoming regulators of all communication equipment." Other main bottlenecks to networking are that there are no clear communication policies to support data communication in general. Also, there is usually a lack of co-operation between the private or academic sectors and these government-run PTCs. This has slowed down the implementation of intensive networking in Africa.

Because of their rigid policies where telecommunications are concerned, the PTCs have actually slowed down the implementation of the Internet to Africa. In most African countries, these PTCs have the monopoly over all telecommunications infrastructure and no competitors are allowed to try and improve the services provided by the PTCs. The existence of several players in the telecommunications field greatly improves the services of the companies as each tries to outmanoeuver the other.

If the state monopolises telecommunications, there are no controls to the prices that they will charge for accessing the Internet. The problem is even compound in Africa because of the few telephone lines, which exist. (Cohen, 199) puts it this way: "A few statistics illustrate why the basic requirements of access-a-telephone-line presents problems for less industrialized countries. Globally, 49 countries, 35 of which are in Africa, have less than one telephone per 100 people". The lack of telephone lines in some areas makes it difficult to cultivate an Internet culture, as there is need for a telephone line and a computer in order to be able to gain access to the Internet.

Besides not having reliable telephone lines which are necessary for usage of the Internet, cost is also inhibitor to Internet access. (Guinness, 1999) states that access is:

> *...typically at around US$3 for half an hour...Equipment prices are [also] high once you move north of South Africa. Add up to a third once you hit Namibia or Botswana, more as you reach Zimbabwe and northwards. In one very typical African country, even a modest secondhand PC can cost at least $1,000- the price of a new machine in America. And signing up to an ISP [Internet Service Provider] could cost $130 a month.*

Some governments at times tries to regulate the content of the information accessed over the Internet. According to (Cohen, 1999), this happens in countries where telecommunications are monopolized by the state. Governments can also restrict access for political purposes and economic gain. (Cohen, 1999) further observes: *"Globally, some governments have chosen to control the liberalising effect of the Internet by* *denying access to entire segments of their populations, either through exorbitant charges or by confining access to select groups".*

2.2 Computing Equipment in Short Supply

(Adam, 1993) highlights the fact that both hardware and software are difficult to source in Africa in terms of cost. Therefore, equipment is usually in short supply. If it is available, it is either obsolete or under utilised. In an institution, one may find mainly old mini-computers and low-end personal computers with limited application software.

One is convinced that if the policy makers appreciate the importance of computer literacy, the resources would be made available to purchase computers for schools. The policy makers would also see to it that computer education is included in the school curriculum.

2.3 Low Investment in Research and Development

Statistics indicate that African universities and governments invest only a small percentage of their budgets in research and development. The policies implemented by the governments may only be short-term and do not take into account any long-term research options. As (Adam, 1993) put it, "the research staff work under extremely difficult conditions. Salaries and incentives are limited and not sufficient to promote the use of modern technology for research".

Usually an individual researcher or a research department in an organisation or an institution is not able to afford the costs of using computing technologies in research and development. A lack of understanding of the impact of electronic communications on the telecommunications infrastructure and the impact on research and development is one of the persistent challenges to network development.

2.4 Extreme Dependence on External Technological Sources

There is an extreme dependence on external donors in the area of information technology. This dependence could be in the form of finance for purchasing equipment or computer hardware and software donated to an institution. According to (Adam, 1993), this has a few disadvantages such as:

1. The use of information technology is mainly limited to themes selected by donors, consultants, etc. If the donors have donated equipment which they want to be used in the engineering department of the school, then even if there is a greater need for the equipment in the computer science department of that school, the equipment cannot be shifted there.
2. There is an overall dependence on the importance of information technology equipment and accessories, often at high cost. Such dependence limits the type of scope of use of the equipment and is often controlled by consultants. These consultants may be preaching their own approaches which usually lack concern for the growth of national networks (Adam, 1993).

Despite these disadvantages, external sources are very important in bringing the Internet to Africa. They have the financial resources, which are needed in order to purchase equipment and train the system operators and users. Without them it is not feasible to try and implement a network plan in Africa which will benefit a greater part of the population. So there actually has to be a trade-off between the resources which have been donated by these external sources and the control that they have over the use of equipment.

2.5 Lack of formal training in the area of networking

There is an observable slack in the area of formal training in computer networking. (Adam, 1993) observes:

There is a lack of formal training in the area of networking in Africa to give a broad view of electronic communications, including telecommunications policies and intermediate and advanced networking technologies. Network administration is a new field, even in developed countries, and it is often difficult to find skilled resources for it

Because of the lack of training in network design and management, and the fact that those who are skilled in the networking area move to places that offer better salaries which is usually in foreign countries, there is, therefore, a shortage of human resources in the field in Africa. In order to curb the brain drain, industries should be challenged to give salaries and conditions of services, which are comparable to those in countries, where the experts in computer networking are moving to. To curb the brain drain, industries should be challenged to give salaries and conditions of service which are comparable to those in the countries where the experts in computer networking are moving to.

2.6 Lack of culture for sharing information

In academic institutions and industry there is the problem of lack of a culture of sharing information, which should exist mainly in these circles. There is an unwillingness to share information and resources, maybe because of the competition for foreign resources.

With companies which are competing, this is understandable. Each of the companies wants to get ahead of the rest of the competitors by improving services and, therefore, increasing their customer base. In academic institutions, this problem sharply limits progress in the area of computer networking. If one has an idea or information that they have been able to source, then sharing it with others will also improve their understanding and maybe bring in new insights that they had not realized before.

3. Suggested Solutions

The problems, which have been listed in the previous section, have seriously affected the connectivity of African countries to the Internet. Although the Internet is essential, building intensive Internet connections require a thoughtful plan, long- term commitment, financial support for sophisticated Internet technology, sufficient human resources to run sophisticated networks, and in-depth knowledge of networking.

3.1 Sensitisation and Teaching

Sensitisation and teaching are important activities in networking. Continuous sensitising and teaching theory of networking costs system operator's time, but is most useful during the first stages of building a national network. There are several ways in which people can be sensitised on the use of the Internet. One method is to introduce electronic mail (email) through easy and understandable means.
Email is an Internet facility, which can be used by anyone needing to send a message to someone else who is connected to the Internet. This facility should be automated and user friendly in order to catch the attention of researchers in different fields who have no interest in the Internet.

3.2 Frequent Updating and Change

Communication resources are usually used up to the extent they become available. Networking is a dynamic area that needs frequent updating and change. Realising the fact that there is a continuous change in computer technology, there is a grave need for frequent upgrading of the equipment that an organisation has, and an improvement in the skills of the people in the computer field.

3.3 Collaborate with PTCs

Government-owned Posts and Telecommunications Corporations (PTCs) have been one of the major stumbling blocks to networking in Africa. PTCs actually claim to know much about networking than they do. If policy makers and key industry players collaborated with PTCs, they would be able to encourage each other in networking technology.

PTCs should also acknowledge that electronic networking would not threaten their networks or reduce annual telephone bills but would rather improve their capacity and generate demands for newer services. In essence, this would be an advantage for the PTCs. If they have improved services, they are better able to compete with new players who come into the telecommunications market. Thus, long-term collaboration schemes should be established between community and government PTCs.

3.4 International Cooperation

The networking map indicates that Africa lags behind all other continents in the use of data communications technology. While the global Internet is growing at a phenomenal rate, its potential changes to society are becoming immense, and the creation of a truly global internetworked research village is becoming evident. Isolation from this global movement is still very much in evidence in Africa. African network enthusiasts can only become self-sufficient through learning from the experience of the international community.

3.5 Institutional Support

Institutions play a major role in promoting networks. Lack of institutional support and political will to promote a network initiative are, according to (Pimienta, 1993), major stumbling blocks to networks in the region. To quote him directly, "Building of network user groups, supporting official structures for academic institutions such as science and technology commissions, and involving active researchers to obtain political backing from their institutions, " are ways of improving institutional support.

3.6 Financial Resources

Technical plans and network architectures should be based on available financial resources. (Pimienta, 1993) lists the following as major costs of a network: the coordination of a network from conceptualization to implementation, the installation and configuration of a network, network support, including training (user support), the maintenance both at user level and at nation level and communication costs. Dependence on foreign assistance to cover all of the above costs makes national network overly dependent. When such donors withdraw, national networks may be jeopardised. (Pimienta, 1993) suggests methods of building cost recovery tools into the national network to help to support it. Some of these tools include institutional subscription fees, additional fees for conferences or other Internet services and training and support fees.

3.7 Technical Plan

A sound technical plan is also a critical element in sustaining a network. Networks should match national infrastructure and user requirements. (Pimienta, 1993) suggests an affordable yet advanced entry solution such as UUCP, a migration strategy to Internet, and the development of Fido-based networks wherever and whenever appropriate. (Pimienta, 1993) further suggests that concentrating efforts toward building large national hosts (rather than numerous smaller nodes) allows for better transmission media and continuous support for the improvement of bandwidth.

Wireless technologies are actually being seen as one of the most important ways of addressing the needs of a continent with the least developed telecommunication systems in the world. (Jensen, 1996) though argues that "although wireless systems can offer far more rapid roll out times, greater reliability, lower maintenance costs and better security, wireless Internet connections are also not inherently more viable than wired networks – they are more appropriate in applications where traditional solutions for some reason are not feasible or cost-effective. These traditional solutions would include access to the Internet via a telephone line and a modem.

Apart from the additional equipment that makes wireless systems more costly, they often require skilled technicians to install. The TCP/IP protocol was designed for a relatively error-free environment and, according to (Jensen, 1996), many wireless technologies are inherently prone to errors.

Conclusion

Although Africa is lagging behind the rest of the world in Internet connectivity, it is rapidly trying to catch up. Africa has realised what a cost-saving measure it can be, and how it can address the big problem that Africa is facing, which is isolation. The past three years have seen an explosion of Internet sites, by Africans for Africans. The Internet is also becoming increasingly sophisticated in the dissemination of news and information and dozens of African newspapers are now producing editions that can be read on a computer screen.

The Internet is a communication tool that should not be confined to industrialised nations and begs to be utilised now to address Africa's chronic need for communications and development of education. The ushering of Africa into the new information age will be realised through a partnership of African governments, private business and donor agencies. The desirable outcome is a sound telecommunications infrastructure, decrease in access costs and equipment costs, proliferation of telecentres in rural areas, heightened computer awareness and improved communication.

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AGENT-BASED WORKFLOW SYSTEMS IN ELECTRONIC DISTANCE EDUCATION

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Abstract

Current workflow systems largely assume a closed network where all the software is available on a homogeneous platform and all participants are locally linked together at the same time. The field of Electronic Distance Education (EDE) on the other hand requires the next-generation workflow that will integrate workflows from a distributed heterogeneous environment in order to support students who are not only dispersed over a wide geographic area but are working at different times. The notion of agents, particularly mobile agents provides an elegant way of executing workflow processes across geographic borders. This paper looks at integrating agents into the current workflow systems that support distance education in order to create a theory for the design of intelligent workflow systems. This will enable an active collaborative work among participants who subscribe to EDE.

Introduction

The Internet has accelerated the development of electronic distance education (EDE) as a medium for providing efficient global communication. At present numerous virtual universities have sprung up. However, none of these sites is totally automated as human intervention is required for routines such as exchange and assessment of course work. The teacher makes no provision for the student to initiate submission of course material. Almost equally passive is the teacher's action. Here the teacher sends the student course material and waits for the student to reply via e-mail. There is no automatic notification of the tutor once the coursework arrives on his machine. A push strategy is required to speed up submission of course work by the student and quick response on evaluation from the tutor.

Neither EDE nor the Internet respect artificial boundaries and the teacher and student may be situated at many different locations spread across the world. A worldwide audience of students is able to benefit from one specialist in a particular field through subscribing to EDE. The quest for higher education will see a lot of movement towards EDE. Therefore methods have to be used to ensure efficient student –lecturer interaction in an EDE environment. The other reason why there is need for efficient EDE implementations stems from the poor data communication infrastructure installed in most developing countries. This infrastructure was meant to support voice traffic rather than data. The bandwidth is generally limited leading to reduced performance. The result has been increased timeouts as students try to download their courseware. In most cases the bandwidth is limited to 64k putting a strain on the system and in some cases resulting in congestion. The use of automated systems will result in reduction of congestion in the network. Data can be cleared pretty fast due to the use of agents which are employed in the routing process. The longer the data stays in the system the higher the loading of the system.

It is inevitable that EDE systems will use different software and hardware platforms. To support such a heterogeneous environment, EDE software must be able to execute uniformly, unaffected by the platform on which it is executing. Automated mechanisms are needed to cut across the different virtual environments.

In education, just like in many business applications decision-time is a crucial factor that provides a cutting edge over competitors. Reduction in interaction time through automation in education requires close coordination between the tutor and student. But more EDE applications still involve a substantial human element, which in turn limits the speed at which interaction occurs. Consequently a major objective of EDE research is a reduction in human involvement in the intermediate stages of course delivery. An EDE system should therefore support the ability to embed intelligence in the system, to automate strategic decision-making that was traditionally performed by humans. Moreover the decision-making capability provided should be dynamic, reacting to user needs and the current environment.

Typical course offerings over the Internet require many interactions, each of which must be communicated over the Internet, which is much faster than prior human-to-human communication but relatively slow compared with the computers that the Internet interconnects. An EDE system that can perform interactions locally without repeated Internet communication will achieve significant performance over prior approaches. To satisfy these requirements for an EDE system, mobile agent technology emerges as an appropriate technology. This technology allows an agent in the form of program code, data and execution state to be packaged into a message and sent across the Internet to remote computers. The mobile agent can execute on remote computer, and only bring back the results to .

In the educational marketplace, many suppliers adopt a push strategy to announce their coursework and conduct surveys of student response to the quality of the coursework. Traditionally this has been done by humans, who visit the student on behalf of the tutor. With appropriate automation, mobile software agents can be sent to many student sites, quickly and with low cost, obviating human involvement in the educational process. Mobile agents can be used as student assessors to determine the quality of education. In the past this would have been achieved by querying many students individually in a student survey, analysing the response, and determining the optimum quality of teaching and to maximise the student. With mobile agents these calculations can be done dynamically at student sites, to determine the student response and quality of courseware and to adjust the courseware accordingly. The objective of the mobile agent technology is to maximise the returns of the courseware.

Workflow automation is emerging as the most rapid, cost-effective enabler of change even in EDE. It allows organisations to become more adaptable by continuously customising their work processes. Workflow automation achieves this through intelligent applications of codified business rules, processes and best practices, and by automatically providing the right individual with timely access to relevant information. It allows employees to perform their jobs more efficiently and cost-effectively. Workflow automation in conjuction with agent technology will improve the efficiency of EDE-related workflows.

2. What is workflow automation?

Workflow automation is the automation of business processes, in whole or in part, during which information of any type is passed to the right participant at the right time according to a set of intelligent business rules [White, 2000]. This allows computers to perform most of the work while humans have only to deal with the exceptions. At its most basic level, workflow is the passing of documents, information or tasks from one participant to another, or from one application to another. Workflow automation has the potential to deliver the following benefits:

- Improved productivity
- Reduced operating and labour costs
- Improved customer service
- Increased sales
- Reduced waste and duplication

- Improved access to timely information
- Minimal IT and job-specific training

Routing, rule enforcement, role/relationship definition and tracking/auditing are essential characteristics of workflow systems. Routing involves transferring information from one defined person or automated process to another. For example, data from the fixed format part of a Web questionnaire might be routed to another program for analysis, while data from a "comments" section on the same questionnaire might be routed to a human being for review. Rule enforcement is a defined procedure that determines the action taken when a particular information task is received. A rule might state, for example, "If a sale decreases inventory to a certain level, then launch a new work task to restock that item."

Role/relationship definition is a group of one or more people in a workflow environment who share common responsibilities [Workflow, 2000]. For example, "authorized virtual university student" could refer to any one of several individuals who might fulfil that role. Data in a workflow system is often routed to an individual by virtue of their authority to serve in a specific role. The assignment of a specific person to take on the role is based on who is available when and where a particular task needs to be done. Tracking/Auditing is the ability to readily find out where a particular task is and where it has been already. This capability is often missing from the processes that automated workflow systems are intended to replace, i.e. the old "it must be lost in somebody's inbox" problem. Questions such as "has the course material been delivered to the authorised student', and "has the right course material been delivered" are answered by this.

Workflow systems can be classified as image-based, form-based and co-ordination-based [Workflow,2000]. Image-based workflow systems are designed to automate the flow of paper through an organisation, by transferring paper to digital images. These are used in EDE to transfer documents between the student and the lecturer. These were the first workflow systems that gained wide acceptance. Form-based workflow systems are designed to intelligently route forms throughout an organisation. These forms, unlike images, are text-based and consist of editable fields. Forms are automatically routed according to the information entered on the form. In addition these form-based systems can automatically remind people when action is due. They can be used be the tutor to alert students when the coursework is due. This can provide a high-level of capability than image-based workflow systems. Form-routing systems vary from traditional vertical market workflow systems, like those used for insurance claims processing, to the recent crop of products that handle general administrative tasks like travel expense reimbursements across many types of businesses. Coordination-based workflow systems are designed to facilitate the completion of work by providing a framework for coordination of action. The framework is aimed to address the domain of human concerns (business processes), rather than the optimisation of information or material processes. Such systems have the potential to improve organisational productivity by addressing the issues necessary for customer satisfaction, rather than automating procedures that are not closely related to customer satisfaction. They are useful in defining the sequence of course modules in EDE.

Workflow systems can also be classified as queue-centred systems, ad-hoc systems and collaborative systems. Perhaps the most familiar queue-centred system comes in the form of telephone interactive menu systems, where you wait till a person is available to handle your request. In distance education the student sends in their assignment and wait for the teacher to reply. These systems can be more complex when they provide, for example, elaborate workflow handling for exceptions, or serve as a front end feeding into other workflow systems. Ad hoc systems mimic what was once done in face-to-face meetings and phone calls. They typically exploit the ability of "GroupWare" software and modern email systems to handle routing slips, voting, etc. Circulating resumes or getting approval of minutes are two examples of how such systems are used. This form of workflow is also finding application in distance learning where it can be used to simulate traditional classroom interaction. Collaborative routing systems are appropriate workflow tool in a regulatory approval process, for example, where circulating drafts are to be reviewed and revised until they are rejected or approved for handoff to the next system. These systems may handle both highly structured data typical of "forms routing" systems as well as less formal data characteristic of ad hoc systems.

Agents in conjunction with workflow automation offers a chance to improve the efficiency of EDE-related workflows.

3. What is an agent?

An agent is a simple heterogeneous autonomous communicating software component. Autonomous agents are able to work on behalf of the user without the need for any interaction or input from the user. They act without human intervention, tirelessly performing tasks. Some of these systems scour the world's databases, usually via the WWW or other generic access methods returning interesting and relevant information such as the literature recommended by the tutor.

Intelligent agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing employ some knowledge or representation of the user's goal or desires. A typical example might be an information-gathering agents. Agents operate without the direct intervention of humans or others and have some kind of control over their actions and internal states. Many agents are meant to be used as intelligent electronic gophers - automated errand boys. Tell them what you want them to do - search the Internet for information on a topic, or assemble and order course material according to your desired specification - and they will do it and let you know when they are finished.

The typical client/server architecture communicates via requests and responses, which require a round trip trek across the network. Often the client and server pieces are on separate machines and they communicate over the network. When the client needs data or access to resources that the server provides, the client sends a request to the server over the network. The server in turn sends a response to the request. This 'handshake" occurs again and again in a traditional client/server architecture.

In mobile agent architecture, the client actually migrates to the server to make a request directly rather than over the network. When the client in the mobile agent architecture needs data access to a resource that the server provides, the client does not talk to the server over the network. Instead the client actually migrates to the server's machine. Once on the server's machine, the client makes its request to the server directly. When the transaction is complete, the mobile agent returns home with the results.

Mobile agents solve the client/server network bandwidth problem such as that arising in EDE as a result of the poor communications infrastructure versus efficient student-tutor interaction. Network bandwidth in a distributed application is a valuable and sometimes scarce resource. A transaction or query between a client and a server may require many round trips over the wire to complete. Each trip creates a network traffic and consumes bandwidth. In a system with many clients and/or many transactions, the total bandwidth requirements may exceed available bandwidth, resulting in poor performance for the application as a whole. Mobile agent architectures also solve the problems created by the intermittent or unreliable network connections. Agents can be built quite easily that work "off-line" and communicate their results back when the application is "online".

A mobile agent is an entity composed of two different pieces. One piece is the code itself, which consists of the instructions that define the behaviour of the agent. The second piece is the current state of execution of the agent. Often these pieces are separate. For example, in a typical computer program, the code sits on the disk while the executing state sits in RAM. A mobile agent however, brings the two together. When an agent migrates to a new host, both its code and its state are transferred.

If the state monopolises telecommunications, there are no controls to the prices that they will charge for accessing the Internet. The problem is even compound in Africa because of the few telephone lines, which exist. (Cohen, 199) puts it this way: "A few statistics illustrate why the basic requirements of access-a-telephone-line presents problems for less industrialized countries. Globally, 49 countries, 35 of which are in Africa, have less than one telephone per 100 people". The lack of telephone lines in some areas makes it difficult to cultivate an Internet culture, as there is need for a telephone line and a computer in order to be able to gain access to the Internet.

Besides not having reliable telephone lines which are necessary for usage of the Internet, cost is also inhibitor to Internet access. (Guinness, 1999) states that access is:

...typically at around US$3 for half an hour...Equipment prices are [also] high once you move north of South Africa. Add up to a third once you hit Namibia or Botswana, more as you reach Zimbabwe and northwards. In one very typical African country, even a modest secondhand PC can cost at least $1,000- the price of a new machine in America. And signing up to an ISP [Internet Service Provider] could cost $130 a month.

Some governments at times tries to regulate the content of the information accessed over the Internet. According to (Cohen, 1999), this happens in countries where telecommunications are monopolized by the state. Governments can also restrict access for political purposes and economic gain. (Cohen, 1999) further observes: *"Globally, some governments have chosen to control the liberalising effect of the Internet by denying access to entire segments of their populations, either through exorbitant charges or by confining access to select groups".*

4. The link between agents and workflow in EDE

The concept of an agent, in particular that of a mobile agent which travels around the network on behalf of its owner has gained significant interest in various areas of computation such as Artificial Intelligence, distributed computing and communications [Chang, 2000].

Workflow processes are associated with these agents. For example, a typical organisation usually has its own workflow process defining business activities and overall control flow of work. It seems reasonable to assume that mobile agents in a collaborative environment should have process information embedded within them in order to find a target destination once an activity has been initiated. Additionally a mobile agent must know the various characteristics of the actual roles involved with workflow processes. For example, a mobile agent at a project leader's machine may have all the access priviledges to a deliverable schedule, while a mobile agent at a programmer's may not. Obviously, this difference is not bound to an actual machine but by the roles participants play. Infact, if a programmer is allowed to act as a project leader, (perhaps because the project leader is sick), a mobile agent must change its characteristics dynamically in order to avoid any disruptions in the workflow process.

Virtual universities are a natural application area for image-based workflow systems, since they still process enormous amounts of paper work. Virtual universities can adopt workflow for the routing and control of documents in the form of images between tutor and student. It is almost impossible to make use of imaged documents without implementing workflow software at the same time. Workflow is viewed as primarily a means for tracking and controlling documents. The five benefits for adopting workflow systems are the following. There is faster processing of work, since the total transaction time is generally much greater than the time to complete the work steps. Workflow systems are usually based on the client-server architecture, as opposed to mainframes. The information processes of the "work flows" are made explicit and are more easily changed. The amount of paper used is reduced. eliminated. Financial losses from misprocessed paper are also eliminated.

Workflows in EDE involve the following procedures:

- Rapid information dissemination of coursework from the tutor to the student
- Submission of assignments to the tutor by the students in the shortest possible time
- Efficient feedback mechanism on submitted assignment from the tutor to the student.
- Evaluation of the quality of coursework by student for the tutor
- Authentication of access to resources by students who subscribes to a particular university
- Collaboration with other virtual institutions on exchange of course material
- Connecting students who subscribe from other virtual institutions
- Search for literature across the Internet/Intranet /Extranet as advised by the tutor.
- Scheduling of courses
- Computer conferencing hours between the tutor and student.
- Scheduling of examinations
- Tutoring

4.1 Student assignments

In traditional paper-based distance education, course material follows a sequential route through the tutor, post office and student. In contrast companies employing workflow utilise imaging systems to manage information. The course material is entered into a computer system. With a few strokes information is routed, tracked, stored and managed by mobile agents. Students in different geographic regions can simultaneously access the material, perform their assignment, and send it back to the tutor. No multiple copies of a document are needed in order for the different students to work on it. At the stroke of a button the coursework is sent back to the tutor.

4.2 Authentication of students

Depending on the structure of the virtual university, if the courses are available over the Internet, then there is free access for all to the course material. But where an Intranet/Extranet exists access to courseware is controlled. For example, where an Extranet exists, the virtual organisation mails the password to the subscriber, and where an Intranet is concerned only the staff and students can have access to the password that allows them to access the resources. Agents can come in at several points. There can be an agent to direct a student with a particular password to the appropriate resources. Another agent to trace a product, i.e. that student X has not been sent the same assignment twice.

The agent should incorporate features that ensure minimum delay in transfers. The agent should monitor the routing options and select the most optimum route. The agent can enforce security by preventing unauthorized access to the data itself by other users of system other than the recipients. This agent should be able to determine multiple retransmissions and therefore block retransmission of same data. Systems without agents suffer service degrading due to too much traffic load.

4.3 Search for literature across the Internet/Intranet /Extranet as advised by the tutor

The sheer quantity of information accessible through the Internet poses the question of where to start searching for prescribed literature and where to go next. Another problem is that the networkable capabilities of many current systems mean that the data to be examined may exist on many different machines in a variety of forms. This means that a variety of access protocols have to be used in order to obtain the data in the first place, and then it has to be converted into a suitable format for integration with other data sets currently under investigation. The problem of searching for data is suited to an agent-based approach. Setting the agents off and allowing them to integrate data sets from different databases across the world requires autonomy and asynchrony [Beale, 1994].

4.4 Scheduling courses and exams

Having a desktop agent that can manage your time and scheduling of multiple courses is an example of a local application that is suited to agent-based interaction. This task is inherently difficult due to the problem of trying to satisfy multiple sets of time constraints, and due to the asynchronous nature of the information transfer between geographically separate users. Each user has to have an agent that is able to communicate with other agents.

4.5 Tutoring

The heart of tutoring is an intelligent agent. This agent imbeds sufficient knowledge of a particular topic area to provide "ideal" answers to questions. The Intelligent Tutoring System [McAuthur] can monitor the student as he/she solves algebraic problems and can determine every step in the right direction. Tutoring agents are entities whose ultimate purpose is to communicate with the student in order to efficiently fulfil their respective tutoring function, as part of the pedagogical mission of the system [Mitsuru, 1997]. So, educational applications, in general, are based on Tutor and Mentor agents.

4.6 Assesment of student work and quality of courseware

Pedagogical agents have a set of normative teaching goals and plans for achieving these goals (e.g., teaching strategies), and associated resources in the learning environment [Thalmannn, 1997]. The utility driven agents (e.g. Web agents) are used by pedagogical purpose like reminding the deadline of homework.

Conclusion

Workflow systems for EDE need to combine flexibility with optimisation. Agent technology offers mechanisms for such. They support not only local but decentralised, distributed and flexible workflow through asynchronous communication. This research looked at the integration of agents into EDE workflow systems, and how this integration improves the efficiency of these workflow systems.

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Conceptions & Tensions, Theories of Action, for Embedding Learning Technologies in Higher Education

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Abstract: An evaluation studied the perceptions and structure of awareness in program designers involved in a consortium of programs for supporting embedding of learning technologies in higher education. Technology embedding was idealized in terms of alignment of use with learning objectives, alignment of different technologies and practices, penetration within the university, and alignment with cultural perspectives in organizations. Frameworks for developing skills in technology integration were discussed in terms of integration with course production, through training programs, through evaluation activity, through research activity and by creation of new institutional structures. The study concludes by outlining possible tensions in the EFFECTS theory of action, 1) between academic's operational needs, demands and the potential for those interests to develop into scholarly reflective practice; and 2) between accreditation as a motivator to participate and the disincentive of evidence reporting and 3) between the often technical skills offered and the scholarly goals intended, and 4) between the widespread operational need for skill development and the mostly teaching staff target audience for the program.

Introduction

The limitations and costs of poorly integrated technologies often obscure their benefits and, as a result, the technologies and their use do not receive wide-spread understanding or achieve effective use. This gap between affordance and understanding signals a need for professional development. The EFFECTS project is a multi institutional initiative in English Higher Education funded by HEFCE and DENI as part of TLTP (the Teaching and Learning Technology Program). The project objectives are given by Oliver and colleagues (1998) as, "to draw up a professional development program (for academics) so they may receive accreditation by developing a set of generic learning outcomes for staff development in the use of C&IT that will enable existing courses to be accredited at a national level." This paper studies the program designers' perceptions and beliefs about actions required to achieve the program goals. The EFFECTS project is part of a strategic approach (represented by the broader goals of TLTP) to achieve long term high quality teaching and learning with technology. The evaluation study is scoped to include useful data that will inform this overall goal.

The Study

There are five institutions involved; as results are presented below the reference to each institution has been omitted to protect confidentiality. A co-constructive interview approach began with a series of questions developed in conversation. The approach implies the continuous development of understanding in the target area. New issues and questions are introduced at each data collection event depending on the researcher's sense of progress and opportunity. This process is not specifically designed to enable inter-institutional comparison but rather for developing a coherent and progressively deepening sense of the perceptions held by program developer group. The first set of questions addressed program designers notions of embedding and of frameworks. This progressed to discuss the target audience for the programs, strategic role and alignment with organizational practice, implications for organizing practice and chances of substantive scholarly results, the role of institutional independence and centralization on success.

Findings

The question, "What is embedding?" was dealt with mostly in our first interview and we were able to provide three aspects of embedding that capture the perceptions in the project. The first, technical integration, describes the extent to which systems work together in this case how well technical systems work with the human systems in place in the university. The second is described as cultural integration which describes the normacy of use. The third aspect of embedding is the alignment of learning outcomes with the affordance of the technology. This aspect can be ascertained though first understanding the teacher's learning goals for the instruction and then having them reflect on the value of the technology in achieving these goals. This dialog continued after discussing definitions of the concepts to elaborate short case-studies which illuminated each of the three conceptions. The discussion continued to elaborate on another three possible conceptions for the idea of a framework. A second series of questions considered the *impact* of the EFFECTS programs in each of the sites. This topic helped illuminate differences among the institutions involved. One group stood out from the rest in the by showing no interest in developing an accredited course in the area. They preferred to see their role as understanding 'the integration problem'. However each of the other sites have had significant difficulties and become progressively indifferent to the idea of the accredited course in learning technology integration until at the time of writing the evaluator's impression is that only one group is strongly in favor of the approach.

What's in a Course?

_The EFFECTS program is specifically about *courses* for professional development to be accredited at a national level. For a student a course may be a hurdle to qualification or a focus for interesting activity, for a university administrator it is a unit of production in the workflow, and for peer quality control it is a suitably targeted, contained, consistent and financially sustainable activity. For staff developers, courses do not normally follow the same pattern as for academics. For most of the partners the content and syllabus of the academic staff development programs are determined partly by the emergent needs of the participants. Such a "syllabus" might eventually include everything the course participants need: principles of instructional design, practical media development expertise, a reflective practice approach and an understanding of the available tools and techniques. But syllabus is generated by the nature of program participants not necessarily by the needs of the institution for development and attainment of high-quality teaching and learning with technology. Neither is the content specifically determined by any notion of discipline integrity (what the learner's ought to know). In two of the interviews the informants demonstrated reservations about the course model, instead one identified a "research" approach where there was no use of accredited professional development or evidence-based assessment.

> "Philosophically I don't believe a course is the right way with this, this is a research program about coming up with a framework which is a different entity in my mind/my way of thinking. So I thought right we can use this money to bring a person in who will actually have one leg in learning resources and one leg here, they had to have higher education teaching experience and experiences as a techy in some way shape or form, actually doing stuff as a techy so they talk in both languages not an easy combination to get hold of, [ ] he's done a tremendous job and he's bridged that gap."

Another concern with an accredited program delivery method is one highlighted by commentaries on agencies of change (*e.g.*, Balogun & Hope-Hailey, 1999). This is a concern which applies to change agencies rather than to professional development programs *per se*. The pertinence of the concern therefore depends on the goals and evaluation stakeholder interests, which for the EFFECTS project, remains unclear. Balogun and Hope Hailey tell us that in an *educational* model for change that participants can very easily voice support and then walk away and do nothing. These symptoms were found in several places and appear a major reason for flagging enthusiasm among tutors. In one site it was the intention to keep an on-going cohort of staff who could share development experiences which would be gained by reflection on action. This group found, on their pre-accredited pilot course, while interest in the targeted support was strong, the motivation for the accredited certificate was not high and participants were not interested in completing aspects of the course that would eventually lead to certification. Participants may walk away either because they don't support the goals of the program or because the method of achieving those goals is not consistent with their work goals and practices, or because there are other pressures on their time which reduce the priority of the activity. Program developer views were based on time constraints.

> ""I mean a lot of them said they appreciated the course and they would like to have spend more time going through the materials but once they were out of our room they just didn't touch it, didn't have time to go near it. [ ] perhaps there is a degree of naivety in thinking that accrediting a program like this would have been a reasonable carrot for most academics and maybe this sort of gets to the heart of the institutional differences [ ]. You don't stop teaching the students, you don't stop doing the other administration because other people place pressures on you, so the one thing that goes is the thing that I have control over – my own staff development. It is short sighted from the individuals point of view, it's short sighted from the University's point of view but it happens all the time."

However it is a particular view of staff development that places new skills acquisition in the peripheral role that a course approach suggests. That the individual can walk away from the program without affecting their short term goals may suggest a problem with the program design. The reflection-in-action (Schön, 1983; Schön, 1987) and activity research approaches to professional development favor the realism of practice as context for development which in this case would be the teaching which the informant claimed was impossible to interrupt. The problem appears to lie in the design of a reflective action model within the framework of a course. The course model seemed to cause difficulties with the organizational culture of validating academic effort. At least two of programs experienced frustrations in their course validation process. While in each case these have been overcome, the difficulties still attest to the unfamiliar and unusual pedigree of the programs. One participant declared their motivation for the course was not in-line with what is expected by the standard course validation process.

> "The validation panel said "look when you validate an academic program we're only interested in the outcomes for the individuals, we don't care what the institution needs we only care about the outcomes for individuals" so we went away and rewrote our course proposal to say "individuals really need to have these skills to cope in the current climate" and so on. We had done that work of translation well enough to pull the wool over their eyes [ ] they explicitly did not have that perspective that we had as developers."

From the academic staff development perspective the program would provide skills for the functioning of the university which were needed for successful progress. However the validation committee is more used to accepting courses on the basis of student demand and discipline integrity. In one site we found the course was not accepted at the first validation stage. In this case the problem was lack of academically qualified teaching staff and was solved by bringing in external professorial teaching and research resources from academic units outside the support group. In this way aligning the teaching function of the initiative with the teaching organizational units in the university. At two sites it was demonstrated that without the willing support and active participation of others involved in the information infrastructure in the university, these skills would not amount to successful integration. The successful achievement of improved teaching and learning with educational technologies is unlikely while treated as if it were the sole responsibility of the teaching academic or even the academic in partnership with the staff developer. Teaching in this sense involves other important roles in the university, librarians for example, technical support systems, general information infrastructures, policy commitments and champions in positions of influence. The lessons of other programs and projects of enhancement also suggest that focusing on academics' competencies is insufficient to achieve quality delivery (Bates, 2000). The EFFECTS project was not directly concerned with non academic staff (which is clearly stated in the project objectives) and to this extent may be misguided but program developers demonstrated their experience of attempts to address the issue.

> "I think in this institution we have been very successful in accreditation schemes for academics, so we have the Learning and Teaching in Higher Education course we've been able to put together Embedding Learning Technologies and lots of other modules. But an attempt by people in the support areas to put together qualifications for support staff has been met with great resistance."

The program emphasizes *scholarly practice* to support reflection on operational activity which represents a departure from traditional approaches and deserves attention. The tensions between need for technical support and the desire for scholarly practice combined with limited time signal a concern which we explored with the informants. At one site after beginning with a cohort approach a more personal approach soon became the normal mode of interaction. It appears that much of the support (particularly when provided one-on-one) took on a technical flavor and was generated from the immediate problems, interests and concerns of the participants. One reason for this was that the skills available from the support person serving the EFFECTS participants were often technical and so the support was almost inevitably technical but those with a learning agenda appeared to experience similar reactions.

> "I have an education background and I find they tend not to like having the educational input and they get very uppity about it, so you have to couch that in the technology part, in a way you have to be technology led and then feed in the other part, back to front, because they see someone as coming and teaching them what they already know. Even though of course they don't and its different with the technology in any case."

The interviews suggested that support of a pedagogic nature was less welcomed by the participants and for that reason was hidden within suggestions about the technology (technology as cover story) rather than made explicit. Technical support may well be what the clients of a project like EFFECTS would want and our informants often believed this.

> "There's a study done by the TALISMAN project [ ] which revealed that the number one thing that people want or need in order to get started with learning technologies is technical support. Number two is training, skills development in particular and sort of knowledge about how to use learning technologies and the education side I'm afraid comes like third or fourth quite often."

Both of these explanations alert us to the possibility that demand or needs-led approaches may, without additional interventions, inherently tend toward solution-oriented knowledge acquisition and a particular set of materials and experiences rather than acquisition for understanding (Ohlsson, 1997). In as far as the EFFECTS programs have been demand-led in their interactions with participants this would affect the nature of any scholarly work done and would seem to affect the potential for development and change. The benefit and particular use of different technologies was under-stated in the interviews. The technology referred to most was the centralized computer-based testing system that was referred to extensively in two places. The value of this was introduced each time as a solution to a teaching and learning problem.

> "[the problem was] particularly assessment, you know they have cohorts of up to a couple of hundred and they had to do assessments for all of them and it was just taking so much time, they were looking for some method of automating it."

This technology plays a learning management support function rather than a teaching and learning one. It is more integral to administration of learning than to learning itself. If the balance of technologies referred to in the interviews were reflected in actual implementation this would also be a cause for concern and one intuitively consistent with a demand-led approach.

Institutional Independence.

In considering the direction that the EFFECTS project takes in relation to national initiatives it is worth recalling what the Dearing report had to say about the centralization of information and communication integration plans.

> "We believe that the creation of C&IT strategies will create a focus for debate within institutions and throughout the sector. Central initiatives can help, but they alone cannot deliver our vision of higher education for the next century. Institutions themselves must do that through ownership of their C&IT strategies. Dearing report (CIHE, 1997) 13.19.

Others have noticed the trend which is counter to those commercial organizations for the public sector to develop what Blacker critically calls the new machine beurocracies (Blackler, 1995). So should teaching and learning strategies be any less in the control and ownership of the individual institutions? Does centralized accreditation and framework alignment make individual creative design any more difficult? From our interviews is seems that the EFFECTS project compliance with SEDA, is viewed positively because their framework is designed for professional development in mind. The framework regards reflective practice and support as key to development and while maintaining or proposing a resource-based academic investigation has tried to avoid occupational standards and competency oriented outcomes approaches.

> "I mean we have a really large team delivering that course, we do it in a way which is based very much around the SEDA model, very much about values and support, supporting people in the first year of their experience of being a lecturer and they have this real cohort to really support one another it's like their first experience of being in a cohort sort of thing. That's not true for all but I think there's lots of things about that course which are very motivational which are nothing to do with the fact that there is accreditation at the end of it. [ ] It's about the SEDA values and reflective practice more than it's about accreditation."

It is hard to see that a set of very general and apparently well-designed professional training guidelines could detract from the success of initiatives to develop the goals of the EFFECTS project. However it is also hard to infer from the SEDA guidelines the kinds of strategies or alternative frameworks suggested above. What's at stake here is whether approaches other than those of staff development, for example, central management of projects, doctoral programs in teaching disciplines in each faculty, and others, are likely to arise from staff development workshops. In the author's tentative opinion such are the theories of action from other communities of practice and would be unexpected. Exactly what could be expected from the design of a project like EFFECTS in terms of relation to national policy is not clear. We cant read the hypothetical basis for action taken by HEFCE in supporting this project. However the intention of the project to provide a framework for national accreditation would suggest alignment with the centralizing agenda and would certainly signal the concerns raised several times by Dearing. Institutional independence from national initiatives could allow other approaches to take hold and yield a better chance of at least some institutions achieving successful integration. Even after this evaluation the nature of EFFECTS in terms of strategic approach remains unanswered largely because of access difficulties with stakeholders. The important issue for programs like EFFECTS is that if it really is a strategic approach then it can be evaluated as such by the normal criteria associated with agencies for change. Is it the result of sensitive analysis of roles and needs? Is there a well-defined transition state to which the project is directed? Is the program a collaborative, participative, coercive or educational initiative for change and is the selection of method appropriate for the cultural and social context of the organization(s) involved? The project does not make explicit these choices within the bigger picture of change in higher education and because of this may leave itself open to the critique that the project has no clear idea who it serves.

> "The points of difficulty are around things like areas of responsibility for the computing services training team as against' educational development as against staff development where traditionally staff development is for non academic staff or is sort of for everybody who is non academic, whereas education development is traditionally academic development and computing services traditionally train people to use computers. [ ] in practice organizations are not just individuals as learners they are also

empires and power structures and people wanting to hold onto their bit of security, that's the big thing you that you come up against."

In fact the weakest point in the evaluation comes from our inability to identify and access the evaluation stakeholders. The project has argued (EFFECTS, 2001) this issue need not be addressed because its only objectives are processes for the positive and constructive growth of professional and personal development. However, with the deliberate selection of resource-based learning, the provision for evidence based assessment and the proposal for centralized brokerage of credit, its hard to take this claim at face value.

New Institutional Directions

Here we look at some of the developing initiatives in the institutions affected by the EFFECTS project. While program developers were often understandably frustrated by difficult working relationships with support groups in the rest of the university several constructive solutions were suggested. One approach would be to introduce EFFECTS programs (or similar) for operational staff within the university. In fact one site involved the broadest cross-section of university staff in their workshops and consulting activities.

> "We've got lecturers on the course and we've got some support staff on the course and that's because it needs to move across the entire University, I'm not here for the lecturers I'm here for the University and OK they're the people who are teaching but they don't teach in isolation."

It is possible such an approach might not only address the immediate difficulties for teaching academics but would be more in-line, and consistent with the changing and converging roles of all staff in the university. Non-academic librarians may for example participate in such a program and choose to focus on development in information literacy; computing staff focus on on-line support for users and so on. The partners recognized this difficulty and (probably for other reasons as well) are moving elements of their staff development units much closer to academic faculties.

> "We're merging in a way which we don't know the full details of with {an academic department concerned with research in education} to produce some sort of unit [ ] that focuses on higher education research. The primary reason for that move in fact has been in relation to the development of our certificate of academic practice [ ] is in that in order to run an accredited unit we really needed or it was thought that we really needed to be part of an academic group rather than a central support group."

From this it would appear the institutional approaches to addressing the EFFECTS goals have been modified by the institutions.

Conclusions

The EFFECTS project has been an ambitious initiative involving participative, communicative, and developmental activities in a wide spread of Higher Educational sector in the UK. This study has looked at some of the perceptions of program developers and has provided some reflection on those perceptions. The EFFECTS framework has been a coherent and important spur to action in all these related developments. It is the framework that must be concluded on and not the interpretations created by the individual institutions.

The core aspects of EFFECTS are widely thought to be what are known as *the learning outcomes*. These key process pointers which are partly derived from the SEDA key values are recognized as playing a vital role in guiding successful reflective action research in teaching and learning. Other aspects of the project which were valued included the cooperative sharing approach taken by institutions which led to stimulating development activity for all the project participants including the program developers. These two aspects of the project were favored most highly. The main aspect to attract less support and more concern was the exploitation of accreditation to achieve the overall strategic aims of the project. However the core aspect which we think is most important here is what (Agyris & Schon, 1978) would simply call the project theory of action; the hypothetical basis for action taken to achieve the project goal. The EFFECTS theory of action is that action-research staff development in learning technologies will achieve high quality teaching and learning with technologies. For policy makers the important transfer question is whether the EFFECTS theory of action is useful. In fact the EFFECTS approach involves a series of claims that can be summarized as.

- Scholarly professional accredited research activity at a masters degree level will support reflective practice and achieve long-term high quality teaching and learning with technology.
- Participant effort led by demands and needs will lead to enthusiastic engagement.
- National program accreditation is an opportunity to enhance the status of teaching and learning with technology as a scholarly activity rather than an end in its self.

This study has raised several concerns with this theory of action which can be summarized as:

- Demand-led (just-in-time) support tends to lead to technical and solution-oriented knowledge acquisition rather than learning for understanding. It leads to solving problems rather than finding niches.
- Technical support for small projects may motivate more than accreditation of programmatic effort.
- The course model serves the leverage of resources to integrate the technology but may be out of synchrony with the needs of learners and jars with the validation process.
- Accreditation has led to weighty evidence reporting that was unattractive to program participants.
- There may be other alternatives which could work better (although they are not the subject of this study).

Perhaps the main outcome of a this study of the project lies in things that are learned, new hypothesis that are held by the designers and will drive the design of programs designed to achieve similar aims in the future. In this regard we see that among those we interviewed there was a strong sense that these matters were often outside their control. In its various forms the EFFECTS project has made it a central commitment to achieve scholarly reflection in consort with developing new skills and technical knowledge. There were considerable doubts expressed about the design of the program, the value of a course, the potential of a course to keep academics interested in spite of their other work commitments, difficulties fitting the course into the standard delivery program, demand for scholarly support and the potential for contributing to quality while led by participants operational demands. In short there may be an uneasy fit for an academic staff development program, taught with the involvement of traditional staff development centers, providing masters degree credit normally only available directly from academic units, for the purpose of satisfying a nationally conceived goal.

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Reflective Learning with Agent Simulations in Emergency Team Training

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Abstract: Learning in high fidelity virtual reality simulation environments presents great advantages to emergency training where real practice is impossible and drills are costly and ineffective in preparing for non-recurrent incidents. Simulations of group communications require de-briefing with team members and representations for reflective coaching. We present a tool used to reify the communication acts of team members that demonstrates support for reflective practice in action. The representations of emergencies in Nuclear Power generation and in Underground Railway emergencies are both shown and the reflective tools illustrate the different cultures of practice in team interaction.

Introduction

We claim that simulations provide an ideal environment for learning through situated practice, especially when support for reflection is also available. We also claim the case is reinforced in those areas where the cost of the alternative realistic preparations for situations are prohibitive. It is also true that learning with simulations can be a very frustrating experience and that practice at least in certain stages of competency can lead to poor outcomes. However the approach here modifies the traditional simulation in two important ways. In the first place ours are team interactions and when skills are limited, an expert collaborator or an expert agent can provide direct guidance. The second form of guidance is given by the careful design of representations to help reflect on team interactions.

There is no doubt that reflective thinking plays an important role in the development of self-regulatory cognitive skills. Reflection enables planning which often leads to the regulation or revision of a prospective course of activity, sometimes even before the activity has begun. We usually think of reflection as a tool for assessing outcomes after the event, often when activities have failed to lead to the desired outcome. These ideas have been in currency since Dewey (1933) and have been applied in more recent years particularly to attempts to develop informed and self monitoring approaches to scientific reasoning. Schauble and his colleagues including Robert Glaser (Schauble, Raghavan, & Glaser, 1993) developed a graphical framework and representational language for reflection in scientific reasoning. The language reifies goal and sub-goal hierarchies in an attempt to help users remain aware of reasons for their actions. It also focuses problem solvers on the relation between goals to which particular activities are directed to help users concentrate on hypothesis driven activities and not simply data driven search. Their DARN (Discovery And Reflection Notation) tool was achieved through an activity trace that was then recast into a graphical format for viewing by the user.

In a similar way we have developed a graphical trace that begins to address some of the key learning requirements for emergency executives, and indeed for all kinds of team-work, by capturing the historical events of communication acts that occur during execution of the group simulation. These acts are the key forms of interaction between collaborating agents. Our tools provide reification of the important communicative processes, compensatory speech acts, anticipation of needs and so on, that are found to be important in the current emphasis on participation. Just as Glaser's tools helped learners to reflect on strategies used to achieve problem solving goals by reifying aspects of the problem solving process, so our tools provide representations of the communication acts which occur among our problem solving teams.

The reflective tool currently provides three representations, 1) a histogram of communication acts to and from each actor, 2) a control-monitor or baton passing representation showing the passing of floor control between actors, and 3) a sociogram which shows a view of the complete set of communications after the training event is over.

Training Objectives

The team behaviors that we are trying to encourage are derived from a number of past taxonomies (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; Fleishman & Saccaro, 1992; McIntyre & Salas, 1995; Nieva, Fleishman, & Reick, 1978; Swezey & Salas, 1992). We use the term 'team competencies' when talking about the behaviour of individuals which directly contributes to team performance. Those that we have chosen to implement within the intelligent agents and which are emphasized in the training are those perceived to have priority for the end users. They are applicable to communications intensive environments that require shared understanding of team and individual goals, and the plans, procedures, and roles of individuals to achieve those goals.

- mutual performance monitoring,
- giving and receiving performance feedback ,
- loop closing communications, *e.g.,* checking that information is received,
- backing-up actions of other team members with informative compensatory and anticipatory speech acts,
- adapting to resource scheduling conditions by actively balancing task-loads,
- co-ordinating action with compensatory and anticipatory communications,
- modeling team players to understand roles.

The emergency management teams we are interested in are the control room team of the underground Metro Bilbao in Spain, responding to a fire on a train in an underground section of the metro; and the emergency response teams of the Spanish Electrical Power generating company, Iberdrola, who advise and co-ordinate external resources during a nuclear accident at a nuclear power plant (NPP). In both cases any training exercise they undertake requires the commitment of considerable public resources since they both employ various public emergency services, ambulances and fire brigades, in resolving the incidents. Any exercise also causes disruption to the normal public service, which is unacceptable on any frequent basis. The Metro Bilbao team work in shifts and although the team normally work together they must all be recalled simultaneously for training. Training also requires that they use the same space and resources that the operational shift are using. In the case of the emergency management team for handling nuclear incidents they are experienced personnel who do not normally work together and have commitments that make it difficult for them to assemble simultaneously in the same place.

The ETOILE project sets out to solve these problems. The re-creation of suitable environments is being addressed through the development of networked simulation based learning systems using desktop virtual reality to create a sense of presence. The problem of assembling a complete team at the same time is being overcome by incorporating 'intelligent agents' as substitutes for absent team members. These features increase the frequency of opportunities for training and the opportunity to learn is designed around the reflective practice that will help learners to adapt current practice through a review of past performance and importantly, through basing the training, and necessarily the activities of the computer based agents, on the explicit recognition of the role that shared mental models play in the development of team competencies (Cannon-Bowers, Salas, & Converse, 1993; Cannon-Bowers et al., 1995).

In summary, the perspective is a fusion of the need for situated practice with realistic interactive shared representations of work place practice, a focus on develop communicative competencies in teams, the goal to development flexible competencies in response to new and complex emergencies through the study of exemplary error mitigating behavior, and the need to focus in situ on representations which form both a part of practice and can be used to describe and reflect on it.

The Reflective Tools

The sociograms shown in Figure 2 allow the overall quantity of communication between each participant to be estimated. The size of the arrows on the lines joining participants gives a qualitative estimate of the number and hence load, and possibly by implication stress, on any individual. The representation also allows patterns to emerge in the dialogue which relate to beneficial and undesirable communication clusters. This circular representation works by placing all those agents (passive and intelligent) and human learners involved in a scenario in an equidistant ring arrangement. Messages collected during the scenario are filtered and shown as lines between participants. The density of communication between any two players is shown by the size of the arrow head going in any direction. From this we can see the distribution of messages relative to particular individuals in the group; a feature that can yield useful reflections on the work-load balance within a scenario. The sociogram representation is most effective in showing the densities of communication between roles (lots of lines joining to one agent). Where the team members are in the same room it also provides an easy method of assessing whether they are physically talking across one another. Each of the circles representing a participant in the communications can be presented on screen into the physical locations of the team members; hence rearrangements of seating plans could be made that reduced, cross conversations.

The baton passing representations (see examples in Figure 2) show the control of communication among agents in the dialog. When an individual speaks, their contribution is logged against a time record. The next agent to talk has her contribution logged similarly, and the two coordinates are joined, in this way generating a continuous line of communication control through time. These representations show the same data in different ways and therefore make best advantage of the representational affordances of each representation. Several vital instructional benefits are available from these tools for the learner to support reflective insight. The most important of these are,

- time and resource distribution in communication behaviors,
- relative significance and roles of passive and intelligent players in the construction and storage of shared mental models, and
- the occurrence and progress of specially typed speech acts in team communication.

The relative affordances of each representation means they can be used to address certain conjectures and working hypotheses about team behavior. Such conjectures also point to aspects of behavior to look for in the analysis of interaction within a particular team. In our on-going work we are experimenting with several example sets of data from team interactions (mostly under stressful circumstances) and we are beginning to notice useful correspondences among variables that are all made clear from the representations. For example, hierarchically organized teams tend to exhibit concentrations (densities) of communication around particular team members usually the leader. In drill situations and even emergent circumstances where skill demands on the team remain close to recurrent this appears to have no effect on performance. However, when emergency situations present complex novel problems to solve these teams do not perform so well as other teams with more devolved decision making and consequently more balanced communication patterns.

The Study

The scenario provided from our underground railway emergency demonstrator shows the traffic operator (TF) being trained with the emergency center supervisor and with a trainer also present. The scenario is an enhancement of the one provided by (Maseda, Arenillsas, Garzon, Arcos, & Castano, 1999) describing requirements and roles of participants but with a few other selected events and errors which take place. The scenario includes only a small number of people and roles which could have been involved. Indeed of the more than twenty roles identified in the requirements document this scenario includes only nine roles and an agent for managing events called the scenario agent. What we see from using the log analysis tool.

The distribution of communication events around the team involved in dealing with the Metro Bilbao underground railway scenario is broad. From the sociogram representation (Figure 1, left) we see there are no overly sized arrows between any of the communicators. This illustrates that no two participants have to take an unbalanced weight of communication during the unfolding of the emergency. The sociogram reveals its own limitation here however, in that while no two participants are responsible for an over heavy set of communications, the traffic operator (shown as TFOperator) communicates with other agents than any other. This we can see quantitatively from a histogram that is also available to the users but cannot be shown here because of space limits. The accumulation of communications from several individuals, which can be seen by the addition of the smaller arrows leading to his role, mean that the traffic operator's role in the emergency is actually quite onerous compared with others in the scenario although overall the pattern remains balanced.

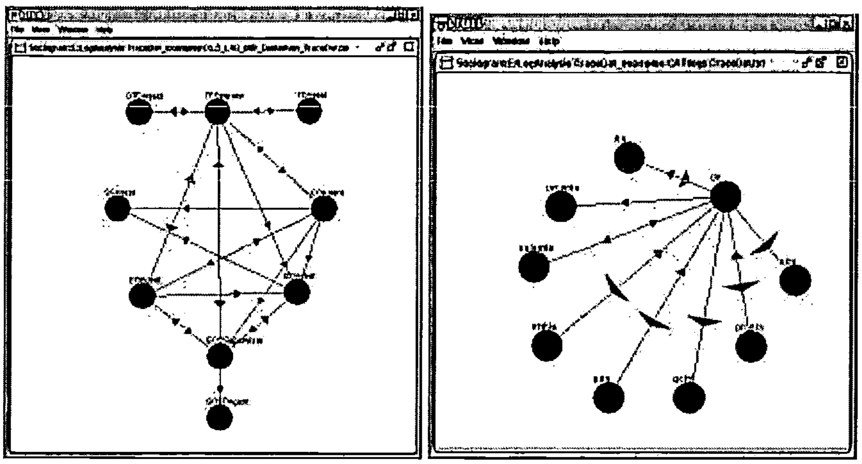

Figure 1:
simulated emergency (right).

The diagrams also provide a very quick and simple method to check that all the proper communcations

back against the emergency protocol in (Maseda, Arenillsas, Garzon, Arcos where we find that the train driver is supposed at one time to communicate with the station supervisor agent. This

error checking with a team in post hoc analysis.

differences between those that appear on the sociogram and those which appear on the floor control diagrams. The reasons fo

complete set of human agents excepting those filtered to edit out the technical agents from the human and pseudo human roles). This means that any human or agent played human role will be shown on the

any one role players' experience of a scenario some players do not need to be implemented to demonstrate that role. In our demonstrator many of the 'peripheral' roles are not implemented. For example, the communication between the SOS agent and the police, the ambulances, the hospitals the red-cross and the government mediation services, even the communication between the driver and the public who are the first to alert the driver to the emergency, are just not shown on the graphic, because they are not functional to the individual needs of the target individual in the training scenario. We think this reveals a need to improve the simulations so they may provide a broader picture of the relatively peripheral roles for any given agent.

In the floor control representation (Figure 2), communications which do not generate immediate responses from anyone do not show up either. A lot of the communications in teams is informative, broadcast for information to all, and therefore unlikely to generate immediate responses, and will not appear on the floor control diagram in its current implementation. There is also currently a limitation in the algorithm for presenting the data. At present the each time an agent speaks the time is noted and a line drawn back to the intersection of time and identity of the previous speaker. In this way the continuity of speaker contribution is maintained through the team dialog. This representation is based on use within a closed group of speakers, often in the context of face-to-face management meetings, or board meetings. The representation is used as a tool for analysis of power relationships in groups. However in our simulations agents often talk to other agents who do not speak to other agents within scenario. For example, when the SOS agent receives a message from the emergency center supervisor in the underground railway simulation, this is likely to precipitate a message to the ambulance or the government mediation service. But since they are not shown on our demonstrator, the message from the SOS agent will not be shown, and the relative importance of his role will not be seen. The baton passing representation is therefore contextual to the scenario and for the people for whom the scenario was developed to train.

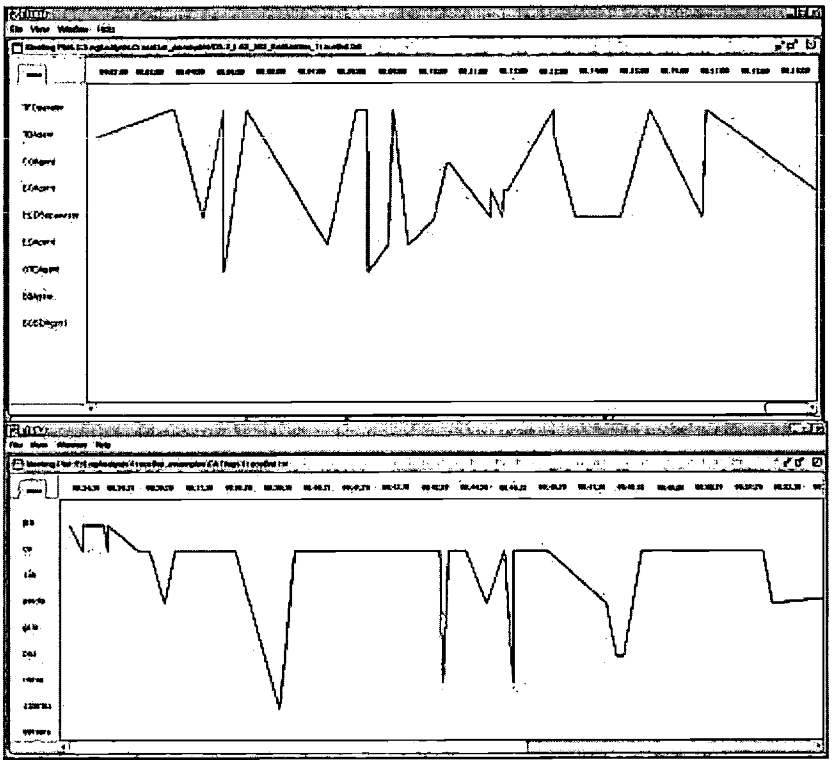

Figure 2: Control passing representations of Underground railway (top) and Nuclear Power Generator simulated emergencies (lower).

In comparing the nuclear demonstrator with the underground railway demonstrator we can see immediately from the sociograms (Figure 1) that the role of the emergency director is one principally of informing others around him and with relatively little feedback from those other role players. Compared with other role players he receives a similar amount of information but his role in sending this information to others is perhaps six fold that of any other agent. From looking at the baton passing representation from the nuclear demonstrator shown in figure 2 (lower) we can see the extent to which the baton remains in the hand of the emergency director. The flat lines drawn along the DE axis of this graph show situations when the emergency director (DE) communicates and then the next communication to follow was also from the director. The role did not have to wait for further information to continue. The spikes on this diagram show that the director mostly generates the questions for new information from his team mates and is quickly provided with it (shown as a quick return spike) whereupon control and stability returns to the director.

The two scenarios display very different communications patterns aspects of which can be seen through each of the three representations shown in the log analysis tool.

Conclusions

The log-analysis tool studies showed that communication patterns varied widely between the two simulators illustrating differences both in practice, culture and process in the two scenarios. Organizational factors in communication during unfolding of emergencies that may not be obvious without these carefully constructed representations. The tools have potential to help users understand the entire sequence of an emergency, not just their own role, and this should promote the development of shared mental models and better performance in teams. The representations are likely to take some time to master: even when they are improved in those ways suggested, but the study provides encouraging evidence this effort will be worthwhile.

We believe the development of these demonstrators has been a significant contribution to the application of innovative pedagogy and new communications and information technologies in two fascinating, complex and pressingly important domains.

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Using PDP As A Skills Audit Tool To Support Professional Development

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Competitiveness in today's knowledge and technology-based economy requires constant professional updating to meet the demand for new skills in an increasingly global market.
Skills acquisition and development, coupled with the concept of lifelong learning requires a framework or tool to support skills audit, profiling, planning of learning and development, integration of teaching, learning and assessment processes, evidencing of progression, recording of achievement and 'value added' for Quality Assurance purposes and also for accrediting competences and capabilities.
The paper-based resource most currently in use is bulky, not easy or cost effective to update, and can easily be lost or destroyed, suggesting a need for a flexible, electronic tool for individual or organisational use.
This project is involved with the development of a web-based Professional Development Planning (PDP) <http://www.ePDP.net> tool prototype that offers more cost-effective integration of a number of educational, training and development and organisational processes.

Quo vadis, School: Looking Back and Ahead
or: How Can Schools Be Supported by Meaningful Online Services?

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Abstract
Due to the german initiative "Schulen ans Netz" (schools online) a lot more schools were enabled to work with computers and networks than with any other experiment or pilot project so far. In particular schools where neither teachers or pupils had any experience with computers or networks were invited to take part. Of course this meant above all to show them how teaching and learning can be supported by these new media and which possibilities were opened by working with computers and world-wide networks. This supplement tries to give answers to the following question: How Can Schools Be Supported by Meaningful Online Services?

Schulen ans Netz e. V. (Schools online), a joint initiative of the Federal German Ministry of Education and Research (BMBF) and of Deutsche Telekom, set itself when starting in mid-1996 the initial aim of connecting 10.000 schools to the Internet within 3 years. This aim was largely surpassed by the association: more than 13.000 schools providing general or vocational education have been connected with the help of suitable supportive measures. And a certain number of schools were able to connect by supplementary initiatives of Federal States and in cooperation with regional sponsors. By end 2001 all German schools will have access to the Internet thanks to Deutsche Telekom.

Why Should Schools Be Online?

Due to this initiative a lot more schools were enabled to work with computers and networks than with any other experiment or pilot project so far. In particular schools where neither teachers or pupils had any experience with computers or networks were invited to take part. Of course this meant above all to show them how teaching and learning can be supported by these new media and which possibilities were opened by working with computers and world-wide networks.

Due to initiatives such as eEurope, eRate (USA) and similar activities on other continents an extensive discussion about the pro and cons of suitable media use has been launched. The currently most heatedly discussed opposing position on the use of the new media in class is represented by the Alliance for Childhood under the header „Fools Gold: A critical look at computers in childhood“. Unfortunately the positions are presented in a diction that can be summerized in phrases like: "S/he who uses technology in class hates children". Or "technology use in class is industry-driven". It is certainly not helpful to discuss sensible IT use in such 1-0 or black and white scenarios. The numerously scientific studies published by now show that how the use of media in class has to be looked at differentiatedly. The musician Dizzy Gillespie once said it took him ten years to master his instrument and another ten years to know which pieces he should better not play. Transferred to our discussion it means we should allow us minimum five years of exchange of experience before coming to first conclusions. It will certainly need more than these five years in order to know at which point it would have been better to abstain from technology.

We, that are the assets at Schools Online, started out with the conviction that media accompanied teaching can sensibly support the new forms of teaching and learning. In particularly in the field of communication we saw for schools a substantial potential for development:

- opening schools by communicating and co-operating with other schools in Germany, in Europe as well as world-wide,
- competent and responsible use of networks as well as the creation of a specific culture of information and learning in the framework of a contemporary media education,
- the support of interdisciplinary partnerships between schools, training centres, education facilities and universities

The Working Platforms of Schools Online (Schulen ans Netz e.V.)

To support the work with the new media in day-to-day teaching, Schools online, a registered association, provides various online platforms:

- The **Homepage of Schools online** (http://www.san-ev.de) is the initiative's communication and information medium. This is the place where all interested find topical news items about and around schools, latest news on current activities as well as background information on all working areas of Schools online. A monthly newsletter to the subscribers at home gives the latest news of the Schools online web pages. This newsletter is also available in an offline version which could be pinned to the school's pinboard.

- **Lehrer-Online** (http://www.lehrer-online.de) (Teachers-Online) is the up-to-date online service to all teaching. Schools online offers here an extensive subject and school related portal with individually adapted service offers for preparing classes and teaching practice. In the centre of Teachers-Online are of course the new media and the indication of strategies for their meaningful use and implementation into classroom teaching. **lo-net** (http://www.lo-net.de) is the interactive communication and working platform of Lehrer-online which provides teachers with a multitude of possibilities: they can manage their files online, they can design their own homepage with a few mouseclicks, but they can also work together with colleagues in group rooms on specific projects or deal with their own students in their classroom on lesson projects which they can present online via lo-net, if wanted.This service is supplemented by ***LeaNet*** (http://www.leanet.de) a site which addresses exclusively female teachers in the Internet. Apart from numerous information offers this service has a "Ladies only" discussion, learning, and working platform. By registering all LeaNet members get automatically a free e-mail account and access to all offers and working areas.

- **Business@school"** (http://www.business-at-school.org) is a co-operation project together with The Boston Consulting Group. The aim of the project is to improve the insufficient knowledge on economy at school by making this topic come alive. To reach this goal, teachers and students explore with the help of the Boston Consulting Group experts the topic economy by studying real business situations and finally develop as a team new business ideas. In detail, the aim is

  - to develop a feeling for economical questions,
  - to come to know about the reality of corporations, medium size and small size companies,
  - to develop an entrepreneurial way of thinking,
  - to improve presentation and public speaking faculties,
  - to train result-oriented teamwork,
  - and finally: to relay the fun that is also in this topic.

- **"Naturdetektive 2000"** (http://www.naturdetektive.de) **Nature Detectives** is a environment related activity in co-operation of Schulen ans Netz e. V., and the German "Clearing-House Mechanismus" (CHM) and further partners. The action is supported by the Federal Ministry of Environment (BMU).

  Students and classes as well as individuals and nature conservation groups all over the republic have here the possibility to gain information on environmental and nature conservation by the help of the Internet. They can transmit their own observations and take part in a direct information and knowledge exchange on environmental activities. The aim is to increase and strengthen the awareness of students of all ages on environmental and nature issues by immediate experience and personal action.

- The project **"Exil-Club"** – the establishment of an online-magazine on persecuted intellectuals was initiated by Schulen ans Netz e. V. in cooperation with the "Else Lasker-Schüler – centre for burnt and banned poets/artists" foundation. In project groups students do research on the biographies of exiled intellectuals in the past and present. At the same time they grasp the historical, sociological, and political backgrounds which led to emigration. The Federal President wore in a letter to the persons responsible: „(...) Your decision to use the new means of communication and put the Exil club into the Internet with a homepage of its own distinguishes this project from others. (...) I do welcome it very much, that you don't only ask teacher and pupil to get active and to take over guardianships for applicants for political asylum but also offer to publish papers and projects online. Your engagement is an important contribution to the active concern of young people with the situation of foreigners in this country. To be sensitive to the problems and needs of foreigners is the basis for tolerance and defiance against rightwing violence." The results are presented on the "Exil Club" website (http://www.exil-club.de).

- ***LizzyNet*** – **Female Students in the Internet** (http://www.lizzynet.de) is the online project which Schools online started in April 2000 with girls and young women as specific target group. Here they find offers to how to communicate and play in cyberworld. Apart from that they find information and education platforms that look at the world of computers, jobs and life in general from the particular angle of girls and young women's view. The project targets its proposals at beginners as well as at the "Internet pros" and offers innovative possibilities for a self-determined and active use of the Internet.
- In autumn 2000 a CD learning programme called **"Surfcheck"** was published. Its aim: to enable the student to gain access into the Internet by him/herself; but experienced surfers too can find many information around the network of networks. With this programme we wanted to show that the Internet does not have to be a closed book and that the use of this new medium is accessible even with little technological know-how. Voluntary tests at the end of each chapter check whether the subject has been grasped correctly. After having

worked through the whole course it is possible to do a (multiple-choice) online test in order to obtain a surfing license and get an according certificate, issued by Schools online, providing the test was passed. In addition to that „**Surfcheck online**" (http://www.surfcheck-online.de/) provides an online offer for instance for school classes, computer groups or individuals to do this course, if necessary with the help of online tutors, and also obtain a surfing licence.

Co-operation Projects: What is Meant by That?

Schools online has launched a number of initiatives respectively accompanied them in partnerships where the aim was not only to learn co-operation but also to experience it as an active process. In general such projects were initiated in form of competitions, such as the following examples:

EnterPreis:

The above mentioned discussion contribution „Fools Gold" by the Alliance for Childhood questioned in particular the use of technology in primary schools. We wanted to have more certainty: Under the header "EnterPreis – we board the Internet" we started on 1 October 1999 the first Internet competition for primary schools. The patronship was held by Maus from "Sendung mit der Maus " (a popular pre-school plus programme with a mouse as main character), and head of the jury was the well known science journalist Ranga Yogeshwar.

We were looking for thrilling websites, which the pupils created themselves in teams of maximum six participants and which were put out into the Internet. There was no restriction to the children's imagination: paintings, drawings, texts and even photos were permitted – providing they were scanned and attainable from the Internet. The competition was open to all primary pupils in the following groupings: grade 1 and 2, grade 3 and 4, and grade 4 to 6. One or two teachers looked after the teams whose participants could also be from different classes or even different schools. For German schools abroad as well as foreign schools that offer German as foreign language in this age group there was an „International EnterPreis".

The results can be admired at by entering http://enterpreis.san-ev.de. They show in an impressive way how the respective experience worlds of children can be represented in online presentations and how much pleasure the children gained from their results. In the stipulated documentation are listed a number of experiences which can be a source for everybody's own work. However the teams had to overcome considerable problems with regard to copyrights which impaired their work significantly.

uni@schule (university@school)

"Classroom teaching in the middle of a forest – an utopia? What is usually constricted to the rare outings and excursions became the starting point to an very unusual expedition of an under-16 biology class. Tables, chairs and blackboards – the complete classroom equipment was transferred into the forest by students and teachers of the Ernst Moritz Arndt-Gymnasiums in Bonn helped by two biology students of Bonn University.

The team did not need furniture transport. And those who were interested to follow the call of science into the thicket did not have to get the wellies out: this expedition consists uniquely of bits and bytes. And it is so thrilling that even those who normally just shrug when asked the meaning of "photosynthesis" can become real flora and fauna experts. That at least is the hope of Barbara Scherer, team leader and biology and chemistry teacher at the Ernst Moritz Arndt-Gymnasium."

These are the opening lines of a report which we recently published for the above mentioned competition. The scientific studies confirmed in their interim reports how successful developing processes in schools could be assured above all by the participation of university establishments. "Tomorrows teaching, a team effort" was thus the motto for the competition „**Uni@Schule**" (http://www.san-ev.de/uni-schule) which Schools online started on 10 March 1999. „University@school" called upon all those teaching and studying at German universities and schools. Requested were practical lesson projects which include new media realistically while being creative and innovative. With the new competition we wanted to stimulate the creation of didactic and methodical lesson models on the net. 48.000 Marks in all as well as attractive prizes donated by the competition sponsors awaited the winners.

106 teams took part – and in the end the jury had to evaluate more than 50 contributions. The results can be examined at the above mentioned address. We would also recommend to look at the participant's documentation which give a good insight to the difficulties which had to be overcome.

Further, mainly internationally important co-operation projects are:

Thinkquest

The ThinkQuest Internet Challenge is a competition for young students which is held annually by Advanced Network & Services (USA). The objective of the competition is the promotion of the "Internet way of learning" – an interactive variety of learning which trains the student to use the Internet as a continually growing source of information as well as an important tool. To this aim a team, consisting of two to three students and one to three coaches, designs a website. The winning teams will split scholarships and prize money of more than one million Dollars between them. For further information see http://www.thinkquest.org or http://www.thinkquest.de.

Netdays

Each year thousands of projects in Europe, initiated by schools, vocational training centres, youth clubs and cultural institutions, make use of the internet and the new media, adding up to a colourful array of events. The overall name for these activities is Netd@ys Europe. This broad initiative wants to demonstrate how much the new media can facilitate learning, teaching, and discovering in an information society. The idea of Netd@ys came up in the USA in 1996 and contributed decisively to the fact that over 50% schools there are connected to the Internet. In contrast to America the main focus of Netd@ys Europe is not just on improved technical computers and Internet equipment. The objectives of Netd@ys Europe are:

- the promotion of the use of the new media and of the Internets for teaching, learning and discovery purposes;
- the exchange of experiences and developments of new pedagogical contents;
- the support of interactive projects in education and culture.

In the year 2000 this event will take place for the fourth time running. Netd@ys Europe's influence is increasing with every year. It helps to form new partnerships, to inform more and more organisations and to increase the number of participating countries. By now Netd@ys Europe has become a unique event: it has become the biggest event in the world which aims at raising awareness for the use of the Internet and the new media in the fields of education and culture in all places and for all ages. These aims can only be attained if new partnerships between the public and the private sector are established and if organisations of all kinds and sizes are brought together. To this end Netd@ys Europe is engaging itself.

Outlook: Working in Networks

Currently the public discussion turns around the so-called "digital splitting" (cf. http://i-d21.de/news/disp.pdf) and the consequences of IT applications in schools (s. a.). On the spot, however, a number of problems have to be solved first. The most important tasks for school governments is the practical putting into action of school development plans. With regard to a responsible costs-benefit relation the desired planning measures should find their way into them by giving practical examples of how to use the school's infrastructure effectively. Additionally it is important to show more pointedly the utilization potential of further online services (s. a.) as well as to demonstrate suitable embedding of IT into lesson teaching. It should also be assured that an exchange of ideas on the benefit of IT use in class takes off by providing suitable platforms.

Based on scientific evaluation it can surely be said that there is a positive attitude towards the use of new media in schools. It could be considerably improved by providing proper technical access solutions. Research groups pointed out a number of action options of how schools could be supported at this. There is enough proof to demonstrate how the initially euphoric and then successfully used implementation of IT infrastructures came to a standstill or even stopped altogether due to organisational alteration processes. This point has to be more closely watched in future.

Another very important point is the need for a suitable teacher's training to assure a successful introduction of new media in schools. A non-representative survey among its networking schools led the Bertelsmann Foundation to point out a possible strategy which is based on a decentralized training course for teachers (cf. http://www.netzwerk-medienschulen.de/dyn/1006.asp). A German research team was able to show that we are only at the beginning of e-learning activities. Therefore it is not possible to give conclusive answers on the possibilities of meaningful online learning. More time and experiments are needed.

Computer Based Video Production

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Abstract: This article contains video production procedures for distance education systems. Important criteria for efficient preparation and production of video materials for distance education are the used technical tools and procedures for video production. These include videotaping procedure, digitalization or transmission of the video to the computer, digital non-linear editing and video conversion into a suitable format for computer presentationn and efficient transmission via WWW. The article introduces the procedure of non-linear editing and the procedure and conversion of the video for fast and efficient transmission via the Internet, as done at the Center for Distance Education Development (CDED). The center is involved in several international projects, which include video at a high level of integration as a study media. Some results are already presented on the Center's web pages.

Introduction

Nowadays, the most useful and popular learning aid is the computer. Learning by means of moving pictures is a well-known, efficient and popular way of studying. Because of its efficiency and capacities it is not only used for studying but also for the production of study materials in video form. This article contains video production procedures for distance education systems. The following paragraph presents the Basic video Equipment needs and the procedure of video production. The third paragraph contains the rules for the correct lecture recording and description of non-linear video editing and transmission procedure from a camera to a computer and opposite. Its popularity and interactive design make the WWW currently one of the most interesting media, whose advantages can be well used for distance education. Below given is an example of how viewing of a longer video can be provided for the users with somewhat slower transmission connections.

Basic Video Equipment

Professional digital video cameras of the DVCPRO format are lately substituting efficient Beta analog video cameras. Some less demanding recordings, e.g. lectures, may be taped by the cameras of the Mini DV (Mini Digital Video) format. An important criteria for a satisfactory video recording is sufficient light: not too dim, too bright or contrasting. The camera requires a stable support, provided by a well-grounded tripod. Emphasis lies also on the sound quality. Its loss may result from the size of the room, distance of the microphone from the speaking person and additional surrounding noises.

Transmission, Digitalization, Digital mounting, Coding systems

Video is transmitted to the media directly (e.g. videoconference) or edited by computer video mounting (postproduction). Recorded by a digital camera, the video can be transmitted to the computer in a compressed (MPEG-1, MPEG-2 formats) or uncompressed form via a fast Firewire (IEEE 1394 standard). Data storage onto a disc depends on the available hardware. More expensive equipment allows work with non-compressed data but demands extremely high capacity of storage discs. The advantage with such mounting is in the preservation of the original video quality. When individual clips are stored on a hard disc, digital mounting begins. The procedure is composed of: cutting the video to shorter clips, sound adding, adding of sound and visual effects, film production or tape rendering, video coding and transmission to other media. Suitable hardware and software equipment for the production of learning videos is of middle price range (e.g. Speed Razor 4.7.), which costs approximately 7000$. There are many cheaper systems available, suitable for production of shorter videos, but are characteristically unstable. After viewing, the video is cut to individual clips and only those are preserved, which are later used for the final video. They are stored with sound and visual effects in the project folder. Video tracks are arranged according to the planned scenario in the time window and supplied with transitions. Sound tracks are supplied with additional sound or / and sound effects. The results of editing are simultaneously viewed on the video monitor. When the modifications are satisfactory, the video is rendered in a single file. Rendering is a time-consuming procedure, which can take up to a few hours. The final product is stored on an outer media - CD, DVD or over the Firewire on videotape. Coding is a mathematically extremely complicated procedure, therefore such process can last for hours. Each second of non-compressed video takes up to 20 MB of disc storage space. The Mini DV format is based on 5:1 code ratio. Video material quality depends on the system and level of encoding. A CD can store up to 65 minutes of an MPEG-1 coded video. The MPEG-2 format allows an outstanding picture quality and can even be stored on an ordinary CD, yet its capacity allows only 10 of these video minutes. The MPEG-4 format is very popular because it allows good quality as well as large data quantities.

Video lectures on the Center for Distance Education Development server

Software equipment (browsers) allows video broadcasting in various formats with the addition of video players (Real Media, Windows Media Player, Quick Time). Broadcasters allow two ways of transmission or broadcasting. Video via the network (*.avi,*.rm,*.mov) video is transmitted to our computer's storage unit and is viewed, when the transmission is finished. The other allows simultaneous viewing from the moment of data transmission (Advanced Streaming Format). ASF allows transmission of various combined data (video, audio, URL addresses etc.) in a single data stream via the Internet. The ASF format allows the production of different video qualities. Several files are made, of which the user chooses the quality that allows undisturbed viewing of the multimedia presentation according to the transmission bandwidth.

The CDED at the University of Maribor organized and formed the first on-line presentation of dissertation in Slovenia. The presentation was given as a web lecture, supported by a video and transparencies. The ultimate sound and picture quality were provided by two types of files to allow undisturbed transmission of files via the 56 Kb/s and 128 Kb/s modems. The data can be compressed for higher transmission speeds, which results in better video and sound quality. The latter is rarely used, primarily in the local environment with cable modems. Both variations focus on the quality of sound rather than picture. At compression, the picture size and its quality are adjusted according to the required data speed at transmission via the Internet. After video mounting and editing the video file is equipped with orders for synchronization and connection to additional materials (electronic transparencies, web pages, subtitles, index and other materials). All suitably formed materials are combined into one web page. Video supported lecture in the duration of 43 minutes is available at http://www.cded.uni-mb.si/predavanja/dr/potocnik/index.html.

Conclusion

Modern computer technology and development of telecommunication systems allow efficient transmission of streaming video via the Internet. The systems for digital mounting, storage and transmission are in full swing and are becoming price wise accessible. In Slovenia, the first introduction of ASF video supported Web lectures was given as a doctorate dissertation by the group, active at the CDED at the University of Maribor.

Standardized Metadata for Education: a Status Report

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Abstract

This paper starts with a brief background to worldwide standardization activities in the field of educational technologies. It then focuses on the specific area of metadata, and introduces the two most relevant approaches there: IEEE LTSC LOM and DC-Education. We review how different communities adopt and support educational metadata for their constituencies. This paper can be considered as a follow-up to [20].

1. Introduction: the role of Standardization

The main aim of standardization is to achieve interoperability between systems or components from diverse origins. Interoperability in this context can be understood as 'enabling information which originates in one context to be used in another in ways that are as highly automated as possible' [1]. In an educational context, this should enable reuse of tools and content across functions (cataloguing, discovery, etc.), levels (simple to complex), semantic and linguistic barriers, and, of course, technology platforms.

Standardization is a requirement for large-scale deployment of learning technologies, as it prevents users from being locked into proprietary systems. Moreover, standards are needed to develop an open base infrastructure that components can be plugged into. This is especially important in an educational context, because of the wide diversity, and the lack of consensus on a universal best solution.

It is important to realise that a standard does *not* impose a particular implementation. Rather, as a common specification, it establishes an opportunity for competition or collaboration by diverse groups.

Very important in the domain of education and training, is that standards can help to establish a base technology infrastructure with *permanency*. This is a high priority need in our field: many impressive results of R&D projects from the last 15 years (and more!) are gathering dust on shelves, because the tools and the equipment that they rely upon no longer exists, or are no longer maintained. Without such permanency of technology, we will not be able to build upon the results of our predecessors, and we will never achieve real *impact*!

Finally, it is important to note that 'real' standards are produced by 'accredited' organizations, that guarantee an open, fair, transparent and inclusive process, and that take care of the maintenance of the standards. Rather different from these 'de jure' standards, 'de facto' standards are based on specifications made by a consortium or company. The proper process (see also figure 1) relies on the development of specifications in consortia, where experience can be gathered on their practical use. When specifications have matured, they can be fed into accredited organizations that can use this input as the basis for 'real' standards.

2. Standardization of Learning Technologies

There are three important accredited standardization organizations in the domain of education and training.

2.1 IEEE LTSC

The aim of the IEEE Learning Technology Standardization Committee (LTSC) is to develop technical standards, recommended practices, and guides for software components, tools, technologies and design methods that facilitate the development, deployment, maintenance and interoperation of computer implementations of education and training components and systems [2]. The LTSC includes a number of working groups, which deal with:

- general issues: architecture, glossary;
- learner issues: learner model, student identifiers, quality, competency;
- content issues: interchange, sequencing, packaging;
- (meta)data: Learning Object Metadata (see section 3.1), localisation, bindings, protocols;
- learning management issues: Computer Managed Instruction, tool-agent communication, platform and media profiles.

The LTSC scope explicitly excludes issues that the organization believes ought *not* to be standardized (evaluation methods, delivery systems, etc.), and issues that it believes ought to be standardized *elsewhere* (multimedia, education standards, cultural adaptation). The overall strategy is to standardize the smallest, useful, doable specification that has technically feasibility, commercial viability, and widespread adoption. The group started in 1996, and holds quarterly meetings.

2.2 CEN ISSS LTWS

The CEN ISSS Learning Technologies Workshop (LTWS) has developed a report that identifies requirements for standards on learning technologies [3]. The main requirements are to improve support for reusability and interoperability, collaboration, metadata, quality, legal issues, multilinguality and multiculturality and accessibility. The report includes recommendations on:

- promotion activities on standards in the educational arena in general, and on accessibility guidelines in particular;
- the development of taxonomies and vocabularies, as these can increase 'semantic interoperability' and enable translations and mappings of (meta)data;
- the elaboration of an 'educational copyright license'.

More generally speaking, the report emphasizes the need to support multilinguality and cultural wealth. It is explicitly recommended to avoid English as a lingua franca. The workshop has also been working on localisation issues of the IEEE LTSC metadata standard (see section 3.1), in order to ensure that European requirements for cultural diversity and multilingualism are properly met. A French, German, Catalan, Spanish and Italian version of LOM have been developed.

2.3 ISO/IEC JTC1 SC36

Recently, a new subcommittee on 'Information Technology for Learning, Education, and Training' has been set up under the umbrella of the ISO/IEC JTC1 Joint Technical Committee. Its scope is 'standardization in the field of information technologies for learning, education, and training to support individuals, groups, or organizations, and to enable interoperability and reusability of resources and tools' [4]. Working groups are currently being set up on issues such as vocabulary, architecture, learner-related activities, learning object metadata, learning management systems and collaboration technologies. Both LTSC and LTWS have liaison status with ISO/IEC JTC1.

3. Standardized Metadata for Education

In order to promote (re)use of learning content, identification of appropriate learning material needs to be accommodated. This requires searchable descriptions of the material, called metadata, if we want to go beyond simple keyword searches and support queries like 'simulations of a nuclear power plant, that run on the Linux operating system, take students of undergraduate university level 45 minutes to work through and learn about the influence of cooling water temperature on nuclear reaction speed'. As interoperability is key to collecting a critical mass of metadata, standardization efforts in this field are especially relevant. In the remainder of this section, we present and compare briefly the two main initiatives in this area.

3.1 IEEE LTSC LOM

The purpose of LTSC Learning Object Metadata (LOM) is to facilitate search, evaluation, acquisition, and use of learning objects by learners or instructors [5]. The purpose is also to facilitate the sharing and exchange of learning objects, by enabling the development of catalogs and inventories, so that users can create and publish educational material.

This three-year-old initiative has developed an elaborate metadata scheme with a hierarchical structure. Data elements are regrouped under categories (general, lifecycle, metametadata, technical, educational, rights, relation, annotation and classification). Especially relevant is the educational category that includes elements such as

- interactivity type (active versus expositive),
- learning resource type (exercise, simulation, questionnaire, etc.),
- interactivity level (from very low to very high),
- semantic density (idem),
- intended end user role (teacher, author, learner, manager),

- context (primary education to vocational training),
- typical age range,
- difficulty (from very low to very high),
- typical learning time,
- description,
- and language of the typical intended user.

Besides these data elements that are specifically geared towards the domain of education, LOM also includes a rich set of data elements in the other categories. The core specification is now in version 5.0, which will be submitted to a formal ballot. The schema specification seems to be quite mature and stable. The main reluctance from the user community concerns the restricted nature of the vocabularies for certain LOM elements. That is why it was recently decided to change the status of these vocabularies to suggested good practice.

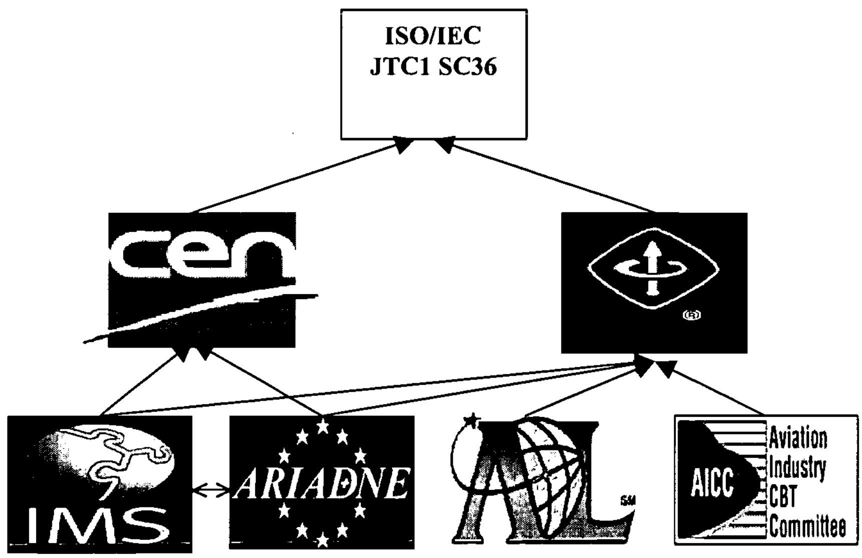

Fig. 1: The main organizations involved in standardization for education and training

3.2 Dublin Core – Education

The Dublin Core (DC) is a set of 15 metadata elements intended to facilitate discovery of electronic resources in a general sense. The objective of the Working Group on Education in the Dublin Core Metadata Initiative is to develop a proposal for the use of Dublin Core metadata in the description of educational resources [6]. At this moment, the Education group recommends to add the following data elements to DC:

- *audience* (both intermediate. like teacher or author, and end users, mostly learners);
- organizational, professional, province/state, national, and international *educational standards*;
- *interactivity type*, *interactivity level* and *typical learning time*: for these, the DC-Education group recommends adopting the corresponding LOM data elements.

3.3 Comparing LOM and DC-Education

LOM was originally developed specifically for the domain of education and training, and is becoming gradually more and more deployed outside of this specific domain. It is rather the other way around with DC-Education, as the Dublin Core metadata element set was originally developed for general resources, and is now being adapted for the specific field of education and training.

It is clear that LOM provides a far richer structure with more detail for 'semantically interoperable' metadata on learning objects. The use of namespaces to achieve semantic and syntactic interoperability between DC-Education and LOM is being discussed in a working group with representatives from both organizations.

Awareness in the sector of education and training on the issue of learning technology standardization in general and on metadata specifically, is definitely growing fast. On the other hand, with awareness of the importance of these issues also seems to grow the confusion and misunderstandings. For many interested parties, the difference in status between for instance consortia and accredited standards organizations is not at all clear (see above). And, as has happened so often before with educational technologies, there is a definite danger that expectations are being raised unrealistically high.

4. Adoption in Practice of Educational Metadata

4.1 Adoption in Consortia

There is considerable overlap in the work of the different consortia (ADL, AICC, ARIADNE, IMS, etc. – see figure 1 and below) that work on actual implementations of metadata and other standards. This is quite natural, as many of these consortia contribute to the development of the standards, and then adapt them to the needs of their constituencies, a process referred to as 'profiling' in the standards world. In fact, having several independent implementations of the metadata standards increases the probability that problems or shortcomings will be identified early on.

In this section, we briefly review some recent developments in a number of the more relevant such consortia.

- The *ARIADNE* project (1995-2000) recently transformed into a permanent self-sustainable Foundation [7]. One of the most important aims of the Foundation is to organize the further development and exploitation of the Knowledge Pool System, a distributed database of reusable learning components, with associated metadata that describe them. ARIADNE and IMS (see below) jointly submitted their metadata specification to the IEEE LTSC and continue to collaborate on this issue. Within the ARIADNE community, the so-called metadata recommendation makes 23 of the LOM elements mandatory. ARIADNE has developed a taxonomy of science types, disciplines and subdisciplines. These are used to indicate the semantics of the learning object, using the facilities that LOM provides for this purpose. The technological basis for the ARIADNE tool development is XML and databases.
- The *IMS* 'global learning consortium' released version 1.1 of its metadata specification in May 2000. This was a minor update to the previous version, based on LOM version 3.5 [8]. The IMS specification includes suggestions of controlled vocabularies for 12 elements. Often, it lists multiple suggestions, with their origin and suggested applicability. A binding to XML, in the form of a DTD, is also defined.
- The US Department of Defense launched the *Advanced Distributed Learning* initiative in 1997 [9]. In January, ADL released version 1.0 of the 'Sharable Course Object Reference Model (SCORM)'. This reference model applies LOM to raw media (7 mandatory elements), content (15 mandatory elements) and courses (15 mandatory elements). Since January 2000, developers have started to implement the model, which culminated in the so-called plug-fest in May. In parallel, a test suite for SCORM is being developed. The main technology binding is XML.
- *EDNA* [10] relies on DC with additional elements for when the metadata were entered, who approved them, when the learning object is to be reassessed, the user level, categories, conditions, indexing, review, version. EDNA includes its own lists for types of learning objects, user levels and coverage, for the Australian context. The main technology relied upon are HTML META tags.
- The *EUN SchoolNet* initiative regroups most of the ministeries of education in Europe [11]. For its metadata applications, it relies on the Dublin Core metadata element set, with additional elements for rights, approver, release, user level and version .
- The *Gateway to Educational Materials* (GEM) [12] relies also on the Dublin Core element set, with additional elements for DC with additional elements for audience (distinguishing who uses a tool from who benefits from its use), cataloging, duration, essential resources, grade, pedagogy, quality and standards. GEM has also defined controlled vocabulary for audience, format, grade, language, pedagogy (divided in teaching methods, grouping and assessment), relation, resource type and subject (a two level classification system).
- NEEDS [13] and SMETE [14] are build defines its own metadata element set for searching, with title, contributor, publisher, subject heading, affiliates keywords, platform and MIME type.
- The European Joint Research Center has developed a 'Global Education Multimedia server' (called GEM, but not related to the Gateway of Educational Materials mentioned above), which should act as a clearinghouse of information, products and services [26,27]. Similar to for instance ARIADNE, a

relational database is used to store the metadata on the server. Access in four languages takes place through a web interface. The GEM system can import from or export to LOM.

4.2 Adoption in Projects and Use in Research

Many smaller scale projects, typically confined to one organisation, are including metadata in their development efforts. Sometimes, the basic idea is to provide a useful service within the own organisation, and sometimes, the main focus is on further research that requires metadata support as basic functionality. Below, we review some of the more noteworthy activities in this domain.

- Work at Carnegie-Mellon investigates how metadata can be used to develop tools that automatically evaluate the consistency of a course [22]. The core idea is that the course is composed of learning objects whose metadata describe the prerequisites and learning objectives. Thus, it is possible to verify automatically that no learning object is presented before the necessary prerequisites have been covered (as learning objectives of preceding material).
- The GESTALT project implemented an extended version of LOM [23]. Tools were developed to match metadata against user profiles, so as to implement personalized educational programs. A CORBA based architecture was developed to access an 'asset metadata server' and user profiles from an LDAP server.
- LOM was adopted as the metadata set for a database of resources for schools in Hawaii [24]. These resources include Ph.D. students, software, weather stations and remotely controlled cameras, courses in computer science and mathematics, telescopes accessible through the web, etc. For this context, the LOM structure was extended (as anticipated in the specification) with more detail on audience, community involvement, discipline, educational objectives and pedagogy. In this process, much earlier work by GEM (see section 4.1) was integrated in the LOM context. These experiences influenced some final developments and fine tuning to the LOM specification.
- At the Darmstadt University of Technology, a LOM editor has been developed in the context of a project on adaptive hypermedia [25]. Learning strategies based on different kinds of relations (is_a, proceeds, part_of, etc.) are supported by dynamically matching metadata of so-called 'media bricks' with a 'concept space' that describes the structure of the application domain.
- At Acadia University, one theme of LOM related work is the use of XML tags and Xlink to connect metadata and the learning objects they describe [15]. Another theme relates to the description of the potential role of the learning object: for that purpose, the concept covered by the object, its context (including prerequisites), ways it can be used in instruction and possible student activities are described [16].
- At the University of Paderborn, granularity of learning objects has been researched, distinguishing between media elements, learning elements, content modules and thematic metastructures [17].
- The Essen Learner Model includes an extension of LOM to provide more detail on didactical methods used with a learning object [18]. Learning sequences are represented as processes that cover the main activities, interactions, information systems and persons involved.
- At the University of New South Wales, the role of learning objects, with associated LOM metadata, in administration, content authoring, learning resource catalogues and delivery has been studied [19]. Basically, the authors argue that these different components should be more tightly integrated.
- Commercial systems are beginning to support LOM, even though, as noted above, the standard is not completely finalized yet. An example of such a commercial systems is imc's CLIX [21], which has been used to build learning sites for companies like Lufthansa, Chrysler-Daimler, and others.

Conclusion

It is striking to note that, at present, there is little activity on interoperability between independently developed systems for metadata management. Some demonstrator work has been done between the ARIADNE and GESTALT consortia (see section 4.1), but larger scale developments are rare at this moment. We believe that it is now time to start this interoperability development, as the specifications and implementations are maturing. Only then will we be able to amass a critical quantity of learning material, and will the standard indeed serve its ultimate goal.

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A Requirements Model for a Quality of Service-aware Multimedia Lecture on Demand System

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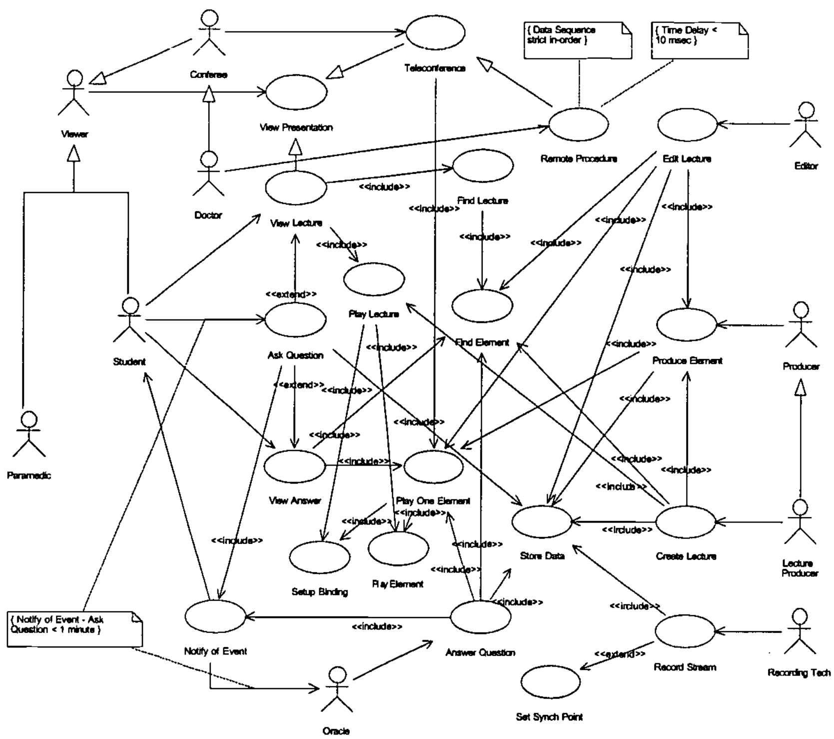
Abstract: We present a case study in requirements modeling for a medical multimedia Lecture on Demand (LoD) system. Our focus is to produce a requirements model reflecting the functional and the Quality of Service (QoS) requirements for LoD instruction on medical procedures, and to also consider requirements from other telemedicine multimedia applications in order to create a general requirements model for medical LoD systems. We discuss the medical LoD application, characterize requirements for other telemedicine applications, and represent the resulting requirements model as a UML use case model.

Introduction

The OMODIS project focuses on developing infrastructure to support Quality of Service (QoS)-aware distributed multimedia and LoD systems. The effort reported here is to develop the requirements model for the medical LoD prototype (Wang 2001), capturing both functional and QoS requirements. For this we focus on the Multimedia-Supported Learning of Practical Procedures Project (BachGansmo 1998) at the Medical School of the University of Oslo. A project goal is to deliver lessons of actual procedures, recorded in the hospitals, over the internet. We have also drawn requirements from other telemedicine projects (e.g., http://www.telemed.rito.no).

QoS is critical for these medical procedures. For example, from audio, it must be possible for a student to learn to differentiate between stridor, caused by an obstruction of the large airways, and asthmatic breath sounds. In a remote controlled medical procedure, the delay (for both the video and the controlled instrument) between the remote operator and the procedure site must be well less than human response delay. Thus, some individual use cases may be subject to QoS constraints, and there may also be QoS constraints between pairs of use cases.



We present our requirements model as a UML use case model, see (Fig. 1). The core LoD model developed seems to be relatively well structured and flexible. We were able to easily extend the model with a Teleconferencing area that supports both consultations and Remote Procedures. We also show adding QoS constraints to a use case model. As examples, data sequence and time delay constraints are shown on the *Remote Procedure* use case, and an event-response delay constraint is shown between the *Ask Question* and *Notify of Event* use cases.

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Please note change of title to -Improving Conference Design Through Better Use of Technology

Allan Ellis, Southern Cross Univ., Australia; Roger Debreceny, Nanyang Technological Univ.,

Technology has much to offer in refining and improving conference design and management as well as raising delegate satisfaction. Based on experiences from the Southern Cross University AusWeb conference series (http://ausweb.scu.edu.au), this poster presentation discusses the advantages of end-to-end electronic submission, refereeing and publication to the Web, CD-ROM and paper. Pre-delivery of papers (via the Web and/or print via mail) to delegates ensures that delegates are fully briefed on the content to be discussed at the conference. The option to link Web-based multimedia presentations to the formally refereed papers provides authors with the opportunity to expand upon, present updates and in general invite delegates to explore in greater detail the ideas and concept they are presenting. In this way conference sessions can be designed to reduce the time for the delegates presentations and to increase interaction between authors, moderators and delegates. Conclusions are drawn for the design of educational delivery systems.

Accreditation of Prior Learning through Internet Technology

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Abstract: This paper describes the CREDIT-system, an Internet-system that helps people with the assessment and accreditation of prior knowledge (APL). Users can have their knowledge assessed through the Internet, with the help of an advisor. For a full accreditation, the user will have to provide the system with evidence for already acquired knowledge, which will be judged by a human assessor. Otherwise, the user can opt for a self-assessment, to get a clearer view of personal knowledge and skills.
The usefulness of this system is evident: People do not have to go through cumbersome paper and pencil exercises, but can use the system to organize their evidences. Another use of the system is competence management: companies can easily chart their employees' knowledge and skills. The CREDIT-system makes it possible to do assessment in a time and place independent way.

Introduction

A consortium of training companies, software companies and a university joined in the CREDIT-project, that develops the CREDIT-system (www.eurocredit.org). The general goal of the CREDIT-system is to support the assessment and accreditation of skills and knowledge combined with the offering of advice in further learning and training. The system gives insight into the competencies of people, by building an electronic portfolio through collecting evidence (Groothuismink & Oprins, 1999).
Many people acquire knowledge and skills through self-study, volunteer work or other means, for which they cannot show official diplomas. The CREDIT-system supports two routes: formal assessment through evidence collection, potentially leading to an official accreditation, and informal assessment, allowing users to self-assess their knowledge and skills in a particular area. For companies it is useful to have insight into the skills and knowledge of their personnel for the arrangement of training, for the allocation of staff, for the selection of personnel, or other Human Resource Management related tasks (Groothuismink & Oprins, 1999). The CREDIT-system makes it possible to do the processes of assessment and accreditation in a time and place independent way. At present, the CREDIT-system is available in the languages English, German, Spanish, Portuguese and Dutch. The domains for which the CREDIT-system is available are Childcare, First Level Management, and Software Engineering, but it is easy to incorporate new domains (Sandberg et.al., 2000).

Description of the CREDIT tool

The CREDIT system consists of four different tools (see figure 1.). The Skills Matching Tool is used to investigate the skillsets that are available within the CREDIT system. It gives insight into what domains are available, and what skills are required for the various qualifications and accreditations. Users can also perform a quick self-scan/self-assessment to get an idea of their own performance in a certain domain.

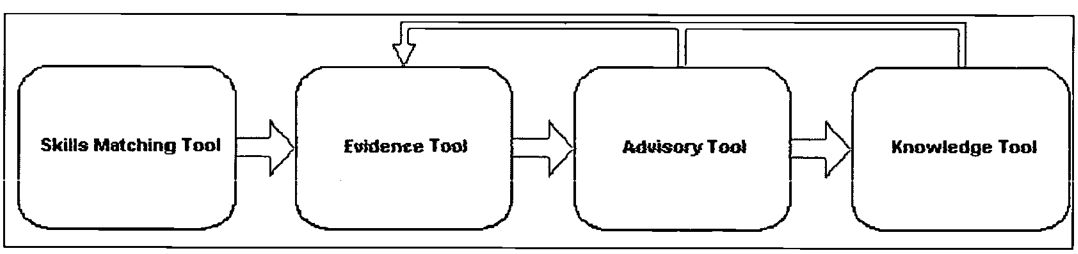

Figure 1: Overview of tools within CREDIT. The evidence tool works off-line.

For the Evidence Tool, which works off-line, it is necessary to download a set of skills to be assessed against. With the Evidence tool, the user can collect evidence to prove he has acquired the skills and knowledge for a specific

domain, or skillset within a domain. This evidence can be of any type (photo's, video's, references, certificates, descriptions, etc.). Since the matching process can be time-consuming, this is done off-line. When the participant is ready, he can send the entire file (skills and evidences) to his advisor to get advice or to an assessor to be evaluated. The Advisory Tool is used by the advisor for feedback on the user's evidence. It typically will mark which skills are acknowledged, which skills need more evidence, and what skills need further training, in order to be acknowledged. Learning routes to fill the training needs will be offered to each individual.
The last tool, the Knowledge Tool helps the participant searching for possible learning materials. (For a full description of the system, please refer to the User Guide by Matt Street, 2000).

Evaluation results

The first version of the CREDIT-system has been evaluated with user-trials. The goal of these trials was to gain information from users, and be able to improve the system. 115 users from different countries and different domains were involved in these user-trials. Three methods of evaluation were used during the trials. A web-evaluation (on-line), that was available for the general public, and where people could try the system and give comments. A workshop evaluation, in which the system was demonstrated to a group of users. And an individual evaluation, in which users had to work with the system while being observed by a researcher. Afterwards the users had to fill in a questionnaire and were interviewed.
The main result of the first user trials is that users judge the system as useful. They can easily imagine to use a tool like this in the future. Most users did not have difficulties to understand the functionalities of the system, and they approved the idea of the different tools. However, many remarks concerned the User Interface Design. The Interface was generally judged as too complex, more help and guidance should be available, especially for the more complex procedures (Oprins, 2000).

Discussion

The CREDIT-system is based on user requirements, gathered with a survey amongst the potential users of the system. It is a valuable tool in the in the area of lifelong learning. Users can get insight into their own level of knowledge, they can get diplomas and certificates without having to go though courses and exams again, and thus save much time. For example, this possibility is expected to be very useful for people that are moving from one country to another within Europe, and that want to have their diploma's acknowledged across the two countries. Another example is represented by women re-turners who often acquire knowledge and skills in an informal way during their non-working period and who will through CREDIT find a way to demonstrate their knowledge and skills. For companies the system offers an easy possibility to have their personnel gain official certificates (for example when these are obligatory due to official regulations). Furthermore, companies have a strong tool to find the right man for the right job. User trials indicated that the CREDIT-system is on the right track, but that it needs improvements. Currently, a new version is released and new user trials are in progress.

Current work

At this moment, the second version of the CREDIT-system, having implemented a completely new interface, is ready, and the system is evaluated through a second set of user trials. This time the evaluation set-up is different. More users are involved (appr. 300 participants), and they will have to perform certain scenarios with the system. Training companies within the different countries have created these scenarios specific to their country and their situation. About 20 different scenarios are created this way, covering all the aspects of the new version of the system. Thus during the second user trials a full evaluation of the entire CREDIT-system will be performed.
During the presentation, not only the CREDIT-system will be demonstrated, but also the results of the second user trials will be discussed. Furthermore attention is given to the user friendliness and usefulness from the viewpoint of organisations and companies, that want to use the system and want to be able to swiftly add new skill domains, job descriptions etc.

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Distributed Group Design Process: Lessons Learned

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Abstract: A typical Web-based training development team consists of a project manager, an instructional designer, a subject-matter expert, a graphic artist, and a Web programmer. The typical scenario involves team members working together in the same setting during the entire design and development process. What happens when the team is distributed, that is when the instructional designers and the developers are not in the same setting? How can a geographically dispersed team work together meaningfully? What are the challenges they will face and how can they be overcome? Because it is becoming more common for instructional technologists to be brought in from several locations long-distance team building presents an important challenge to the process. This paper addresses several issues that instructional designers face when working in such distributed environments based on our experiences during a collaborative project between Syracuse University and a multi-national corporation. Toward this end, we propose using Web-based CSCW systems to support distributed group design process.

Introduction

The distributed group instructional design project was the outcome of an initial understanding between a multi-national Corporation and the department of Instructional Design, Development and Evaluation (IDD&E) at Syracuse University. It called for a collaborative engagement between a higher education institution and the industry. The task as set out by the multi-national Corporation was the design of a Web-based instructional product to train its clients on how to read financial reports. Although a print-based product existed, the development of a version effective for web-based delivery was in line with the client's goal of using the World Wide Web (WWW) as an emerging and competitive tool for training. For the purposes of this task, an instructional design team was formed in Syracuse. The development team and the user group were at another location together with the project manager provided by the client.

Since the design and development teams were distributed among several locations, the challenges and issues faced by such a group were vastly different compared to those of a conventional design process of Web-based training (WBT) where the team members are located in the same setting. We quickly realized that two factors were critical to the process: group-model building and computer-support for communication. Besides being interested in the design process we had some specific questions we wanted to explore:

1. How can communication and collaboration be achieved at a distance?
2. What works and does not work for a team working from different geographical locations?
3. How to create an effective, cohesive team when the team is geographically dispersed?
4. What are the best and effective modes of communication using the WWW?

5. What are the critical processes involved in a distributed instructional design group using a technology-mediated environment?
6. What are the group dynamics that support a distributed design process?

Reflecting on our experiences, this paper discusses a number of important issues concerning work practices, especially communication and cooperation among people, group facilitation and the group-model building process between the instructional design team and the development team. Finally, we propose using Web-based computer supported collaborative work (CSCW) systems as a working environment for distributed group design process. The paper concludes with important elements that such systems should incorporate in their design in order to support and enhance distributed group design process.

Distributed Group Design Process

Group design refers to the design approach in which different stakeholders, such as users, designers, and graphic artists take active part throughout the design process. We adopted Gould and Lewis's (1985) three principles: (i) early focus on typical users and tasks, (ii) empirical measurement that focuses on intended users, and (iii) an iterative design process. In the area of software design and artificial intelligence strong emphasis has been placed on group design (Bannon, 1990; Greenbaum, & Kyng, 1995). Bødker, Grønbœk, and Kyng (1991) also advocate participatory design in the area of software design: "computer applications that are created for the workplace need to be developed with full participation from the users-both from a democratic point of view and to insure that competencies central to design process are represented in the design group" (p.215). However, they point out that users may require help to take on the new role of participant, and designers may need help in their new roles as facilitators: "Full participation requires training and active cooperation…designers should know how to set up the process and need to make sure that everyone gets something out of the interaction" (Bødker, Grønbœk, & Kyng, 1991, p.215-216).

These comments of Bødker et al. highlight an important need for group design that our experiences have also confirmed: group-model building and team facilitation. Our collaborative design process can also be distinguished from similar work with one very important factor: the instructional design team was not in the same location as the development team and user group. Therefore, a very important challenge was that of team building at a distance. Designing training at a distance with a distributed design-development was a unique experience. Besides, neither of us had prior experience with designing training where more than one instructional designer was involved. Since, our experiences with designing WBT also showed a great diversity it was necessary to find a solid base for our efforts.

Group-model building refers to a dynamic model building process in which all the stakeholders are deeply involved in the process of model construction (Vennix, 1999). For instance, the system dynamics community has made considerable progress in developing tools and techniques to support a group-model building process and knowledge elicitation (Morecraft and Sterman, 1994; Richardson & Andersen, 1995; Richardson et al., 1989). Vennix (1996) has connected these efforts of system dynamics model builders to the realms of decision-making, small-group dynamics, and group facilitation. Empirical studies show ultimate gains from group-model building activities in these contexts. Although these domains are different from those of instructional design, the group model building process may likewise enhance instructional planning and analysis. The added advantage is that participants in group planning processes fit well with the notion of participatory design.

Our process can be likened to the reference group approach (Randers, 1977) used by the system dynamics community. Characteristics of a reference group approach are: (a) the product is a process of learning rather than a statement of fact, hence the model becomes a tool to improve discussion; and (b) the group becomes tangible hence providing a continuous interaction between its members. The reference group approach consist of a number of stages (Sternberg, 1980):

1. initiation of study;
2. establishment of reference groups;
3. initial meetings with reference group to define problem;
4. construction of the initial (simple) model based on discussions with the reference group;
5. model improvement through scenario discussions with the reference group;
6. reporting;

7. further discussion.

Our initial group meetings started with a series of audio conferences and e-mail exchanges with the client for the purposes of project planning, and we agreed upon tasks, timeliness, responsibilities, and deliverables. Then, the instructional design team began the process with task analysis, negotiating the conceptual framework and content outlines of web-based training module. Our deliverables included detailed storyboards created on Microsoft Word™ that the developers could then use to create the actual training Web site. A preliminary initial model was made by the instructional design team. Microsoft Word™ was used as the primary software tool for creating the storyboards as a special request from the development team. In order to maintain consistency, a template with the color scheme and the overall layout was developed to help us replicate the user interface. The team members divided the tasks and began to create sections of the product in his/her own student directory.

As the creation of the storyboards progressed, we began to engage in an iterative, nearly simultaneous process of design and revision. The rapid revision process that followed was a direct result of our use of a mediated environment consisting of e-mail messaging and a shared design and common file sharing area on the Web. As one member of the design team designed a piece of the product, other team members would comment on it and provide feedback; making changes, when appropriate. Thus, the team's multiple perspectives resulted in a product that was emergent Records of all e-mail, face-to-face and audio communications were also maintained.

As we came together to work on the project, we agreed on having open communication with each other. This proved as an effective group work leading to improved productivity. The team members worked collaboratively sharing or linking related elements. Our group members each wore many hats. Where skills were lacking, team members with greater expertise coached the others. We followed a collaborative design process by asking questions, requesting technical information, and seeking opinions about dealing with problems. Often, alternative views resulted in major differences of opinion. We acknowledged opposing viewpoints, questioned alternatives, and negotiated differences of opinion. In order to move the design process forward without drifting away, we found that it was important for team members to establish a shared understanding and vision of the final product. Our team organized itself in a way that made the most of individual strengths.

After the design team completed the first prototype, it was sent to the development team and the user group to provide feedback. These efforts were facilitated by the project manager. First tests were conducted on the paper versions before the actual prototype development took place. This iterative process of design and testing took place until all the members were completely satisfied with the overall interface design and the presentation of the content leading to prototype development.

WWW as an Enabling Technology for CSCW Systems

Although our experiences with electronic mail has proved to be successful confirming the past research (Bullen & Bennett, 1990; Grudin, 1991) using a sophisticated, seamless, shared, electronic workspace as described by Ishii, Kobayashi, and Arita (1994) would have proven to be more efficient. Our team members relied heavily on e-mail accounts on different systems and were also using the student accounts on the university's network server. Later on we set up a group account on a web-based shared file storage drive that all the team could access. It facilitated our work affording file sharing and version control. At the beginning of the project, our problem was in gathering and compiling all the materials and information with the necessary tools for design and communication. Our design process was guided by our own input as users, learners, and designers, and was facilitated by the types of communication exchanges that the e-mail system supported. However, we felt a great need to have a Web-based CSCW system that could have made the communication and collaboration more efficient and effective with the other members of the team. Such a system would make organization, communication, and revision of materials easier.

For widely dispersed working groups, where members may be in different organizations and different countries, issues of integration and inter-operability often make it difficult to deploy existing groupware applications. Although non computer-based solutions such as telephone and video conferencing technologies provide some support for collaboration, empirical evidence suggests that computer systems providing access to shared information, at any time and place and using minimal technical infrastructure, are the main requirement of groups collaboration in decentralized working environments (Gorton et al. 1996; Rao, 1995). By offering an extensible centralized architecture and cross-platform browser implementations, increasingly deployed and integrated with user environments, the Web may provide a means of introducing CSCW systems which offer much richer support for collaboration than e-mail and FTP, and thus serve as an 'enabling technology' for CSCW. Bentley et al. (1997) explain why the Web offers a potential platform for enabling the CSCW technology very well:

- "Web client programs (browsers) are available on all popular computing platforms and operating systems, providing access to information in a platform independent manner,
- browsers offer a simple user interface and consistent information presentation across these platforms, and are themselves extensible through association of external `helper applications',
- browsers are already part of the computing environment in an increasing number of organizations, requiring no additional installation or maintenance of software for users to cooperate using the Web,
- many organizations have also installed their own Web servers as part of an Internet presence or a corporate Intranet and have familiarity with server maintenance and, in many cases, server extension through programming the server API" (p.3).

As a basis for deployment of CSCW applications in real work domains, the level of acceptance and penetration of Web technology in commercial and academic environments is grounds alone for suggesting that CSCW should pay serious attention to the World Wide Web for supporting distributed group design process.

Conclusion

Given the context, our instructional design process can be characterized by two very distinguished factors: (a) group design, and (b) distributed design teams. Although the team as a whole was primarily interested in the design and development of Web-based training we were also concerned with studying the process and the learning that supported it. We believe such distributed group design projects will soon be a reality in the field of instructional technology.

While the above case presented the distributed group instructional design process, experiences were specific to our own group; we believe our skills as collaborative designers have been enhanced. The strength of the group-model building model for distributed design process is in making designers aware of process that is often covert.

As team members began to develop expertise in the process their initial roles began to evolve. No one member possessed the expertise of the entire group. All team members contribute their expertise and full participation took place. In turn, our individual team building skills and content specific skills were enhanced. The group became a self-organizing system.

We believe that Web-based CSCW has a lot of premise in supporting group design efforts, especially when the group is geographically dispersed. However, in designing such systems, it is important to closely consider the dynamics of collaborative design teams. The system should also allow implementation of group-model building techniques.

We also argue that the field of instructional design should start to address group design. Tennyson (1995), states that ISD has undergone four generations of evolution: first (behavioral-linear model), second (behavioral-cognitive with phases from a systems perspectives), third (primarily cognitive with strong influence from software engineering and cognitive science-waterfall design), fourth (cognitive-constructivist with strong influences from action research and activity theory). The first two generations do not adequately address the collaborative nature of design appropriately. Their focus is more on the processes, i.e., analysis, design, development, and evaluation (Gustafson & Branch, 1997). The third generation models to address the issue, affected by software engineering but the models are to generic and do not focus on the roles of people involved. We found Tennyson's (1995) ISD-4 particularly useful in that focuses on the activities of those involved in designing instruction that the process itself varies greatly depending on context and circumstances.

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Current Practice in Designing Training for Complex Skills: Implications for Design and Evaluation of ADAPT^{IT}

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Abstract: ADAPT^{IT} is a European project within the Information Society Technologies programme that is providing design methods and tools to guide training designers according to the latest cognitive science and standardization principles. An extensive needs assessment phase has been completed. The aim of this effort was to explore current practice in instructional design and associated with that, the needs of the training designers in order to improve their practice and to insure that real world needs will be addressed in the project and its products. This paper reports the needs assessment procedures and outcomes informing how they guide the efforts within the project.

Introduction

Advanced Design Approach for Personalised Training- Interactive Tools (ADAPT^{IT}) is a European project coordinated by the Dutch National Aerospace Laboratory (NLR). The aim of ADAPT^{IT} is to create and validate an effective training design methodology, based on cognitive science and leading to the integration of advanced technologies, so that the training community can better meet the many challenges of the information society of the 21st century. The effort falls with the European Commission's Information Society Technologies programme (IST; see http://www.cordis.lu/ist/) and includes as partners: National Aerospace Laboratory, the Open University of the Netherlands, the University of Bergen, SevenMountains Software, EuroControl, the Swedish Air Traffic Control Academy, and Piaggio Aerospace.

ADAPT^{IT} is developing a personalised training design methodology, providing associated design tools for the efficient realisation of that methodology, and validating the methodology in different training domains. The three-year project began in February 2000, with an estimated total of 181 person-months required for completion. The effort is broken into these 9 work packages:

1. Project management
2. Design preparation
3. Design of the ADAPT method
4. Development of the ADAPT tools
5. Using ADAPT: Design process evaluation
6. Using ADAPT: Design product evaluation
7. ADAPT^{IT} revisions
8. Standardisation
9. Integration, dissemination, exploitation

The aviation industry is targeted for this research and development effort as it is a key industry that is faced with difficult training problems and complexity of skills for which the design method is intended. Current challenges for aviation training relate to the increasing complexity of dynamic task environments, increasing time constraints, and increasing demands for cognitive and information-managing tasks. As technology takes over or automates many basic tasks and adds functionalities to operational systems, the result is that more demand is placed on humans to perform higher level and supervisory tasks. The problems within aviation training are exemplary of highly complex and automated task environments that require flexible skills and are likely to forecast training problems in other professional domains. Two quite different training areas within the aviation industry (air traffic control and aircraft maintenance) are involved so as to insure generalisability of the methodology and the tool to other subject areas and industries (see Eseryel & Spector, 2000 for more details).

Project partners are currently collaborating on designing the ADAPT methodology and associated tools (work package 3). The early literature review and training requirements analysis indicated that the most appropriate and relevant methodology was the four-component instructional design (4C/ID) model (van Merriënboer, 1997). In developing ADAPT methodology, the 4C/ID model will be: (1) extended to become a personalised training approach; and (2) tailored to meet the needs of actual designers or design teams in a variety of training domains, economical sectors, and company sizes. In order to achieve the latter, current practice in designing training for complex cognitive skills had to be identified. The project team realised this through three different data sources. First, the literature on training designers' needs was reviewed. Then, in order to better understand the instructional design practice of our target group, questionnaires and extensive interviews were conducted with training designers in the aviation industry and in other business and industry sectors across Europe that involved training of complex skills (work package 2). In this paper, the findings of this needs assessment phase are presented. The next section contains a review of the literature on current practice in instructional design together with the findings of the interviews and questionnaires conducted during the needs assessment phase. The paper concludes with implications of the needs assessment phase for the design and validation of ADAPT methodology and ADAPT^{IT} instructional design tool.

Current Instructional Design Practice & Needs

Literature review on current instructional design (ID) practice reveals that ID practice is significantly different from what is prescribed in ID models (Holcomb, Wedman & Tessmer, 1996; Klimczak & Wedman, 1997; Loughner & Moller, 1998; Pieters & Bergman, 1995; Rowland, 1992; Seels & Glasgow, 1991; Visscher-Voerman, 1999; Wedman & Tessmer, 1993; Zemke, 1985). The most prominent activity prescribed in ID models, but rarely completely performed by practitioners, is task analysis. Other instructional design activities that are often omitted or only partially performed are assessment of entry skills or characteristics, and the pilot testing of programs prior to implementation. Studies that investigated expert instructional design performance also revealed important differences between the activities expert designers perform and what is prescribed in ID models (Maistre, 1998; Perez & Emery, 1995; Rowland, 1992).

In the literature, several reasons have been identified that might explain the lack of proper application of ID models. These reasons can be divided into reasons that are either internal or are external to ID (Gros, Elen, Kerres, van Merriënboer & Spector, 1997). Internal reasons refer to insufficiencies of current ID models that might be responsible for their limited usefulness. These are threefold: (1) the models are not sensitive to the design context; (2) the models do not match with the way designers work in practice; and, (3) there are many ID models and they are hard to differentiate. On the other hand, external reasons refer to deficiencies in the application of existing ID models. These can be attributed to the lack of professionalism in the ID field and lack of necessary design skills and knowledge. In order to improve instructional design practice, ID tools have been developed to fill this gap (Spector, Polson, & Muraida, 1993). However, what have been missing in the area of automated instructional design are sufficiently elaborated design models with associated guidance and frameworks that are appropriate for the design of training for complex cognitive skills. The ADAPT^{IT} project is intended to fill this gap with the set of methods and tools available to instructional designers. For the project to be successful, it is important for the design team to know the needs of the probable users of system. Therefore, training designer's need across Europe had to be identified as a next step of needs assessment phase in the project.

Next to the more global literature review, designers' needs were identified by means of questionnaires and interviews (see ADAPT^{IT}, 2000). The target group was training designers in Europe who are actively involved in the design of training for complex domains. Training designer needs are defined as the requirements that have to be met in order to change and improve current design practice. These requirements refer primarily to instructional design practitioners' perceived needs for support to use and apply instructional design theories and models.

The questionnaires were sent to respondents in different sectors: education, information and communications technology, transportation, business, and manufacturing. The response rate was low (8% of in total 150 questionnaires), which is attributed to the length of the questionnaires and the time required to fill them out. Although this may be counted a weakness, the questionnaires provided in-depth information to make informed judgments about the target group. Besides, the questionnaires were backed up with extensive interviews in order to gather more detailed information on current training design practices, the problems that are encountered and the desired support and specific needs during the training design process.

Each interview took around three hours. In total, 10 interviews were conducted involving: 1 naval college, 3 air traffic control centres, 2 aircraft maintenance organisations, 1 telecommunications organisation, 1 information technology company, 1 training consultancy organisation and 1 distance education company. Unlike the questionnaires that produced data in one format, the more in-depth interviews were intended to provide detailed and rich information about company design practices. As interviewee background and companies differ substantially, the interviews were loosely structured in the sense that questions were open and no pre-defined answer categories were supplied. This was intended to stimulate the interviewer towards more natural, personal and company-specific responses. Some structure was provided for the interviewer by a list of questions and themes to be addressed. The interviews not only yielded more detailed information, but, more importantly, they yielded an impression or feeling of current design practice, which did not emerge from the questionnaires.

The emphasis during these data gathering efforts was on the difference between current and ideal training design practice, on the problems experienced during the design process, and on the ideal characteristics of an instructional design tool. Table 1 provides an overview of the most important characteristics of current design practice that emerged from the results of the questionnaires and the interviews. The literature review, the questionnaire survey and the interviews have also resulted in training designer's needs for ADAPT^{IT}. The most important designer needs for ADAPT^{IT} are summarised in table 2.

Category	*Current design practice*
Training designer background	• A majority of training designers have an operational background and became designers after having worked in the operational field. They are not fully occupied with designing training as it is often combined with roles as instructor or training manager.
Training design process	• Current training design practice does not follow a standard Instructional Systems Design model. Activities are carried out selectively and often partly and are often characterised by implicit and intuitive methods. • The analysis phase is not carried out explicitly and in detail, mostly due to constraints involving time and resources. • The design phase appears often to be combined with the development phase, and often happens implicitly as part of the development and implementation of training. Specific instructional design models or principles are rarely explicitly used by designers with an operational background. However, many basic ideas and some instructional design principles seem to be intuitively understood and used. • A detailed and systematic evaluation does not occur and is for a large part based on subjective data. The distinction between formative and summative evaluation is not found. Formative evaluation seems to take place informally. Summative evaluation mainly focuses on short-term evaluation.
Organisational aspects	• In general, training is not designed in formally structured design teams. The most important actors in a team are subject matter experts and instructors, who typically design the training. Collaborative design does not seem to take place explicitly.

Table 1: *Characteristics of current design practice that emerged from the questionnaires and the interviews*

Category	*Training Designer's Needs*
Training designer background	1. Target at training designers with an operational background but do not exclude those designers with an educational background; 2. Use non-academic instructional design language, fitting the main target group of designers with an operational background.
Training design process	1. Support an explicit, structured and systematic design process, especially for the analysis, design and evaluation phases; 2. Take into account that current design practice is often characterised by implicit and intuitive methods. Support the designers in the change in design process (e.g. by allowing some intermediate ways of design focusing on the vital aspects of training design); 3. Convince the users to adapt their working practice (e.g. by explaining the added value of the different design steps and explaining the steps by means of practical worked-out examples); 4. Provide pragmatic, practical useful methods that yield quick results and can be easily used to produce at least a minimal required training design (see also 2).
Organisational aspects	1. Address the relational aspects during the training design process (setting up teams, involving users, methods for teamwork, collaborative design, communication etc.).
Design tool characteristics	1. Provide practical worked-out examples; 2. Provide support/guidance in applying instructional design principles; 3. Link together the different training design products; 4. Provide methods for file management and version control; 5. Make information easily re-usable and retrievable; 6. Allow different degrees of freedom (e.g. from structured to non-sequential design); 7. Increased efficiency: design training more quickly; 8. Increased effectiveness: design better training.

Table 2: *Some of the training designer's needs identified by the questionnaire survey and the interviews*

Current instructional design practice and the training designer's needs emerged as an outcome of needs assessment phase strongly suggests the demand for an integrated ID method-tool combination by business and industry. ADAPT^{IT} project aims at bridging the gap between complex training problems and new technological possibilities by developing and validating a training design framework to guide the use of state-of-the-art cognitive approaches within advanced training systems. In order for the project to be successful, the design effort is guided by the outcomes of the needs assessment phase as design requirements (work package 3). These outcomes will also be utilized for evaluating the final outcomes of the products (work packages 5 & 6). The next section discusses the implications of the findings of needs assessment for the design and evaluation of ADAPT^{IT}.

Implications for Design and Evaluation of ADAPT^{IT}

The training designers' needs that form one of the guiding principles for ADAPT^{IT} is originating from the fact that respondents questioned the merit of a tool as opposed to current design practice. Respondents were justifiably concerned with regard to a tool constraining the application of their current working methods and knowledge and skills. As instructional designers vary along the dimension from novices to experts with corresponding cognitive differences in the way they approach their tasks the system should be flexible enough (i.e., weak approach to design) to handle different sequence of uses and the messages should be tailored to the designer's level of expertise. ADAPT^{IT} should therefore be set up in such a way that all designers, including designers without a specific educational background, should quickly become aware of and convinced of the additional value of ADAPT^{IT}. The system should be flexible enough to allow advanced users integrate their own design practise, knowledge and skills. Inexperienced designers may require (ask for) more support in the process of structuring their analysis and design results. For this kind of audience, the use of non-academic language is of utmost importance. In addition, a number of design supports will be integrated in the system:

1. The ADAPT methodology handbook that will describe how to analyse complex cognitive skills and how to design training for those skill along with worked-out examples.
2. The CORE software tool that will support the use of the ADAPT methodology by allowing storing and viewing analysis and design results and by producing a blueprint for training in such format that it can be further worked out with third party authoring software.
3. An online help system and manuals, describing functionality and procedures for using the ADAPT tool with implementation examples.
4. An expert design and standards advisor.
5. An evaluation software (EVAL) to support formative and summative evaluation of the training.
6. Familiarisation training for the trainers to teach to apply the ADAPT method and tool supported by a web-based online tutorial.

The ADAPT system should have an impact on training design practice. Therefore, the method-tool combination is aimed at ensuring effective training design for complex cognitive skill embodying a validated training design methodology for personalized training that is based on the latest developments in the cognitive science. The tool itself also aims at more efficient training design by integrating several technologies, such as the re-usability of intermediate design products, version control, and support for adapting training design to changes in the external constraints (e.g., training time, characteristics of the target trainee, etc.). Furthermore, the system will be customisable to user preferences and allow collaborative design and rapid prototyping.

The project recognizes evaluation for its critical role it plays throughout the lifetime of the system. Functional specifications arising from the needs assessment phase and the aims of the system forms the basis of the evaluation plan guiding the design, production and revision of the full-scale system. The evaluation and validation activities in the project are twofold: (1) evaluation of the training design process; (2) validation of effectiveness of training design products. Integrated in the former, the instructional design modelling approach will also provide the means to pinpoint problems in instructional design guidance that the system provides. In both studies, the impact of the ADAPT^{IT} system will be compared with the traditional practices. The project partners from aircraft maintenance and air traffic control will be involved in these studies to insure the generalisability of the methods and the tools to other domains. The user-centred process adopted for this project insures that the real world needs will be addressed in the project and its products.

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A Study of Technology Cost of Primary School in Taiwan

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The purpose of this study was to analyze the cost of technoloThere are four major goals of this study. Those are:

- Review the current status of using technology in primary school
- Review the goal of primary school technology plan
- Survey the current budget used for school technology
- Analyze the cost of school technology plan
- gy at primary school level in Taiwan.

Investigation research method will be applied to collect data from random sampled primary schools. According to the goal of technology plan and reality, this study will conclude unit costs for many infrastructure and network electronics components of advanced telecommunication systems now being installed in schools. A hypothetical case study of the cost of a typical new elementary school needs increased space and creates other factors raise costs.

A Study of How Technology Influences Interior Design of Primary School

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Abstract: Impact of technology is always one of the major concern whenever applying technology. The purpose of this study was to analyze the technology influence on primary school interior design. Upon the investigating of 238 primary schools, statistical analysis was designed to answer the research problem. Technology used in primary school in Taiwan could be categorized into computer, networks, and audio/video three groups. Power system, light system, air-condition, and physical space were four areas of interior design influenced by technology. This study was concluded that how these four areas influenced by each category of technology.

INTRODUCTION

Technology has always been a factor influencing the process of change. Recent technological developments have presented us with opportunities to explore the farthest reaches of the solar system, personal computers, the capability of storing the equivalent of an encyclopedia on a small optical disc, and the replacement of human organs with manufactured ones (Yang, 1997). One area where this is apparent is in the planning and design of an educational facility. The integration of technology with the interiors of a building is a tremendous challenge. Telecommunication has become the fourth utility in the construction industry, along with electrical, plumbing, and HVAC (McDavitt, 1999). In Taiwan, computer with networking system is a token of technology. It is essential that this utility is planned for in educational facilities in conjunction with interior design. Interior design must suit the needs of student, instructor, and technology (Gregg & Persichitte, 1992). They pointed out that audio, lighting were both interior design consideration could not be neglected. Providing students with optimal design technology environment is the major concern of this study.

Statement of the Problem

The problem of this study was the technology influencing interior design of primary school in Taiwan.

Purpose of the Study

The purpose of this study was to identify how technology influences interior design of primary school in Taiwan. The goal of this study was to:

1. Review the technology used in primary school
2. Review the technology plan of primary school level
3. Investigate the goal and interior changing of implementing technology plan
4. Analyze how technology's influences on primary school interior design

Need for the Study

The motivation for this study was desires to provide an understanding of how technology-influencing interior design of primary school. The challenge of preparing the children for a life which does not yet exist and whose nature can only be imagined is an awesome task for us. Therefore, it is imperative that we in education as well as all concerned laypeople recognize this challenge and begin to take the necessary steps to meet it. Educators have already been busy re-examine every facet of the teaching-learning process in an effort to obtain greater efficiency and greater productivity. The technology plan is under constant review in Taiwan, but interior design seems lack of focus. It is important to make the need of interior design clear.

Procedures of the Study

The procedures of this study consisted of the following: Identify a research problem, Review related literature, Design survey instrument, Conduct the survey procedure, Analyze the data collected by survey instrument, Make discussion, conclusion, and recommendations.

Methodology

The investigating method was used to conduct this research. In this section, population, sample, instrument, data collection, and hypothesis were described.

Description of Population and Sample

The target population for the investigation is primary school in Taiwan. There were 2,583 primary schools. A random sampling technique was used to select appropriate proportions of the sample. Total 258 objects were selected and there were 238, 92%, return questionnaires.

Development of the Instrument

The questionnaire method of data collection was used for this study. The instrument contains 44 questions. Rating scales for each item included: Strongly Not Agree = 1, Neutral = 3, and Strongly Agree = 5.

Data Collection

The questionnaire was delivered to selected primary school. A cover letter introducing the investigator and explaining the purpose of the study and assurance of confidentiality of data was enclosed. It was noted that the person who fill the questionnaire should be the one with job task of conducting technology plan or experience of implementing technology plan. The participants were asked to complete the questionnaires within one week and to return it.

Hypotheses And Statistical methods

Hypothesis 1
It was hypothesized that the score of each statement was not significantly different from degree of neutral.

Hypothesis 2
It was hypothesized that the mean score on interior design statement is the same for each technology, computer, networks, and audio/video.

Hypothesis 3
It was hypothesized that the mean score on interior design statement is the same for each interior changing area, power, light, air-condition.

Hypothesis 4.1
It was hypothesized that the mean score on computer technology is the same for each interior power changing.

Hypothesis 4.2
It was hypothesized that the mean score on networks technology is the same for each interior power changing.

Hypothesis 4.3
It was hypothesized that the mean score on audio/video technology is the same for each interior power changing.

Hypothesis 5.1
It was hypothesized that the mean score on computer technology is the same for each interior light changing.

Hypothesis 5.2
It was hypothesized that the mean score on networks technology is the same for each interior light changing.

Hypothesis 5.3
It was hypothesized that the mean score on audio/video technology is the same for each interior light changing.

Hypothesis 6.1
It was hypothesized that the mean score on computer technology is the same for each interior air-condition changing.

Hypothesis 6.2
It was hypothesized that the mean score on networks technology is the same for each interior air-condition changing.

Hypothesis 6.3
It was hypothesized that the mean score on audio/video technology is the same for each interior air-condition changing.

Hypothesis 7.1
It was hypothesized that the mean score on computer technology is the same for each interior physical space changing.

Hypothesis 7.2
It was hypothesized that the mean score on networks technology is the same for each interior physical space changing.

Hypothesis 7.3
It was hypothesized that the mean score on audio/video technology is the same for each interior physical space changing.

The two-tailed t-test for independent samples was used to test hypothesis 1. The one-way ANOVA was used to test hypothesis 2,3,4,5, 6 and 7. The 0.05 alpha level was selected to test the statistical significance.

Conclusions

Based on literature review and survey result, the technology used in primary school could category into three groups. Those are: Computer, Networks, and Audio/video. Technology influences interior design in four areas. Those areas are: Power system, Light system, Air-Condition, Physical Space

According to the statistical test result, it was concluded that:

1. It is not required an air-condition system for using network technology in the classroom.
2. It was not required an air-condition system for using network technology in computer lab.
3. It is not required an air-condition system for using audio/video technology in the classroom.
4. It was not required an air-condition system for using audio/video technology in computer lab.

Although computer, networks, and audio/video all significantly influence primary school interior design, computer's influence is significantly higher than both networks and audio/video. Although interior design of power system, light system, air-condition, and physical space are all influenced by primary school technology, power system had the highest degree of technology influence. Whenever primary importing technology of computer, networks, and audio/video, the power system made changes of: Capacity increasing, Outlets increasing, Ground system, UPS system, Power backup system. Whenever primary importing technology of computer, and audio/video, the light system made changes of: Indirect lighting, Task lighting, Light control points. Whenever primary importing technology of computer the air-condition system made changes of: Server's room, Classroom, Computer lab.

Whenever primary importing technology of computer, and audio/video, the physical space made changes of: Window shielded, Monitor direction, Reservation space, Zone separation

Whenever primary importing technology of networks, the physical space made changes of: Wiring system, Network outlet, Space reserved for networking instruments, Space reserved for servers, Desktop area and laptop/notebook area, Sign and direction of accessing network service.

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A Study of Teaching Belief of Using Technology in Taiwan Primary School

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The purpose of this study is to identify the primary school teacher's teaching belief of using technology. Belief is the subjective probability of a relation between the object of the belief and some other object, value, concept, or attribute. A teacher may believe that technology possesses certain attributes that a given behavior will lead to certain consequences, and that certain events occur contiguously.

The Hypermedia as Supporting Tool for the Learning Process

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Abstract: The aim of this paper is to present an application of regional interest (a hypermedia on the province of Chubut –Argentina-) using the Hypermedia Model for Meaningful Learning (MHAS, its acronym in Spanish) as innovative tool which facilitates the task of designing educational hypermedia. MHAS provides the hypermedia a structured hyperspace adequate for educational purposes. Helps in construction of the conceptual –interdisciplinary– network, the design of interactive activities and evaluation.

INTRODUCTION

The teacher plans his/her work in the classroom elaborating activities for didactic units. The didactic units are made up of contents, activities (teaching-learning, synthesis and recapitulation) and evaluation. All these components must be related to each other and articulated according to an organizing axis (topic) around which the other components are constructed. The model for the design of educational hypermedia (MHAS) is based on the reappraisal of such activities as central tools for contextualizing and highlighting the information present in a hypermedia.

MHAS Guidelines for Developing the Application

Selection of subject: Definition of axes and sub-axes.
The general subject of our work is about Social Sciences area of the fourth level of the General Basic Education. Denominated: My province, Chubut. We knew beforehand that the subject would produce convocation of teachers, due to its regional significance. We organized both thematic axes and sub-axes around which the hypertext would be constructed. Contents were located in the corresponding axis/sub-axis this location of contents resulted in the linking points (through shared contents) among the axes. The teachers participating chose axes to develop activities.

Contextualization.
On learning theories: The preparation of activities taking the didactic unit as reference, the sequencing of such activities and contents, the selection of materials and their representation (text, sound, image, etc.) according to an objective, provide the structure for the hyperspace and give sense to browsing in the educational hypermedia. Therefore, the preparation of the hypermedia should begin with the elaboration of a script, that allows creating a framework for the topics and educational needs that shall be dealt with by the hypermedia.
On the characterization of hypermedia readers: It is essential to characterize different kinds of readers that may be in contact with hypertext. For the construction of this software, we have taken into account the editor style of reader which include others most passive.

Compilation of Material.
In this moment appear linking points between the concepts and the activities due to the interaction of the teachers that participate. They carrying out of joint activities, leading to a more comprehensive treatment of the concepts and enriching the resulting hypertext.

Preparation of a Script.
The script is the hypertext general structure. The hierarchical navigation is defined to relate concepts, starting from general ones and moving on to more detailed ones. The teachers while interacting find navigation alternatives, which resulted from the relation among different views of the same concept evoked in different sub-axes. Such alternative navigation will be controlled in order to avoid disorientation; the student will be able to exclusively go back to the starting point to continue with the hierarchical navigation or else, move to the newly found axis starting from a main node. Said restriction on navigation tends to strengthen the contextual visualization of each and every sub-axis as well as keep in the student's memory the main axes around which each concept develops. Nevertheless, navigation alternatives due to filtered visualizations contribute to reflect on cross relations.

Selection of Materials.
Together with the script preparation, a pre-selection of the materials compiled was carried out, trying to find in each case the most suitable presentation in order to catch the student's attention as much as possible. In this experience, preference is given to those materials that allow the gradual insertion in the real and concrete world. As these children are highly susceptible to visual and auditory stimuli, the capacity of the hypermedia to represent the same concept through different means (text, image, sound and so on) acquires great relevance. Besides, as children are initiated into inductive reasoning, they learn as they navigate in the hypermedia.

Preparation of the interactive activities and learning evaluation.
Some nodes where self-evaluation activities. The application comprises puzzles, matching activities, crosswords and activities to find words. Besides showing to the student his/her progress, these activities give the teacher some idea of the hypermedia comprehension via the statistics stored to record the performance of each student work.

Implementation.
A simple style was chosen to prepare the pages, the graphics, buttons and text being kept in a fixed position. Each page is self-contained. The text –brief and clear– is structured like a dialogue with the student. The images appear whenever they are necessary. We develop a product suitable to be used in a standard multimedia configuration, so that it could be distributed in the schools in the interior of the province of Chubut, which are not still furnished with highly sophisticated equipment. We use Neobook and Clic to implement, they are accessible and easy to use. These, together with the MHAS guidelines allowed the teachers to actively engage in the design and implementation.

Conclusions

A simple style was chosen to prepare the pages, the graphics, buttons and text being kept in a fixed position. The page size was adjusted to fit a screen. Each page is self-contained. The text –brief and clear– is structured as a dialogue with the student, encouraging him/her to go deeper into the subject, thus fostering research. The images appear whenever they are necessary. In this regard, the decision was made to design a product suitable to be used in a standard multimedia configuration, so that it could be distributed in the schools in the interior of the province of Chubut, which are not still furnished with highly sophisticated equipment. It is worth mentioning that a lot of small communities in the inland areas of our province are now supplied with electricity as the result of the introduction of computers in the schools. We believe that equipment must not be an obstacle that limits its use. Neobook and Clic were chosen as implementation tools, as they are accessible and easy to use. These, together with the MHAS guidelines allowed the teachers to actively engage in the design and implementation.

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DESIGNING EFFECTIVE USER-INTERFACES For COMPUTER-BASED And WEB-BASED TRAINING PROGRAMS

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Abstract:
This highly visual and interactive presentation on designing effective user-interfaces gives practical guidelines on what works and what doesn't work in designing and developing computer-based and web-based training materials. Topics include menus, orientation information, image location, screen design, effective use of colour, controlling animations, highlighting, displaying questions, control options, time delays, and narration. The highlighted software samples are designed from the perspective, "If you have to explain how to use it, you have done something wrong." There will be numerous specific objectives taught. Participants will be able to design more effective menus and screens, use colors more effectively, design clear and concise buttons, effectively highlight text, place orientation information, text, images, and buttons at appropriate screen locations, allow users to properly control animations, design more effective questions, explain why it is generally best to instantly display information, state when to use narration and when to avoid it, and evaluate software.

INTRODUCTION

The following points on the user-interface and screen design are generalities. There are exceptions to these generalities. Also, there is much more to user-interfaces and screen design than can be covered in these notes.

The user-interface and screen design are particularly important on your first project. Those who resist educational technology will often criticize these aspects, especially if they can't find a flaw in the content. So, on your first project, do everything right to ensure that it will be accepted. Consider working with external professionals on your first few projects.

CAUSES OF USER-INTERFACE AND SCREEN DESIGN PROBLEMS

User-interface and screen design problems often result from:
- *Not knowing what should be done*
One typical reason is that people often get into creating computer-based training applications without learning how to do it right. Teaching with computers is inherently different than with traditional methods.
- *Not getting enough user-input*
One of the best ways to evaluate the user-interface and screen design is to watch a variety of novice users use a prototype of the system. As soon as they hesitate or click on the wrong prompt ask them what was wrong. Use the philosophy: "It is impossible to make anything fool-proof because fools are so ingenious."
- *Getting user-input too late*
Get feedback on an initial prototype so that it is cheap to make changes. Also, evaluation and revision should be an integral part of the entire instructional development cycle.
- *Presuming that users have a high level computer ability*
There are always novices and new employees. Also, remember that you are familiar with the interface so what you easily understand others may not.
- *Inadequate budgeting for evaluation and revision*
Unrealistic or changing requirements can take money away from evaluation and revision.
- *Inconsistency in screen and user-interface design*
For example, inconsistent use of colours and varying screen locations for standard components.

To be successful, design from a typical user's point of view, relate the interface and screen designs to what is done in the real world, evaluate and revise early, thoroughly, and throughout the process, be consistent in the overall screen design, use of colour, buttons ... Do not force students to search for repeated components. You should design with the philosophy: "If you have to explain how to use it, you have done something wrong."

MENU SCREENS

To capture a learner's attention, have something "lively" happen on the main menu or first screen that is viewed. This could simply be animated text. A muted image is often attractive for the menu's background. Each menu should have a meaningful title that is easy to read over the background (e.g., with black shadows). Buttons or hot areas should be highlighted when a mouse is over it or a mouse button is pressed down. This is particularly important if buttons or hot areas are not obvious. Buttons should be centered or at least appear like their locations are deliberate. Buttons or hot areas should have meaningful labels that cannot be misinterpreted. The labels should also indicate sequencing if it is important. Menu buttons should have a check mark on them after the learner returns to the menu. These only indicate that the section was entered rather than stating that the section was completed or mastered (for logistical reasons and to not make incorrect conclusions). Menu metaphors (e.g., outdoor table and chairs for a chat location or bookshelf for a reference section) should have labels to ensure the correct interpretation. Most menus should have a prompt indicating what the student should do. The prompt should often state the correct sequence for selecting the menu items. Present the main menu selections in the sequence that they should be chosen and clearly label the buttons.

ORIENTATION INFORMATION

Orientation information should be at the top left of the screen so that it is the first thing a learner reads. It should have a section or module title (usually the same as the menu button), page title, and the page number out of a total page count. Stating the time required to complete a section can cause problems if the learner finishes too quickly (perception of simplicity) or too slowly (feeling of inadequacy).

IMAGE LOCATION

Images should be located to the left of the text because people tend to view images before reading. This allows for natural eye flow across the screen. This leads to elegant screen designs. Images should not be place in the middle of text (i.e., should not be sandwiched by text because this causes the text's flow to be disjointed).

ANIMATIONS

An animation should only begin when a learner is ready to view it (e.g., by clicking an "animate" button). This ensures the learner will not miss the animation and will focus their attention on it. The "animate" button and text prompt should disappear when the animation is playing since the button is inactive. They should reappear after the animation ends to allow the animation to be played again. Do not assume that viewing the animation once is enough. What if the learner was looking the other way or was interrupted? Do not have the animation repeat endlessly after a learner clicks a button to see it. It is distracting when the learner tries to read the text.

TEXT

The text on each screen should have a header. Text should be in a bright colour (e.g., cyan) on a consistently-coloured dark background. The foreground and background colours should have high contrast. Bright backgrounds can cause eyestrain over time. Prompts, when needed, should be placed underneath the content's text or at the bottom right of the screen. The bottom right can be a consistent place for instructions. This is where one's eyes finish after reading a screen. Prompts should be in a different colour than the content's text.

HIGHLIGHTING

Some screens need highlighting to allow pertinent information to be quickly found. Highlighting text with a bright colour (such as yellow – depending on other factors such as the background colour) is better than underlining or bold. Remember that red can be effective but some people have a colour deficiency towards red (and green). Use one highlighting method sparingly. Too many colours or highlighting methods can be distracting. Too much highlighting hides what is important.

CONTROL OPTIONS/BUTTONS

Each screen should at least have the control options of "Exit", "Main Menu", "Page Select", "Previous Page", "Previous Menu", "Hints", "Help", "Glossary", "Calculator" ...
Note that "Exit" is more positive than "Quit". Each button should have a text label that is meaningful. For example, "Return" works but "Main menu" provides more information and gets the learner used to the name of the screen. Text labels are much better than icons since icons can easily be misinterpreted. Framing/separator bars help separate orientation information and control options from the rest of the screen. A de-highlighted previous page button can be used on the first page of a section. This is better than leaving an empty area for the button or having a "normal" button not working. Similarly, a de-highlighted next page button (with a text prompt) can be used on the last page of a section.

QUESTIONS

Orient the learners and make questions obvious by putting in a header such as "Review Question #1". Prompts for questions should be placed underneath the question's text. It should be in a different colour than the text of the question. This clearly separates it and makes it easy to find. These prompts should be removed once the learner makes their choice since the prompt is no longer valid. As is appropriate, each distracter (answer choice) should be grammatically valid, be a reasonable choice, and finish the sentence. Feedback should not be in red if the student answers the question incorrectly since some viewers have a colour deficiency towards red. Consider providing detailed text feedback and even highlighted images for feedback. Only have students try again if there is educational value in the task. For example, it is pointless trying a true/false question again.

TIME DELAYS

Instantly display information. Students can get frustrated if they read faster or slower that the display speed. If there is an educational reason for not instantly showing all of the text, let the learner control when the screen should build. For example, allow this with a "More details" button.

NARRATION

Narration is great for ESL learners. Always give the learner control of whether the narration is heard. Also, have a separate audio toggle button for each paragraph to allow for quick review. Do not automatically start each page with narration. As with displaying text with time delays, narration can also frustrate many learners since the narrator is usually slower or faster than the learner's reading speed. Remember to create the narration near the end of a project when all of the text edits are done. This ensures that the narration matches the text.

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Drawing Together in the Classroom: an Application of the "cartable électronique" Project.

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Abstract: This paper describes a collaborative drawing software developped within the "cartable-électronique"® project, in collaboration with teachers and children. It is a groupware which is intended to be used mostly in classroom settings, by children aged 5-6 years. It provides children with the means of working together to produce graphical realisations. It also includes functions allowing the teachers to regulate the drawing activity. Regulation here resides in the possibility of defining pedagogical scenarios and submitting the collaborative activity to them, thus giving the teacher the possibility of constructing various pedagogical situations. Collaborative drawing appears to be an interesting means for children to learn socialisation and develop oral expression, which are two important skills to acquire in primary education. Regulation functions are grounded on a general theoretical model (the *participation* model) which proposes to take into account the social aspects of collaborative work.

Introduction

Most of the time, when speaking of new technologies to be integrated in classrooms, people think of computers: just buy them, the most sophisticated possible, and use them ! There is no time taken to think about what kind of hardware or soft ware would be useful or what could be done with this hardware or software; and, if there is, teachers are most of the time not involved in the discussion. The work we present here puts the teachers and even the children at the center of the process. We present a drawing software which was developed in partnership with teachers and pupils. We have deliberately chosen to place this software in a collaborative context. We present in what follows the way children can draw together, the way the drawing activity can be regulated by the teacher, and the "participation model", the theoretical model on which the regulation functionality is grounded. We then show the challenges of such a collaborative situation. Before that, we present the overall framework within which this application has been developed: the "cartable électronique"® (electronic satchel) project.

The "cartable électronique"® Project.

In an attempt to address the issues of teaching and learning with technologies, Syscom has established the "cartable électronique"® project. It was inspired by the main object children carry every day when they go to school : the "cartable" (satchel), which contains books and pens, toys and drawing tools. Technology gives us the opportunity to reduce the weight of the "cartable" without losing its content. SysCom is working on this project in collaboration with educational organizations in France (the French Ministry of Education and local authorities representing the Ministry) and the Departement of Savoie local government (Conseil Général).

The long-term goal of the project is to provide an opportunity to develop applications and services that can be considered by teachers, children and their families when they work with the children. The "cartable electronique" has three main axes of development. The first concerns hardware: people involved in the project participate in the design of wireless computers adapted to children. The second is the creation of a support on which services and applications can be put and proposed to teachers, children and their families. An educational web portal has already been developed to play this role. The third is the services and applications one. The collaborative drawing application refers to this third dimension. We here pursue the same objectives as I3net ESE projects Nimis (Nimis website), (Hoppe et al. 2000) or Kidstory (Kidstory website): developing new technologics for educational purposes.

The Collaborative Drawing Application

The collaborative drawing software developed within the "cartable électronique" project is intended for children aged 5-6 years and for their teachers. It provides children with the means of working together to produce graphical realisations : drawings and graphics (- note that graphics has to be distinguished from drawings. It is also a drawing activity but a very constrained and directed one. It is used as a pre-writing activity, to develop fine psychomotivity. Children are told what to draw, where and how; they usually draw curves or "bridges" or "scales", like the ones drawn on the fish in (Fig. 1), because this is a way of preparing them to acquire the physical abilities for writing -). It is intended to be used mostly in classroom settings. It also includes functions intended for the teachers allowing them to regulate the drawing activity. Regulation here resides in the possibility of defining pedagogical scenarios and submitting the collaborative activity to them. These functions, as well as the graphical tools proposed to children, have been designed in collaboration with teachers and children themselves. We describe them in what follows.

We should first mention that we have chosen to install the application not on classical hardware (like personal computers) but on pen tablets. These tablets have an interactive pressure-sensitive touchscreen replacing the traditional chalkboard. Children can draw on the tablet with a sensitive pen as if they were drawing with a real pen on a sheet of paper. Tablets are so much more usable by young pupils. Furthermore, they present the advantage of being easily carried, which is an important feature to consider, as we want children to be able to use the application in classroom settings but also at home.

The application has been developed with the JAVA language and can thus be installed on various operating systems (we have already tried successfully to make it run on heterogeneous OS machines including Linux, windows NT and windows 95). We used the SWING package for the design of the interface and the RMI mechanism for communication between the tablets.

The Graphical Tools for the Children

The drawing application is designed around a series of graphical tools that children pick up and apply using the sensitive pen. The tools are:

- crayons of different thickness,
- a palette to choose the colour of the crayon,
- an eraser to do fine erasure,
- a rag to do rough erasure,
- an album to arrange the drawings done,
- scissors to cut out parts of the drawing (a part can then be put in the album or moved around the drawing in order to be pasted on it),
- an "undo" function which makes the drawing go back one step.

These tools can be accessed via the graphical interface shown in (Fig. 1). Particular care has been taken in choosing the icons that represent the tools.

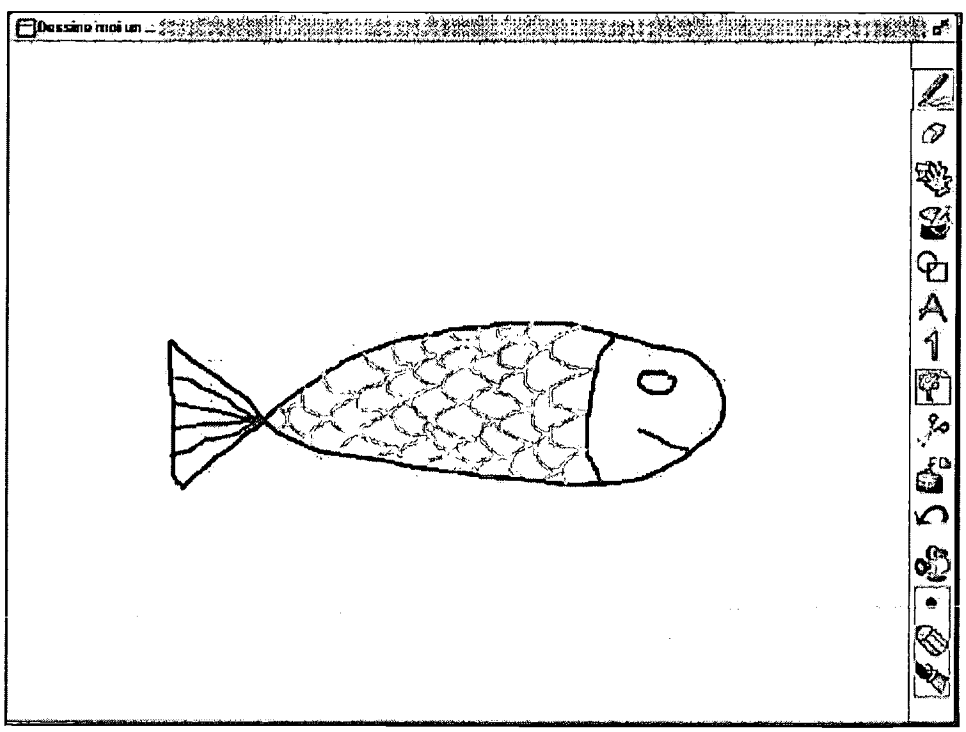

Figure 1: The interface of the collaborative drawing application

Drawing Together

Children can choose to work together or on their own. When working together, each child belongs to one group. In a given group, each child has his/her own tablet and his/her tools. The children share the same drawing space but not the tools. When one child modifies something on the current drawing (by drawing, or erasing, or pasting, or cutting, ...) on his/her pen tablet, the others immediately see what has been changed. It is a WYSIWIS approach, with strict synchronisation of the different children's views onto a shared workspace. Note that, as tools are not shared, the views onto the tools are not synchronised. Thus there is no problem of concurrent access to one tool. One child is either working alone, or as a member of a group. As soon as he/she becomes a member of a group, the drawing of the group appears on his/her tablet : he/she becomes immediately involved in thc collaborative drawing process and can contribute to it.

The Teacher, Regulator of the Collaborative Activity

The teacher can use the graphical tools as if he/she were a child. He/She can be a participant in the drawing process of a group as the children are. But he/she is the teacher : it is his/her social status. So he/she has the specific role of being in charge of the management of the groups and, in a more general way, of all the mechanisms which regulate the group activity. He/she thus has at his/her disposal, through specific interfaces (Fig. 2), functions allowing him/her:

- to create groups ("add group" button in (Fig. 2)),
- to define and describe the participants ("add child" button in (Fig. 2)),
- to define roles or hierarchical positions ("add role" and "add hierarchical position" buttons),
- to put one participant in one group or remove him from one group,
- to attribute tools and/or roles and/or hierarchical positions to one participant,
- to select, from predefined scenarios, the ones which will be put into practice in one group.

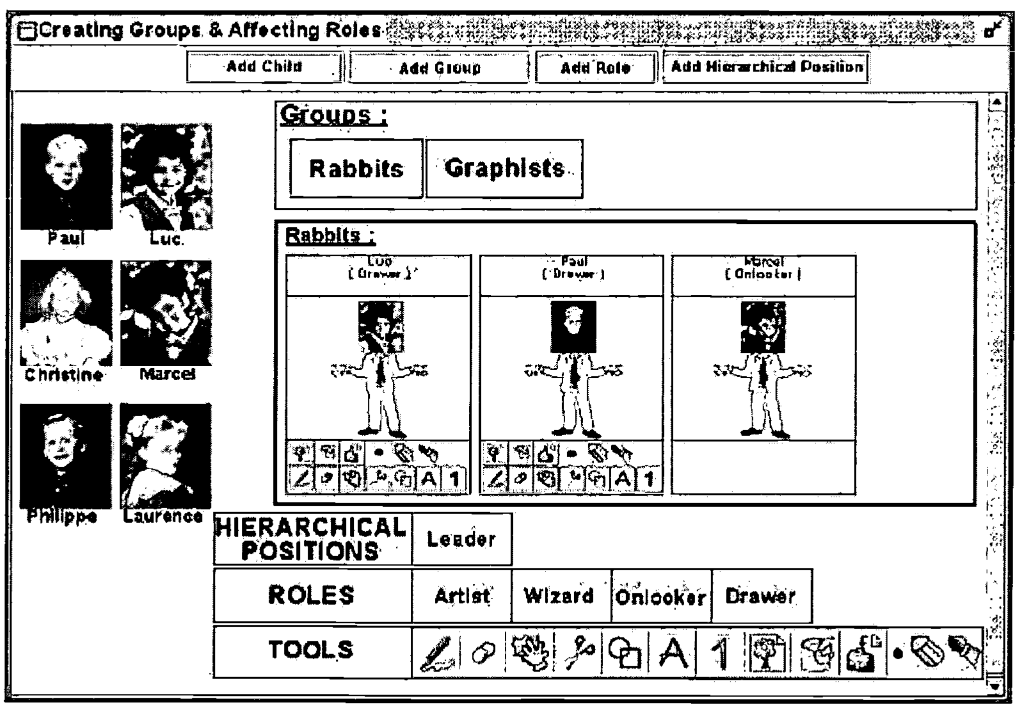

Figure 2: the teacher interface for managing groups and affecting roles

The last three functions use "drag and drop" facilities to be activated. For example, in (Fig. 2), the teacher has created the "rabbits" and "graphists" group. He/she is currently working on the "rabbits" one, which is represented physically by a square in (Fig. 2). Defining who is a member of that group is just a matter of selecting the photo representing the pupil, dragging it onto the "rabbit" square and dropping it into the square. This has been done in (Fig.2) with "Luc", "Paul" and "Marcel". It is the same with the roles, hierarchical positions and the tools; they are dragged onto the pupil to whom the teacher wants to attribute them. Idem with the scenarios which can be selected from a list a predefined ones and dragged into one group to become active (this is done via an interface which looks like the one presented in (Fig. 2), except that scenarios take the place of roles, tools and hierarchical positions).

The roles can be created before dealing with group creation or during this process. Actually, defining a role consists in defining a set of tools which will be attributed to the participant playing this role in the group. So one role can be created dynamically because the teacher has attributed tools to one child and then has defined a role that the child wants to play (he/she may ask him the name of this role, thus contributing to enhancing the imagination and creativity of the child). For example, in (Fig. 2), the "artist", "wizard", "drawer" and "onlooker" roles have been defined. A drawer can use all the tools available in the drawing application, whereas an onlooker is just a spectator : he can't draw. Luc and Paul are "drawers"; Marcel is an "onlooker".

All these functions can be activated dynamically, even when children are involved in drawing. It is thus a good way of giving the teacher the means to influence the way the activity will proceed. It is a way of achieving flexibility in groupware. Note that the teacher plays several roles at different times : he can be a "contributor" to the drawing in a group, the "regulator" at the same time or at a different one , the "supervisor" (he/she monitors what happens in the group at a given time), etc.

The Administrator, Creator of Scenarios.

We have mentioned before that the teacher can choose scenarios to become active in a group from a set of predefined ones. Actually, scenarios are a way of describing the rules and laws, etc. which have to be respected in the group. These scenarios are therefore to be defined. This is a particular function which, at the present time, cannot be handled by the teacher, as it supposes being finely aware of the theoretical model underlying the regulation process (see section below). So it is handled by a person whose role is "administrator" (currently the designers of the software). We have developed a separate interface allowing the administrator to define scenarios (Fig. 3).

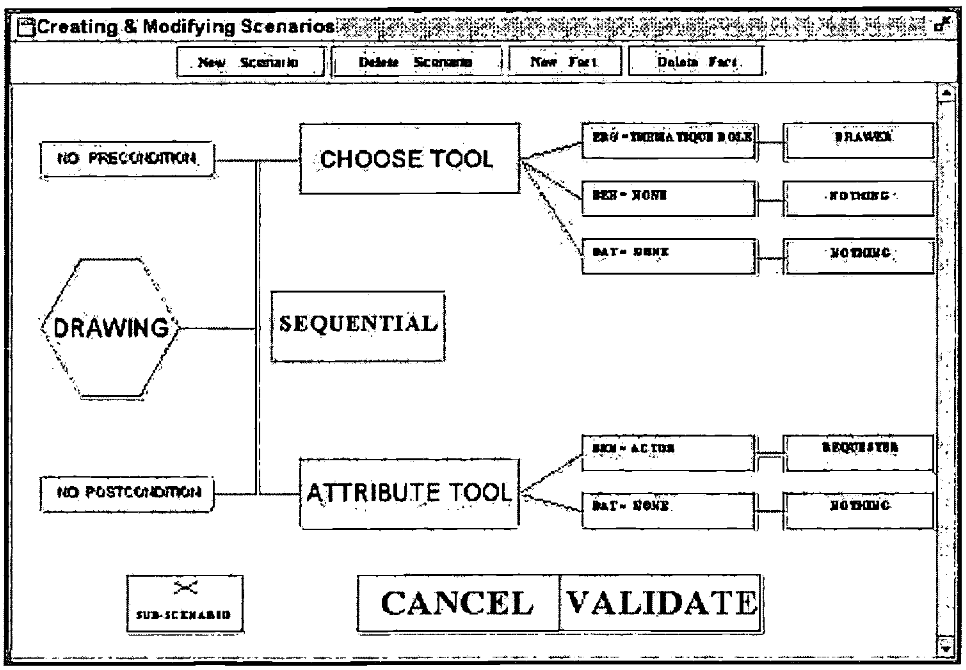

Figure 3: the administrator interface for defining scenarios

A scenario (represented by hexagon) is a sequence of contributions (e.g. : "choose-tool", "attribute-tool") and sub-scenarios. It can have a condition for success and a condition for satisfaction. Roles are linked to contributions by means of semantic cases which determine the involvement of the participant having that role in the scenario (does he make the contribution ? is it made to his/her benefit ?, ...). The "drawing" scenario presented in (Fig. 3) says that *"only actors (participants) having the role of drawer can draw"*. Moreover, as scenarios have to modify what is occurring whilst using the graphical tools during the collaborative drawing process, one more function has been provided to the administrator : it is the means of linking the contributions occurring in one scenario to the corresponding events coming from the drawing application and to the corresponding method invocation.

The Theoretical Model Underlying the Regulation Functions.

The interfaces offered to the teacher to regulate the collaborative drawing activity and to the administrator to define scenarios are just customized views of a general model of regulation that we call "the participation model"

(Ferraris & Martel 2000). This model is a proposition to take into account the social aspects of collaborative work, which most of the time are rarely supported in groupware. It proposes to consider the persons involved in a joint activity as active participants who can organise their activities, define the conditions under which they will be exercised and negociate their commitment to these activities. It can enable compromise between the interests of the group and those of the individuals, between the dependencies that stem from relationships among individuals and their autonomy.

The objective of the participation model is to organise the shared space, the rules and agreements, the users and their actions or interactions. It is a conceptual model that describes, formalises and builds the context of the joint activity, the relationships of dependence and the structure of exchanges within the group. It proposes to describe the *arenas* (locations) where the activity will take place, the *interactive scenarios* guiding the interactions and the actions of the participants, and the participants themselves. They shall be represented in the arenas by means of computer entities which we call *actors*.

The *arena* is the common area where the activity takes place. It contains the actors, the operators and the functions which the actors will use, and the artefacts activated by the operators and functions (the artefacts are the objects that the participants can manipulate in the arena). In the example above (Fig. 2), it corresponds to the definition of groups. Two of them have been created : the "rabbits" one and the "graphists" one. The operators and functions are the graphical and regulation tools; the artefacts are the pieces of drawing which compose an entire drawing.

The *interactive scenarios* describe the social protocols in effect in the group. They were inspired from the dialogue models of the University of Geneva (Roulet et al. 1985) that attempt to explain the succession and the interweaving of conversational exchanges. In the same manner, the scenarios will describe the possible exchanges between participants and define the possible sequence of these exchanges. This does not entail a rigid and deterministic description of the interactions between participants (which does not seem possible to us for most joint activities) but rather the furnishing of guides to help the participants govern their exchanges, such as is proposed by (Bider et al. 2000) for workflow. From a social point of view, the interactive scenario constitutes a means of subordinating the activity to the context (educational, commercial, technical, etc) in which it occurs and explains the typical sequences for each of these contexts.

The actors are computer entities that allow one or more users to fit into a network of exchanges. Their main function is to represent the participants and identify them. They are also supposed to facilitate communication between participants and to assist them in task execution. They are characterised by their *roles (thematic or casual)*, their *places* (hierarchical positions) and their *positions*. An actor plays a specific role during an interaction according to his/her *contributions* (Martel 1998). In the example of (Fig. 2), there are 3 actors in the "rabbits" arena. These actors are named Marcel, Luc, and Paul. They represent 3 children who want to draw together (in the same group). Luc and Paul have the "drawer" thematic role; Marcel the "onlooker" one.

Like many works in CSCW, we are inspired by ethnomethodology and linguistics (Dourish & Button 1998), (Goffman 1981), (Garfinkel & Sacks 1972), (Rastier 1989). We aim to give groupware users the means of co-constructing their environment. We share here the same approach as (Bardram 1998), (Bourguin & Derycke 2000) and (Fitzpatrick et al. 1995), (Tolone 1996).

The participation model has been implemented in JAVA as an independent software that can be plugged in any collaborative application, providing that the application has an API which allows the events generated by the users to be intercepted and to modify the methods invocation.

Pedagogical Challenges

In such a context, collaborative drawing appears to be an interesting technology for children to learn socialisation and develop oral expression, which are two important skills to acquire in primary education. As is done in (Benford et al. 2000) or (Hoppe et al. 2000), the drawing software we have developed provides opportunities for children to discover the benefits of working together. They can choose with whom they want to draw and how to proceed: socialisation is thus encouraged by this means. Oral expression is encouraged by the fact that children, having to achieve a collective task, have the possibility of discussing and negotiating the way they are going to work (what are they going to draw ?on which part of the screen ?who does what ? who is the wizard ? who is the "colourist" ? etc.). They can also react to what is happening during the drawing process itself : for example one child can make suggestions about something new to draw; or they can discover together the need to define "rules" in their group ("hey ! you don't have the right to erase what I have drawn !", which, once again, is a way of discovering life in a group.

The teacher has at his/her disposal a software on which he/she can act. It is flexible and can be manipulated as he/she wishes. So he/she can create various pedagogical situations according to what he/she wants the children to discover or learn. He/she has the means of enhancing collaboration between children. For example, in a situation where children have to make graphics (draw curves for example), he/she can put in the same group one child having difficulties in drawing the curves and one who is quite a good "curves-drawer" so that the second one will play the role of "assistant" for the first one : he will be able to help his friend, to show him how to do the right gesture, in the right direction, etc.

The teacher also has the possibility of enhancing discussion and negotiation between the members of a group. His/her role will then evolve to an animation and observer one (he/she observes what happens in the group he/she has defined). Furthermore, as the drawings are recorded and as it is possible to know who has drawn what, he/she will be able to analyse what was done by each child and then to personalise the way each of them is followed up.

Assessment and future work

The drawing collaborative application will be tested in classrooms in two schools in the neighbourhoods of Chambery during the ongoing scolar year. We expect a lot from this experiment, in particular the validation of the regulation model through the interface proposed to the teacher. Furthermore, we have seen that regulation is teacher-centered in this application. The teacher builds situations where children play with tools and talk about simultaneously. Activity needs not only to be explained to children but also to be negociated with them, step by step. That's why we aim at moving towards a pupil-centered regulation, which will allow children to take hand on activity and to organize the framework of cooperation. This will exploit the reflexive feature of the regulation model. It will be one of our future work. The other one will be to give the regulator, be it a child or a teacher, the possibility of defining himself/herself the scenarios by providing an intuitive interface as this has been done with the management of groups and roles.

Conclusion

The future of education will lead children, teachers and families to use many electronic devices like e-books, the e-satchel, etc. Before the use of these objects becomes a habit, it is time today to construct practical experiments to evaluate their impact in educational processes. This is what we are doing through the "cartable electronique" project and the applications developed within this project.

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Kidstory website : http://www.sics.se/kidstory

Situating Training for Early Childhood Educators in An Authentic Multimedia Learning Enviroonment: The Case of Chelsea

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Materials to assist early childhood educators in working with children with behavioral problems are currently in high demand. This poster provides a demonstration of an interactive multimedia program for use with early childhood providers. The program, "Chelsea", is designed to enhance problem-solving skills of educators by involving the user in authentic, case-based instruction with opportunities to use program resources, utilize tools and procedures needed in real job situations, and respond to reflective prompts to assess decisions. The materials include software and multimedia placed on a CD, resource materials in PDF formats, and electronic performance support tools. Implementation is supported through statewide trainers and online discussion groups. Research with the interactive case-based training materials has documented the effectiveness of learning through multimedia cases for pre-service teachers. The work is presented as a model for effective implementation of technology-enhanced training in a real-world setting. See www.coe.missouri.edu/~vrcbd for further information and availability.

Children as Design Partners: A Qualitative Study of Process and Products

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Abstract: This paper reports the process and results of a qualitative study conducted in a graduate course on designing hypermedia learning environments for children. Learning to produce software using *Authorware Professional*, graduate students from many international countries worked with elementary-aged children in an English-as-Second-Language program to produce creative stories in a hypermedia format with tri-lingual narration. Children wrote and illustrated their stories and worked with their partners to make choices on screen design, animation, and sound effects. Multiple data sources were used to examine the impact of children-as-design partners on their hypermedia programs, features important to the children, and the change in design knowledge structures of the developers. Feasibility issues are discussed for replication.

Designing Hypermedia Products for Children

Too often, software is developed by adults from adult perspectives with evaluation only by adults; input from children is not sought and the voices of children are not heard. In designing new technologies for children, industry has discovered that children have unique likes, dislikes, and needs that are often different from those of adults. As stated by Druin "We need to establish new developmental methodologies that enable us to stop, listen, and learn to collaborate with children of all ages" (Druin, 1999, p. 53). Interestingly, when children are observed using software, researchers find that children use technology in different ways from adults. "Many times they do not have a defined task and their activities are open-ended and exploratory" (Druin, 1999, p. 53). Thus, it is critical to involve children as design partners in the development of software and explore the impact of their participation on us as developers.

Popular forms of software to promote literacy and exploration in young children are interactive books. While these books are "cute" and engaging, there is no evidence that the features of the books are important to children or that children use the books as the producers intended. See for example, *Grandma and Me* (The Learning Company). In fact, adult testers of interactive books frequently cite problems with navigation and 'save' functions of such products, yet the market demonstrates continuing popularity of these products with children.

In this study, children from an English-as-Second Language (ESL) class in an elementary school were involved in writing and illustrating their own stories. Ten children from Bosnia, Turkey, Nicaragua, Mexico, and Rwanda participated. Graduate students in educational technology served as design partners to convert the stories into interactive, tri-lingual stories: English, Chinese, and the child's native language. The child/developer teams decided on desirable features such color, graphics, animation, and sounds. Additional features included text and narration in three languages, electronic writing pad, and an author bio. Observations of the design and development steps were made to explore the design process, usage patterns, and response to interface design.

Description of the Hypermedia Design Course

The developers were enrolled in a semester-long graduate course with dual purposes of learning to program with Authorware *Professional* and to produce hypermedia learning environments. This course was an advanced interface design course for students majoring in educational technology in a college of education. Instruction in *Authorware* was interwoven with readings and discussion focusing on hypermedia design, research in hypermedia, and designing with children-as-partners. The graduate students were primarily international students from Korea, China, Taiwan, and Turkey, with a few from the United States. The teaching team included the faculty member; a doctoral student conducting *Authorware* training; a doctoral student in art education focusing on screen aesthetics; a technical support person for audio, video and graphics; and a student focusing on formative evaluation procedures.

Data Sources and Analysis

Tri-lingual Story Artifacts

The hypermedia stories were examined for use of hypermedia features, balance of input from the child versus adult developer, and story themes. Logs from design meetings were used to track design decisions.

Children Talk about Hypermedia Design

The children were observed sharing their final interactive stories with peers to capture their commentary on their stories and patterns of use. Following direct observation, they were interviewed regarding the features they liked in their programs, changes they would like to make, and how they felt about being authors.

Developers Talk about Hypermedia Design

The graduate-student developers wrote reflection papers regarding their design process, interactions with the children, assessment of the stories, and suggestions for improvement of the design partnership project.

Change in Knowledge Structure of Developers

The graduate-student developers completed two semantic maps during the semester, one prior to beginning design work with children and the second at the end of the semester. Semantic maps are a powerful method for assessing change in knowledge structures, as prior knowledge becomes reorganized in semantic memory. Change reflects growth in knowledge structures as graphically depicted in the semantic maps. (Jonassen, 2000).

Importance of the Work

The results of this study have important implications for designers of hypermedia programs for children, particularly in the area of literacy, creative writing, and multiculturalism. Involving children as design partners provides a bridge between software created *by adults for children* and software created *by children for children*. Published studies on hypermedia have focused on how adults and children learn using hypermedia learning systems (Ayersman, 1996) and have not investigated the question of hypermedia from the child's design perspective. Further, results have implications for training future developers of children's hypermedia and recommendations for replication.

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Students' Evaluation of Web Sites: An Exploratory Study

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Abstract: Although the Web is convenient for finding information, it is not necessarily reliable. While opportunities exist for students to hear about evaluation strategies there is no data to suggest whether they are using what they hear. The purpose of this study was to investigate students' assignment of credibility to a web site to determine whether or not participants believed information found on a site and what criteria they used to make their decision. Researchers utilized verbal log analysis and transaction log analysis to observe college students' evaluation processes as they searched the Web.

The World Wide Web is a convenient resource for finding information. It is available 24 hours a day, seven days a week and doesn't require leaving the office, home or school. It is little wonder that it has become popular among students who are writing research papers. Although the Web is indeed convenient, it is not necessarily the most reliable source of information. The freedom to publish information on the Web is unrestricted and there is generally no review process. People have been known to publish professional looking sites that contain incomplete information, pranks, contradictions, out-of-date information, improperly translated data, unauthorized revisions, factual errors, biased information, and scholarly misconduct (Fitzgerald, 1997; Oppenheimer, 1997). In order to find reliable information each web site needs to be examined with a critical eye.

Librarians and media specialists have recognized the problem of inconsistent quality on the Web and have developed guidelines to assist searchers in choosing credible sites. While differences exist in the criteria for evaluation that are recommended there is also much agreement. At a minimum, web sites should be evaluated based on the authority of the site author, currency, purpose, and objectivity. Opportunities exist for students to hear about evaluation strategies through classes in online searching offered on campuses and on many library web sites; however, classes are often sparsely attended and no reliable statistics exist on how many students visit library help pages. Students may not be aware of the need to evaluate information found on the Web. A study of undergraduate students in a business school found that the students rated information found the Web as *more* reliable than that found through other strategies (Morrison, Kim and Kydd, 1998).

The purpose of this exploratory study was to observe undergraduate college students' evaluation skills as they searched the World Wide Web. This study had, as its emphasis, student *assignment of credibility to a site* rather than relevance of subject matter. The study was planned to determine:

- whether or not students believed information they found on a web site
- how students decided what information to believe
- the criteria students used to make this decision

A qualitative approach was selected in this study because of its sensitivity to gaining understanding of participants' perspectives and to the process of exploring patterns of behavior within a realistic context (using a topic to conduct searches which supported students' coursework requirements, within a campus computer lab). Primary data collection techniques included observation of students' behaviors, recording of their verbalized thoughts, and documentation of their computer interactions.

Participants were questioned regarding their use of the Web and familiarity with their chosen topic. A 'think aloud' procedure was explained to students who were then asked to think-out-loud as they searched the Web, examined the returned results, chose which sites to visit, and examined each web site visited. Participants used a computer connected to the Internet, running tracking software to record their navigation through sites chosen. Participants were asked to choose a search engine and conduct a web-search relevant to one of their courses. Post questions followed the 30-minute think-aloud procedure. These questions probed participants' reaction to sites visited during the think-aloud process and their general attitudes toward web quality.

Transcripts were made of each session using both the videotape and audiotape. Time stamps were used on the transcripts to allow matching between the transcript and the transaction log. Both researchers collaboratively conceptualized and analyzed the data (Strauss & Corbin). Open codes were identified by analyzing whole sentences and paragraphs in the first two transcripts and identifying major themes related to the research questions. Following discussion, codes were agreed upon by each researcher. New codes were established if new information was found in the remaining transcripts that was deemed relevant by the researchers. Transcripts that had already been reviewed were re-examined to determine if any data matched the new codes. Categories and subcategories representing the phenomena of students' evaluation of web sites were thus derived from the data.

Findings

Media Equivalence

Students frequently compared the Web with other media tools, particularly journals, magazines, and textbooks. One student negatively compared a company's web-site with its television counterpart, stating:

> I know the Discovery Channel has lots of good programs and things, but I was kind of disappointed by their lack of resources on the Internet... maybe they feel that they don't need to have that kind of resource on the Internet, because there are other places out there that do it. So I was disappointed in the site. *Adam*

Evidently, Adam's judgment of this web site was based on his experience of the company representation in another media format. His disappointment resulted in part from the advertisement of a video by this site, which although likely to be very relevant to his study, was not free. A much more emphatic rejection of the web – in general, was provided by this student:

> The web just seems like it's more garbage than anything. It'd be better if it were all books... I was thinking that I don't want to do this. [Laugh] I'd rather just get a book. *Amanda*

Of the seven participants involved in the study, this student, alone, expressed a preference for the use of books above web resources. Two students expressed their belief in the equivalent value of web site and text-book/magazine resources:

> On people's personal web sites... the information there is I consider it to be on the same wave-length as if they had published a book. Anyone can publish a book and facts at least in this area, which might be conflicting or have different opinions. *Adam*

> I don't think that this information on websites is any less credible than like a newspaper or journal. And everybody's opinion has points. *Kristen*

Both students justified their belief in the equivalence of web and book resources with the suggestion that each medium offers a forum for expression of personal opinion.

Additionally, two students, Daniel and Katie cited examples of the superiority of web sites compared with other media resources. The complementary use of the Web (supporting the completion of newspaper crossword puzzles) is cited below:

> ...a lot of times you can't look in dictionaries or encyclopedias because the clues are kind of vague but if you just write the clue in sometimes it [the Web] brings it right up, it will tell ya. *Daniel*

The same student later discussed the advantages of web sites in compensating for course content not provided in books:

> ...like in the textbooks for your classes or stuff, you don't get a lot of information. You can't really get a newspaper in that language or something like that, or about those countries. So you can just look on the Internet and read the newspapers in that language or from that country. *Daniel*

Katie also expressed her preference for the use of the Web to locate information:

> I have used it [the Web] for speeches, for class information that I wouldn't have to go to the library for, that's easier accessed by using the computer. *Katie*

This preference for web site resources, above the use of textbooks, was hinged on efficiency.

Use of Domain Knowledge

The participants often used prior knowledge to evaluate the information found on a web site. Two examples were noted: information that confirmed the participant's prior knowledge and information that "made sense" in light of the participant's prior knowledge. For instance, in evaluating the content of a web site Adam exhibited both behaviors:

> Now this doesn't surprise me because there was such a sudden cultural shift. He's calling it an aesthetic and individual religion it probably had no deep roots – which makes sense because they probably, I mean, the roots of this can't have gone very far back, cause, like I said, for nine-tenths of their history, they're a deeply pantheonic people. *Adam*

Kristen and Daniel did not engage quite as extensively with the information they found but they did match the content of the web site to information they had received in class:

> Democratically inclined teachers reporting style and discussion. We definitely learned about the importance of discussion in a democratic classroom. That definitely emphasizes the child-centered aspect. *Kristen*

> Key terms and concepts. This is worth copying down I think. We've touched upon a couple of these things. *Daniel*

In activating their prior knowledge these participants validated their own knowledge, searching for inconsistencies, and reasoning about the new information they found. Since each participant came to the session with a research topic in mind we were not surprised to find the participants had prior knowledge in the subject they were searching.

When asked, "If you're not familiar with the subject that is being addressed on the site, how do you know that it is ? most students mentioned evaluation criteria such as those found in the literature.

> I think if you're not familiar with the topic and it's not a web page that you're familiar with, then you really don't have a good indication. If it's kind of general knowledge, you can take a look at it and if it sounds plausible or the person that

they're talking about has some kind of accreditation if they're a professor or a doctor, then that might be more reason to place more trust in the content. *Adam*

If you're not familiar with it, like if I wasn't familiar with space or anything I would go to NASA. Or like for my sexual education paper, like family services ...you go to the people that you know are associated with the topic. *Amanda*

If you went up to somewhere and you looked at the URL and it was somethin' like members at AOL or somethin' like that, then you know this is somebody making their own little web page, so you might not want to take that information at face value. But if you know if you saw that it was on, like you know, the APA's web site you could tell that its more credible. *Daniel*

A lot of times I try to look for, em, like big web sites, you know like government....but also, like almost anyone can put a web site out like anyone can put a page out so you have to realize that not all information can be correct and you have to go through it and screen things. *Katie*

These four participants mentioned "authority" as an important criterion for evaluating sites when their domain knowledge is low. These answers were supported during the study when they used authority to accept a page. For instance, Adam mentioned at one point that a web site was "good" because there were works cited he transferred the authority from those citations to the web site.

One participant, Eric, mentioned the use of triangulation (used in library science to verify source information by locating it in more than two resources) to verify information on a web site. "I would most likely go to another page. And see if it has similar information and if I match 3 or 4 of them together then I know that it's probably right since they all say the same thing."

Currency

Currency was not mentioned independently during the observation sessions by any participant. Although several sites viewed had "dates of last update" this was not mentioned in students' think-alouds. Some sites visited by participants were several years old. When prompted during the interview session to think about the issue of currency, five participants mentioned knowledge of the "dates of last update" and their possible use to check currency. Only one participant added the caveat "you don't even know if they changed anything". Two of the participants tied the importance of currency to the topic they were researching – one stating that currency was not important when looking at archeological sites and one stating that currency was important for educational sites.

One participant, Katie, stated that she thought information on the Web was more current than information that you could find in the library.

I think sometimes you can get like more current information on the Web, than you can like in the library because, its more updated, its easier to update than it is to like, print a book and then get it in the library and things like that. *Katie*

While several participants mentioned knowledge of this particular evaluation strategy none of them exhibited it during the search process.

Discussion

This study provides rudimentary evidence of the use of web-evaluation skills by undergraduate college students. Results of this study suggest that evaluation is clearly linked with user domain knowledge, apriori the Web search, understanding of web currency issues, and perceptions of web quality, as compared with other media information sources. Data gathered during the student interviews support these findings, however these findings were not always corroborated by students in their practical searches. Inconsistencies between stated knowledge and practice were frequently noted by the researchers. For example, regarding the quality of the information found on web-sites, one student suggests looking at:

> Well...logos I guess and other stuff cause some of the pages just look like a personal essay that someone threw on there. *Amanda*

While Amanda suggests looking at web-site appearance and "like names and like when they tell you who they are" to validate the quality of information provided on a site, she visited and revisited a number of sites which were inappropriate for her search (commercial sites, advertising goods, etc.) without seeming to recognize either the site address, name or general appearance.

Findings presented under the broad category of media equivalence, provided some insight regarding students *expectations* of the quality of web-sites, which in turn influenced their perceived need for evaluation of these resources. It was evident that students came to the web-search experience with certain beliefs (and mis-beliefs) about the quality of information resources found on the Web, compared with those found in other media (television, print, etc.) These expectations inevitably influenced their use of evaluation strategies. For example, despite being asked to visit new sites, two students visited familiar web sites during their search and did not demonstrate any evaluation strategies:

> The nice thing about encyclopedia Brittanica is that it also searches web sites out for you. This one's on Radon and these two only got one star each. Mmmm, although this one has a biography related to Nefertiti... so I'm going to take this link. *Adam*

Clearly Adam placed his trust in the merit of the Encyclopedia Brittanica's star quality rating. He did not question the reliability of these star ratings. On the contrary, he selected sites based on these recommendations.

It must be said that while students indicated (by action or verbal response) their awareness and use of certain web evaluation strategies, the researchers could find no evidence to suggest that the participants did not believe everything they saw on the Web. Rejections were made based on relevance to the chosen assignment. Confirmations were made based on evaluation criteria.

Implications and Recommendations

The researchers make a number of recommendations regarding the methodology used to gather data in this study. The complementary data gathering strategies (interview and think-aloud) are considered a strength of this study. Reliability of web evaluation data is further enhanced by the use of tracking software to document student interactions with web resources.

Additional questions are recommended for inclusion in the interview instrument. Such questions should seek specific information regarding whether or not students have previously taken a class in web-site evaluation, had read any information on this topic, and whether or not students had ever come across a site that contradicted what they already know to be 'true'. Further studies might examine the role of epistemology, in predisposing students toward certain evaluation criteria. Additionally, the role of motivation and interest in determining use of evaluation strategies, is worthy of exploration.

Student knowledge of web search strategies played a large part in the study. At the conclusion of the study, when invited to ask questions or seek assistance on their search activities, each participant asked for advice on improving his/her search strategies. Two participants in this study did not have the skills to effectively search, and therefore infrequently reached the point of web site evaluation. Their decisions to select certain web sites were based on relevance and are thus beyond the purview of this study. The researchers recommend that future studies begin with a brief web search instructional sequence for participants, thus ensuring baseline skills to support web searching and providing opportunities for observation of web site evaluation skills.

Finally, given the lack of research concerning the evaluation phase of the web-search process, the researchers recommend that additional research be conducted with varied age groups.

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A North American Nationally Distributed Multimedia Course

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Abstract: A multi-modal course, Feeding Young Children in Group Settings, was developed and offered for mass audiences in the Western hemisphere. The diversity of a mass audience provides special technological considerations and challenges for professors. Instructional design for the course includes live session broadcast via satellite (now captured on videotape); a comprehensive web site with handouts, bibliography, and web links; and course activities using WebCT. The web site also includes a thorough manual for local site facilitators. A key strategy for the instruction was development of 30 video vignettes of children and their teachers eating in group settings. These diverse vignettes provide multiple points of application for our varied audiences and their local facilitators.

In the United States of America over 5 million young children are in child care and government-sponsored programs for children. Most of these children eat at least one meal per day in these settings. Issues arise in such settings for staff development and training around feeding children. Feeding children in group settings is minimally addressed in local training for child care teachers and minimally in undergraduate programs. Opportunity for training is inhibited because child care teachers are place-bound and time-bound by their jobs. Economic constraints in children's programs result in limited resources for training.

Feeding Young Children in Group Settings is a national North American distance education course produced by the University of Idaho. The intent of this course was to provide access for training about feeding children to a mass audience. The course is offered for academic credit, continuing education units, and as a non-credit professional development activity. The targeted audiences include teachers, center and family child care providers, extension educators, nutrition educators, food service workers, and others who train staff and parents or parents on issues related to feeding children. The targeted audiences also include university and community college students majoring in child development, nutrition, and education.

We selected multiple instructional media to reach the widely diverse audience. These include live sessions broadcast via satellite (now captured on videotape); a comprehensive web site (http://www.aee.uidaho.edu/feeding) with handouts, bibliography, and web links; and course activities using WebCT. Printed curriculum and support materials for the course are convertible to Adobe Acrobat format and are distributed exclusively via the web site. Our web resources page also allows us to gather websites that would be helpful to those who feed young children in group settings. Nearly 10,000 copies of the instructional materials have been downloaded by participants. We have had particular success with the portion of our web site that provides site coordinators with support handouts and materials for their participants. More than 3,000 support documents have been downloaded by site coordinators. Our 15-page satellite coordinator's handbook was downloaded nearly 900 times. Internet-based capabilities add a dimension to the course that brings a much higher "touch" with our students than the satellite or videotape sessions alone.

WebCT courseware is used to provide the on-line course activities. Students seeking academic credit view the satellite or videotaped sessions. Following each video session, students log in at our web page to access course materials and complete assignments. These include readings, analyses of scenes of children eating, evaluation of linked web resources, and practical application of concepts from the sessions. Students submit all assignments via the web.

The video sessions for the Feeding Young Children in Group Settings course consist of four, two-hour programs. Seven to eight field-produced, real-life video segments were developed to enhance instruction for each class session. Approximately 100 hours of videotape were shot at child care centers and Head Start programs across the western United States. The high-quality video segments are important instructional components for the course. Approximately 200 digital still photographs were shot and used to make high quality graphics for the course. Attention to diversity was important to the project team in developing visuals for the varied audiences served by the course.

The Feeding Young Children in Group Settings web site has been an asset for marketing the course, gathering information about participants, and providing instructional materials for the participants. All participant information is compiled in an Access database. The database is published to an internal web site providing all of the team members and departmental staff with immediate access to the information. This information enables the team to help prospective students locate participating sites in their region.

An obvious and essential part of developing a multi-modal course for mass circulation is teamwork. Our team included a multi-media designer, two video specialists, a data base programmer, an instructional designer, and teaching faculty. The determination of content and the production of the materials called for many decision points and much cooperation.

The team developed an understanding of the mass audiences' wide variety of technological skills and access to technology. The concept of the "digital divide" is constantly evoked by the questions and responses we receive as we market and carry out the course. We frequently receive calls and e-mails from first time users of on-line course materials. An invigorating part of the process of working with first time users is seeing the success our participants have as we talk them through learning to use the technology.

Our goal for the Feeding Young Children in Group Settings course is the same as it was when the course was initiated. That goal is to provide widely available, sustainable, cost effective instruction to a widely diverse audience of people who work with children in group settings. The mass audience certainly can be reached using multi-modal technology, and the course can be up-to-date and sustainable with awareness of the ever-changing technology available to instructors and those who support them.

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New Possibility in Medical Education

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Over the last years, a lot of attention has been paid to studying the possibilities of using Multimedia on the Internet as a vehicle for open learning. The WWW system proposes a new way for merging and sharing information in workgroups for educational purposes. As the World Wide Web may ultimately become the delivery mechanism for the majority of education and training worldwide, more emphasis is needed to ground further development in strong theoretical principles related to learning. Our goal was to explore how to integrate it into the medical curriculum in order to lay the foundation of future professional development.

This paper reviews the education in medical informatics at the University of Szeged. All the topics are illustrated with practical examples. The description includes a brief outline of the curriculum, together with the hardware system configuration, software tools, some applications, samples and a description of methodology.

INTERCULTURAL FOREIGN LANGUAGE STUDIES IN THE RUSSIAN ON THE NET LEARNING ENVIRONMENT

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Abstract

The purpose of this article is to describe the learning environment (<URL:http://matwww.ee.tut.fi/venaja) called Russian on the Net developed to support the www-based study of Russian and also to describe how the environment supports the intercultural study of a foreign language. The article surveys situations in foreign language learning as linguistic encounters and preparation for linguistic encounters. The article falls into two parts: In the first part I describe the concept of learner-centred learning underlying the Russian on the Net learning environment, the spaces in the environment and their properties and also analyse the findings of earlier teaching experiments. The latter part of the article introduces the principles of intercultural foreign language learning and describes how this is implemented in the Russian on the net learning environment.

1. Introduction

The development of Russian on the Net, a learning environment for elementary Russian began on the KUOMA -pilot project (concerned with new learning materials for schools) under the more extensive ETÄKAMU -Project. The further development of the environment is being continued on a project in learning environment (<URL:http://matriisi.ee.tut.fi/ao) at the Hypermedia Laboratory of the Digital Media Institute (DMI) of the Tampere University of Technology. The article also includes an analysis of the results of earlier teaching experiments. These findings indicate that the environment's communication tools and the tools designed to enable project work were never used in the experiments. In order to make the best possible use of hypermedia-based learning environments in learning there is a need for pedagogically validated models and concrete instructions in the planning of teaching to be accomplished with the net. The aspect of intercultural foreign language learning may offer new mo-
dels of thought and methods for teaching and learning taking place over the net.

Russian on the Net is a pilot and part of the Tekes-financed Open Learning Environment -Project, whose objective is the development of a technically functional and pedagogically appropriate open learning environment. The underlying notion in the development of this learning environment is the learner-centred conception of learning, in which the activity of the learner is emphasised in the acquisition and processing of information.

The objective of the Russian on the Net pilot is to develop the elementary learning environment created within the KUOMA -pilot content wise, technically and pedagogically. The results of earlier teaching experiments (Hämäläinen & Muhonen 1999) show that insufficient attention was paid to pedagogical considerations, and presumably for this very reason, the properties available in the environment were not fully exploited. In the further development of the Russian on the Net learning environment the objective is to take account of the most recent trends in foreign language teaching, one of the most significant of these being intercultural language teaching. If the aim of foreign language teaching is intercultural learning, then the learning environment ought to support interaction with people from different cultures. On the net interaction, encounter can occur, for example in the form of interaction between learners and teachers and as communication between experts.

In intercultural foreign language learning the emphasis is on communicativity and co-operation that transcends the borders of one's own country. This article aims to illustrate and present ideas and alternative pedagogical hints in order to realise intercultural foreign language learning in concrete learning situations. The teaching experiments due to begin in January 2001 at polytechnics and upper secondary schools operating both in daytime and in the evenings are intended to ascertain how the perspective on intercultural foreign language learning evinced in the article and the pedagogical hints developed thereon are implemented in the various spaces of the hypermedia-based Russian on the Net learning environment. It is hoped that the perspective of intercultural learning will increase the options for utilising the environment in the study of Russian.

2. The conception of learning underlying the Russian on the Net learning environment.

The development of the Russian on the Net learning environment rests on the learner-centred conception of learning. The environment is based on seven learner-centred characteristics of meaningful learning as presented by Jonassen (1995) – constructivity, activity, co-operativity, intentionality, contextuality, transferability and reflexivity. Ruokamo & Pohjolainen (1999) have further refined Jonassen's seven characteristics of meaningful learning to be appropriate for the development of open, network-based learning environments and all the pilots within the A&O Project seek to implement the characteristics of learner-centred learning.

The ideal objective of foreign language study should be the holistic understanding of that foreign language and culture. Nowadays the curriculum is frequently perceived as contents and processes to be assimilated and which is planned by teachers and students together (Kohonen 1998:29). Greater opportunity for the learner to influence his/her own learning increases commitment and motivation to study.

According to the learner-centred conception of learning the learner participates actively in the learning process, plans, acquires and processes materials, makes a critical assessment of the outcome and develops this on the basis of the assessment. All these actions develop study skills; not only the product is considered important, the process of developing holistically as a functioning, thinking human being is also an objective. According to the learner-centred conception of learning the teachers serves to support and direct the learning process (Lonka & Lonka 1993). The change in the role of the teacher for dispenser of information to supervisor and supporter of learning must be gradual, as research shows (e.g. Opettaja 2000) that the pedagogical counselling and support currently available are inadequate.

3. A description of the Russian on the Net learning environment

WWW-based Russian on the Net learning environment is based to support Russian language learning. It contains elementary learning material for Russian and tools that enable communications between learners, teachers and other experts. There are also tools for producing material and accomplishing projects. The Russian on the Net Learning Environment was developed for pupils at secondary and upper secondary school, but it can be used also in adult learning.

A steering group comprising teachers of Russian and experts in Russian language participated in the development work on the environment. The aim of the development work was to support the learner's own learning process. The learner can progress independently in the material at his/her own pace, or then as directed by the teacher, when the whole class progresses according to the teacher's instructions. The environment includes various communication tools enabling the learner to obtain support and feedback from other learners, teachers and experts. The environment also includes tools for project work either independently or co-operatively. (Hämäläinen & Muhonen 1999)

The metaphor for the Russian on the Net learning environment is that of a building containing six spaces in which there is a learning centre. The spaces in the building are Training Space, Studio, Staff Room, Backstage, Links and Gallery. All Internet users have access to the building, and are called visitors, and are admitted to the Training Space, Links and Gallery. A password is needed to access the Studio, Staff Room and Backstage, and the passwords are different for teachers and learners. Teachers and other experts have freedom of access to all the spaces in the environment. With the exception of the Staff Room the learners have access to all the spaces in the environment.

The Training Space contains elementary learning material. This material is divided into various themes and includes audio and video materials, tasks which can be checked by the computer and material based on links and readymade tasks and more extensive subjects for project work accompanied by directions. A vocabulary has been compiled from the utterances on the videos and it is possible to practise the most important utterances on the videos by repeating the sentences in the bubbles. An effort has been made to present grammar material constructively so that the learner can form a picture of the grammatical point to be studied and derive rules in order to learn something. For grammar the links are constructed so that familiar matters already assimilated serve as the basis for new things to be learned. For example, while studying the accusative forms of the personal pronouns it is possible to revert to the nominative forms in order to see from what forms the accusatives have been derived.

The Studio contains tools for teachers, learners and experts to maintain contact and the tools needed to accomplish various types of projects. The real-time Chat -tool enables teachers and learners to communicate. The News-type discussion -tool enables teachers, learners and experts to maintain contact and also the exchange of feedback and instructions. The interactive cartoon strip is a real-time discussion -tool enabling learners to discuss and simultaneously create a cartoon strip of their selected characters. The projects which learners exhibit in the Gallery are done with the www-editor. The instructions for using the www- editor are to be found in the 'help' elements of the environment. Projects can be accomplished either alone or with others.

The Staff Room contains the same communication tools as the Studio, but serves as a meeting place for teachers and experts to which learners are not admitted. The Staff Room enables discussions on Russian language and culture and on matters pertaining to learning Russian. Using the www-editor teachers can make their own materials and locate it in the Backstage. The Staff Room has an archive (BSCW space) for storing completed projects in various programs (Word, PowerPoint, Excel) for the use of teachers and other experts. It is possible to delete material from the archive and to edit the messages of discussion groups. In the section for returned assignments the teacher can look at assignments completed and returned by learners. On returning their assignments learners select their teacher's name from the list, thus the teacher can find his/her own students' work under his/her name.

The Backstage is a space in which teachers, experts and learners can see the material created in the Staff Room. Preparatory material for tests can be located there, while the tests can be located in the Staff Room, to which learners do not have access.

The Gallery is a space for locating work accomplished by individual learners of groups. The teacher's or learner's assessment of the learning process and the final result of the work can be appended. All the completed work can be located in the Gallery and a vote taken as to the best project.

The Links space contains useful and up-to-date information on matter pertaining to Russian language and culture. The space is divided according to subjects, making it easier for learners to find relevant information, for example, for projects and portfolios. Learners, teachers and experts can moreover use Links to search for the information they need. An effort is made to update the links regularly and new links are added as the environment is further developed.

4. Implementation of previous teaching experiments and analysis of principle findings

Teaching experiments using the Russian on the Net learning environment have been carried out at the Teacher Training School of the University of Tampere and Ylöjärvi Upper Secondary School. The target group was teachers and students of Russian at these schools. During the experiment an average of two out of the five weekly hours of Russian was used for studying in the environment. Initial and final questionnaires were used to gather data from students and teachers and observations were made of the students' and teachers' work. In the questionnaires respondents were asked to describe their expectations of using the Russian on the Net learning environment and their conception of their roles as users and their experiences of the characteristics of the Russian on the Net environment.

The students' motivation for the computer-aided study of Russian was fair at the beginning of the experiment and remained fair after the experiment. The students expected the environment to provide variation, interest and versatility in the learning of Russian. The students' conception of studying Russian were grammar-based as they hoped that the tasks in the environment would include practice in grammar and sentence structure.

The students' expectations regarding the use of the Russian on the Net environment for language study were fulfilled. They felt that using the environment was useful and considered the teaching to be more meaningful and varied than conventional learning in the classroom. The students reported that the environment provided material at a suitable level, scope to progress individually and support and supervision in relation to prior studies.

The characteristics most highly rated by the students were the audio and video materials and the interesting and developing tasks. The students desired a list of contents [1] to facilitate navigation in the environment, more exercises, games, crosswords and culture.[2]

During the teaching experiment there was no time to try the link elements, the real-time chat tool in the Studio, the News-type discussion tool or the www editor. One might assume that it is the use of these tools and links which best facilitates encounter with the culture of the target country and native speakers of the target language.

The students felt that they needed more cultural information. Using the discussion tools teachers and students could exchange ideas and opinions, for example, with Russian students, teachers and experts. Expertise could be enhanced through the News-type discussion tool. The theme selected for discussion might be some specific subject to be commented on by students, teachers and experts form different cultures. This would yield topical information on matters of language and culture. Information in the net can be updated: For example, it is possible to disseminate information on new terms and usage over the net. The advantage of the net over textbooks is the option to update information quickly.

The results of the experiment permit the conclusion that the students did not benefit at all from the opportunity to use the options provided by the environment for project work. For example, the environment enables project work using the www-editor for which information may be sought through Links. Such project work demands creative problem-solving skills such as objective setting, information seeking and analytical skills and a critical faculty in finding relevant material. The information available on the net is up-to-date and therefore interesting, but finding appropriate information from the vast amount is a challenge. More attention should be paid to information seeking skills.

When the teaching experiment began, the teachers assessed their motivation to teach Russian using hypermedia to be fair and this level was sustained after the experiment. The teachers expected that the experiment would provide them with variation and stimulation in the teaching of Russian, and that they would discover working methods to interest the students and learn something new. The teachers' expectations of the use of the Russian on the Net learning environment in teaching Russian were exceeded. They considered the best characteristics of the environment to be the option to progress individually, the various ways of working together with other students and the way in which the environment motivated different kinds of learners.

However, it was those characteristics enabling the use of co-operative methods and interaction between teacher and students and the tools for project work (including the www editor) which were least used in the teaching experiment. The teachers estimated that they needed technical support during the experiment, but did not feel that they needed pedagogical supervision. After the experiment the teachers' assessments were similar. One might assume that the teachers' estimation that there was little need for pedagogical support was due to their inadequate knowledge of the possibilities of net pedagogy. There has not yet been sufficient research on the use of net-based learning environments in foreign language teaching and especially of the possibilities of net pedagogy in language teaching.

5. Intercultural foreign language learning

Internationalisation and the increase in contact between cultures lends justification to the goal of intercultural learning in foreign language teaching. Modern ICTs make intercultural contacts easy and fast, and actually possible in real time. The development of the information society poses challenges to teaching and learning to which those developing modern hypermedia-based learning environments endeavour to respond.

The term intercultural, according to Kaikkonen (2000:50) refers to the dynamic process emanating from encounter and preparation for encounter. The point of departure in intercultural foreign language learning is to learn to cope optimally in varying situations in which cultures meet, in which both language and other culture-related behaviour such as tolerance, mutual understanding, interpretation and adequacy or target-oriented action are important. The objective in foreign language learning is to achieve competence in intercultural activity.

Lustig & Koster (1993; see also Kaikkonen 1996; 1997 and 1998) propose eight area of competence which promote intercultural ability. The following characteristics in the learner promote the development of competence in intercultural activity:

1. The ability to respect people who are culturally different and to be considerate and positive towards the other party.
2. The ability to react to the other party's behaviour without emotion or condemnation.
3. The ability to comprehend concept and the messages they convey in expressing thought.
4. The capacity for empathy and understanding of the other party's conceptual world.
5. The ability to recognise the rules of cognitive role behaviour in shared problem-solving situations.
6. The ability to understand the rule of social behaviour.
7. The ability for correct, interactive communication.
8. The ability to tolerate ambivalence

A foreign language becomes real in intercultural situations, authentic encounter of languages and cultures. This encounter may be indirect through authentic textual material or then real-time communication in the classroom situation between teacher and students or increase of expertise over the net and by means of authentic texts.

According to Kaikkonen the encounter of cultures occurs most commonly through authentic textual material. Whether the students feel that the texts are authentic depends on how they are handled and how meaningfully. Contextuality is closely connected to authenticity. Different text

[1] A page map has been included in the environment presenting the content of the environment by theme. This facilitates navigation for alinear progress in the environment.

[2] A culture component has been developed containing current information, for example, on Russian public holidays and the accompanying traditions and information on Russian people and their habitual modes of operation. Games, for example, memory and guessing games are planned to build vocabulary and practise structures.

types are felt to be authentic in different cultures. Van Lier (1996) places great emphasis on the importance of contextuality and the experiential in determining the authenticity of text. He suspects that not all the students in the class will feel the authenticity of language study in the same way as they feel differently about different matters. The same text says different things to different readers. Earlier experiences affect the orientation to learning something new. Learning is an active process in which the learner gradually builds on previous experiences creating new meanings and assimilating new meanings enhances the comprehension of the nature of language and culture.

Frequently the goal set for foreign language study is fluent communication, but in reality, study is guided by the study of grammar, for example on the basis of the passages of test in a textbook and exercise book. Kaikkonen (2000:57) states that the authenticity of language pursued does not always appear even in texts used to support study. The authentic and current material in hypermedia-based learning environments could provide various approaches to foreign language study with respect to pedagogical solutions.

6. Intercultural foreign language learning in the Russian on the Net learning environment – challenges and opportunities

The Russian on the Net learning environment contains many types of material for the implementation of intercultural foreign language learning. Kaikkonen (2000:50) describes authenticity and its components in foreign language learning. Authentic encounter creates a meaningful experience for the learner. Encounter may occur via text, in the form of a net contact or of encounter between teacher and student in the classroom situation.

The Russian on the Net learning environment contains authentic textual material, e.g. videos, links to collections of short stories, the pages of newspapers and periodicals and current informative www-pages on Russian culture and society. The choice of videos has endeavoured to include subjects which mean something to students, such as getting to know people, hobbies, travel and visiting restaurants. The choice of subjects has taken account of the typical nature of language use. In intercultural foreign language learning the emphasis is on preparing for linguistic encounter. By practising typical situations of language use an attempt is made to achieve communicative competence in different types of situation.

The dialogical presentation can be practised through interactive cartoons. In these the subjects occurring are very close to Russian culture and traditions, like making a visit in the Russian way. The learners may appear in the cartoons under Russian names and imagine that they are Russians. It would be desirable for learners identifying with Russians to compare, for example, the Finnish and Russian ways of acting in various situations. The assumption is that the knowledge that different cultures react differently in different situations will increase tolerance for different cultural habits and create a liberal attitude. The teacher and other experts, who are well acquainted with the target culture can direct the discussion and help students in situations where expertise is needed.

The Gallery is the space for intercultural encounter, because this is where teachers and students of different cultural backgrounds can locate their work. Looking at the works in the Gallery permits conclusions about what matters are considered important in the language teaching of different countries. The exhibition of examples of projects in the Gallery provides learners with new angles and ideas for individual practical assignments and more extensive projects and offers teachers new alternative methods in foreign language teaching. The communication tools enable discussion on the work displayed in the Gallery. Public expression of opinions and comments expands learners', teachers' and experts' conceptions and tolerance for seeing things differently. Analysis of the learning process on the net serves to develop skills in information seeking, processing and evaluation.

The Russian on the Net learning environment contains tasks which can be returned direct to the teacher at the Staff Room archive so that other learners cannot see each other's work. Teachers can also store their own work in the Staff room archive or in the Gallery. Such work is visible to all teachers and experts. If all the teachers using the environment store their best work the environment could set up a material bank which would mean added value for teachers of Russian. At present all Russian teachers with a password and user ID have access to this material. For all the teachers using the material bank to produce material for the environment it would be necessary to add a capability to the environment to enable access to the bank only if the individual has produced, for example, two tasks. This carries implications for copyright.

Through net contacts it is possible to communicate with people from different cultural backgrounds. At present access to the Russian on the Net environment does not require any registration. Registration produces mixed feelings among learners, teachers and experts. On the one hand giving one's own personal information and getting to know other people's personal information would increase the feeling of belonging and commitment and provide an opportunity to meet users from different cultures, but on the other hand certain opinions and comments are easier to send anonymously. Anonymous comments can obtain no direct reply to the sender, thus, for example, timely supervision of a given learner is impossible.

Using the News-type discussion tool enables the enhancement of expertise. The theme selected for discussion may be one specific subject for comment by learners, teachers and experts from different cultures. This produces current information on matters pertaining to culture and language. Information on the net can be updated. For example, the net can be used to disseminate information on new words and usage in various situations. The advantage of the net compared to a textbook is the option to update information rapidly.

Although the teacher and learner come face to face in the classroom, an authentic, timely encounter may be problematic as there are numerous factors with bearing on teacher-student communication in the classroom. The learner may, for example, fear the reactions of others, and not attempt to solve the problem emerging in the learning situation. In my experience, Finnish students communicate less with other learners and the teacher than do students from many other countries. An expansion of intercultural communication through the discussion tools could lead to a change in Finnish students' attitudes and to a change in modes of action in the learning situation.[3)] Both authentic encounter in the class and encounter on the net should be natural.

7. Discussion and conclusions

[3)] On the international and multi-disciplinary teaching research and development project involving the University of Oulu, the University of Jyväskylä and in the USA the University of Indiana, called NINTER, an attempt has been made to create a net-based action model for community problem solving (Saarenkunnas et al. 2000). This enables interaction between experts and novices. Net mediated case discussion could also offer opportunities for language teaching. (Kuure et al. 2000)

This article described intercultural foreign language learning in the Russian on the Net learning environment. The first part of the article presented the learner-centred conception of learning underpinning the environment, the contents of the learning environment and its main characteristics and analysed the findings of earlier teaching experiments. The findings showed that the motivation of learners and teachers to use the computer in teaching and learning Russian is fair. However, the characteristics of the environment are not exploited in the best possible manner. Those characteristics enabling co-operative working methods in project work and interaction between teachers and students were used least in the teaching experiments. The teachers' inadequate command of net pedagogy may cause the environment to be used in the conventional way of learning material without taking advantage of the new working methods enabled by hypermedia-based learning materials.

The latter part of the article presented the intercultural foreign language learning perspective and considered how intercultural learning can be implemented in the Russian on the Net learning environment. Authentic encounter is closely connected to intercultural learning. Encounter may be interaction occurring through authentic text, communication occurring indirectly through discussion tools or directly through authentic encounter in the classroom. The tools developed for the Russian on the Net learning environment enable intercultural encounter on all these levels.

The intercultural approach to foreign language learning offers new pedagogical opportunities for users of the Russian on the Net learning environment. Foreign language learning occurring in open learning environments and the opportunities of net pedagogy in foreign language learning has so far been relatively little researched. The use of technology in teaching does not necessarily enhance the level of teaching it those concerned cannot use the equipment properly. There is a need for scientifically validated knowledge on the advantages of hypermedia-based foreign language learning environments over more conventional modes of study in which the main materials are books, cassettes and other non-computer-based materials. Once the advantages of open learning environments have been identified the way will be clear for the development of pedagogical support.

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Technology at the Cutting Edge: A Large Scale Evaluation of the Effectiveness of Educational Resources

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Abstract: The perceived effectiveness of traditional and computer-based educational resources, within the context of a single course in first year biology, was investigated within an action-research paradigm. The study examined the dynamic state of perceptions towards these resources by the major stakeholders involved (students, teaching staff and technical staff). A major focus of the research was the extent to which the computer-based resources were utilised, and the students' perceptions of the usefulness of these resources to their learning. The majority of students found the resources to be of use for their learning but some did not use them at all, even though they had access to the Internet, suggesting that the provision of on-line resources will not necessarily generate value-added learning.

Introduction

At The University of Sydney courses are still campus-based and students attend lectures and laboratory sessions in most weeks of the semester. In first year biology the development of educational multimedia to address the diversity of student characteristics, the ethnic/cultural sensitivities to animal dissections and specific learning difficulties has led to a focus on the use of computers in the learning process. This in turn has led to the development of an on-line virtual learning environment (http://fybio.bio.usyd.edu.au/vle/L1/) enabling the students to access our resources any where/any time. The development of this resource is discussed in Peat, (2000). The current study examined one of the first year courses, Human Biology, which integrates a range of computer-based learning modules, on-line materials and communications strategies with more traditional learning resources such as lectures and practical sessions, designed to cater for a variety of learning styles. The purpose of this study was to provide both a reflective and analytical assessment of a broad range of learning resources integrated through web-based technology and determine their impact on student learning. A major focus of the evaluation was the extent to which the computer-based resources (educational multimedia and information technologies) made available to the students were utilised and the students' perception of their usefulness to their learning. To achieve this, an action research model was implemented with all stakeholders contributing to the collection of data to enable assessment of the learning environment from all perspectives.

Methodology

The research model adopted the Eclectic-Mixed-Methods-Pragmatic Paradigm (Phillips, *et al.*, 2000) considered more capable of handling the complexity of modern society and technology with a focus on practical problems rather that on issues, whilst acknowledging the weakness of current evaluation tools. The overall study was based on the dynamic state of the perceptions of the major stakeholders involved in the course, whilst this paper focuses on the students' perceptions of their use of educational multimedia and communications technologies within an integrated curriculum. The stakeholders included students (n=up to 800), lecturers (n=5), laboratory teaching staff (n=20), technical staff (n=3), and courseware developers (n=2). The target population of students is typically recent high school leavers enrolled in science-based degree programs. The student body has become increasingly diverse over the years, with respect to culture, academic achievements, literacy and science backgrounds as well as extra-curricular activities such as paid employment. The overall data collections involved all stakeholders and data were collected at four separate intervals, using surveys, interviews and/or focus groups. Data from the preceding survey were used to design the subsequent instruments.

Results and Discussion

The results to be described in the conference presentation will focus on the major factors emerging from the research process and examine each of the following aspects:

- student use and perceptions of the Internet, access to on-line materials and views of communications technologies;
- student perceptions about using on-line tutorials in general; and
- student use (specifically) of virtual dissections versus real dissections.

Nearly all students in this course (99.5%) have access to a computer, with 98.5% of all students indicating access to the Internet (84% access at home), however there appears to be competition within the home for access to the Internet line (36.5% of students indicating competition from siblings or parents). Whilst general access to computers and the Internet is good, there is some concern within the student body about access to the biology resources for this course on the Internet due to technological reasons. It appears we can provide the resources but we need to be careful that we match them with student technological abilities and experiences.

The data show that 20% (200 in the cohort) of the students are not using the Internet as a resource for this course but of those that do use it 55% indicate it is useful but not extremely useful. The overall student use of email was high, with 97% of all students surveyed indicating some use (mostly non-course related), however only 10% of the entire cohort found email useful in supporting student learning in this course. Only 75% of students made use of the computer-based tutorials provided to support their learning, but the majority (91%) of those students that did use the materials found them useful. This reinforces the idea that within the student cohort there is a variety of learning styles, which require the provision of a diverse range of learning resources, both on-line and off-line. Oliver & Omari (2001) reported a similar lack of uptake of web-based teaching with 20% of students not comfortable with using the web as their learning environment. The reason for this lack of uptake needs to be investigated before putting a large proportion of teaching and learning resources on the web. From a curriculum development viewpoint it was important to gain an understanding on the relative usefulness of animal dissections and virtual dissections to student learning outcomes which would help inform the debate about the replacement of animal cadavers in student laboratories. Many of the students remarked on the usefulness of both the cadaver and the virtual dissection, indicating that the former was probably more useful for understanding structure and the latter for function, illustrating how different media can be used for different inputs/outcomes. The data, however, indicate that there is little difference between the two types of instruction.

Initial data from this study indicate that there are students who embrace educational multimedia and information and communications technologies and who will find these learning experiences valuable. However, there remains the issue that some students do not find them useful and this reinforces the need to offer a variety of materials on offer. It reminds us that we cannot use on-line as a replacement but we can use it effectively in the teaching program. It is important to remember that the student body requires a variety of learning experiences that not only include the new technologies in teaching and learning but also the more traditional resources. The outcomes reinforce the need to offer a variety of learning experiences that target different learning styles and enable a mix of off-campus and on-campus opportunities.

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Supporting Faculty in the Design and Structuring of Web-based Courses

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Abstract: this paper reports on the development of CEDOT, a tool to support academics in the collaborative and iterative planning, development, creation and delivery of courses. It provides an environment for the conceptualisation and structuring of the different elements of the teaching and learning process situated in a supportive framework. CEDOT output is in XML, and includes both documentation and web-based courseware.

Introduction

> *"The really truly hard part to web-based course design is in content design. A reasonably competent computer professional can provide chat facilities, threaded discussion lists, web pages, on-line registration, etc. But the core of on-line course materials will have to be determined by experts in the field working with experts in distance education delivery."* (Downs)[1]

This paper will discuss the development and extension of an existing concept mapping tool (Webmapper)[2] into a complete on-line course design support framework for academics – CEDOT, Course Elicitation, Development and Output Tool.

The tool provides a course design framework that faculty staff work through in an order of their choosing. It gives context specific help and advice that will enable them to complete all the required elements. But as well as taking them through the course design process and creating a document that adheres to a university-defined format[3], at its core is a concept mapping and navigation tool to plan and structure the relationship between the various course elements, processes and resources. The course design framework outlined here applies to web based courses and to courses designed to be delivered "conventionally" through face-to face teaching or through mixed modes of delivery.

A key feature of CEDOT is that at any time during the course development process the thinking and work carried out so far can be made available via the Web to other academics associated with the course. They can comment on the course structure so far developed and their input can be incorporated into revised versions.

CEDOT will output documentation associated with the course in various formats, exploiting the potential of XML according to the needs of identified groups. This includes information for course administrators and validation/approval committees and information for the student handbook and course guides.

The tool is more than a documentation framework, it also enables the publishing of the course resources onto the Web implementing the navigational structure as developed in the concept map element of the tool. This web structure may be in outline form, i.e a navigational structure is in place with descriptors of the course content for further development or if appropriate, a fully functioning and complete version of the course resources may be output.

A key feature of CEDOT is its use of XML so that outputs can be customised according to the needs of different groups. CEDOT will also conform to emerging standards for learning architectures e.g. the IMS specifications[4].

The need for such a tool

The authors have been involved in a range of projects linked to the design, development and embedding of resource based learning, and in particular Web-based learning and teaching in UK universities[5]. It is clear from this experience and our knowledge of the literature that faculty staff require help and support in the design of appropriate learning materials especially those that take full advantage offered by Web-based learning. While other tools have been successfully deployed that provide guidance and a framework for developing Web-based courseware, we are not aware of any tool that also provides validated XML output, prototyping and development support in one package.

In a recent symposium of recognised experts in learning technology it was noted that:

> "Frequently, one assumes that university faculty have an understanding of learning theory simply because they are teachers. In reality, many are exposed to these ideas for the first time during faculty development experiences. Through working in partnership with instructional designers, faculty can bccome knowledgeable about learning theory and its relationship to course design."[6]

It is a feature of our (and many other) institutions that this level of instructional design support is not routinely available. CEDOT is designed to go some way to address this situation by providing online context based help to guide and support to guide academics one through the course design process and then publish their outputs in appropriate formats

An example of such a support framework is the Teaching for Understanding Framework [7]. The Teaching for Understanding (TFU) framework helps educators to:

- formulate generative curriculum topics,
- define specific educational goals,
- design performances to help students develop and demonstrate understanding and,
- integrate ongoing assessment of student performances to monitor and promote learning.

A similar tool for supporting the process is that provided by MERLIN[8], developed at the Northern Alberta Institute of Technology, Canada. This is a web-based curriculum development tool that adheres to NAIT's guidelines for its in-house Learning Outcome Guide for module development.

In developing CEDOT we wished to produce a framework that enabled staff to work through key elements of the instructional design process in a guided and supported manner while at the same time not being constrained to work through this process in a fixed given order. It is important to support the flexibility and range of modes of development that are typically found in the course planning process so that faculty staff can work in ways in which they are comfortable. Some academics for example adopt a strong top down approach, developing the overall structure, learning outcomes and pedagogical strategy before defining course content. In other cases academics have a model of the overall structure in their head and wish to flesh out elements of the content before finalising the overall structure.

CEDOT is designed to accommodate these approaches. It provides a graphical environment in which the course design process is modelled and from which output both in terms of course documentation and linked Web-based course resources are produced.

The course design model

The course design model on which it is based is represented in the work of Scott[9]. Figure 1 (below) represents the underlying conceptualisation of the course design process used in CEDOT.

Guidance to staff

Whilst working through CEDOT, onscreen context sensitive advice and guidance is available. This is in the form of brief notes linked to Acrobat PDF format documents that provide more detailed explanation and commentary. These are available for viewing onscreen but users are advised to refer to a referenced printed version while working through the software for ease of use.

The key elements of advice and support that exist in CEDOT are:

- guidance on identification of key characteristics of potential students,
- analysis of the relation of the proposed new course to existing courses both in terms of pre requisites and exit outcomes.
- guidance on the development of learning outcomes,
- knowledge and task analysis to elicit course content and structure,

- advice on the identification of student support needs and the student support strategy,
- advice on the identification and specification of assessment elements, identification of teaching strategies to be employed,
- advice on the methods and approaches to course evaluation,
- support in the planning and structuring of course resources and materials

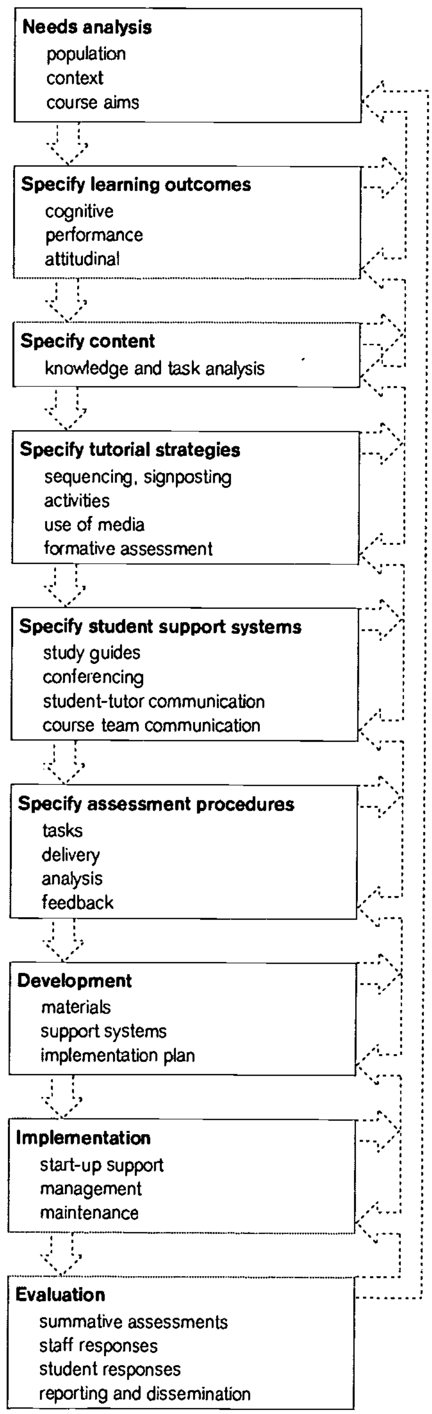

Figure 1. The course design process

Course development in practice
Such models of course design may in practice be far removed from the way in which faculty staff do engage in the process of course creation. In reality course development is a much more fluid, "messy" process. An individual academic may, for example, having in general terms outlined the course structure, concentrate in some detail on one particular element. In another case it may be appropriate to incorporate materials and ideas that have already been developed elsewhere. Issues relating to the assessment system or the best way of providing targeted student support may be the most important concerns at a particular time. CEDOT can capture the ebb and flow of this creative process. It accommodates the building up and sequencing of different elements in a variety of ways so the user will not feel constrained to develop a course in a way that does not suit their own particular approach.

Collaborative roles
We have argued elsewhere[10] that courseware is best developed in a team context, whereby individuals with a range of skills (subject experts, instructional designers, programmers) work together to agreed aims and objectives in the development of a project.

The development of powerful web authoring tools, and tools for the conversion of word processed documents into HTML format can tend to encourage the collapse of these various roles into one person - the universal courseware expert. When using such tools there is a tendency not to map out the courseware first, but in the act of marking up, to try to structure it at the same time. In effect, what happens is that the producer is both attempting to structure and plan the courseware and produce it simultaneously and in the process of so doing may lose sight of the main pedagogic structures and navigational routes.

CEDOT is designed to support interaction and collaboration. At any time the concept map and the associated documentation can be published so that other course team members can comment on it and their ideas be incorporated into the course design. The prototype facility allows a version of the course to the output on the Web and used so that other members of the team can comment on its navigational structure and other features.

The development of CEDOT
This has involved three, interconnected strands of activity.

First, it required work with academics to understand how they develop course materials and to identify particular issues and to specify a tool that addresses these issues

The second element is to design an effective and transparent interface and navigation system which enables course designers to easily 'toggle' between the stages of the course design process, content development and navigational structures.

The third is to explore the capabilities of XML as a way of
- orchestrating data and its characteristics appropriate to this use so that written documentation appropriate to different groups may be produced and that this documentation when aggregated across a range of course can be further interrogated in order for example to produce summative reports.
- facilitating the creation of course resources from CEDOT either at the level of a *prototype mode*, a *delivery mode* or a *simple documentation mode.*

An overview of the software
The technology
The current development has two strands: a programmer is creating a Java-based implementation, and one of the authors (H Freeman) is creating a version in Revolution (a variant of MetaCard[11]) that can be delivered as an executable on Macintosh, Windows and Unix platforms. Revolution is a graphical application development and multimedia authoring package for Windows 95/98/NT/2000, UNIX/X11 workstations, Linux and MacOS. The database behind both implementations is FileMaker Pro v5 (unlimited) running on a Macintosh G4 server although other databases could be used.

CEDOT in action
The Main Menu outlines the stages of course design at a general level as developed from figure 1. Selecting these menu items opens a further window with fields for text entry relating to sub topics.

A key feature of CEDOT is that it provides a visual environment in which the process of course development occurs. Building on the original Webmapper[1], a concept map of a course is created consisting of nodes that can be linked together and which in the final output represent sequences or clusters of Web pages.

Double-clicking a node opens a separate window that enables content to be described or created in the context of all of the headings in the main menu. Certain fields eg those relating to learning outcomes will be populated with text (if entered) from the main learning outcome menu.

At all stages textual entries are guided by on-line guidance and textual clues. In particular, the creation of learning outcomes is supported by lists of approved verb and compound verb lists obtained from the literature.

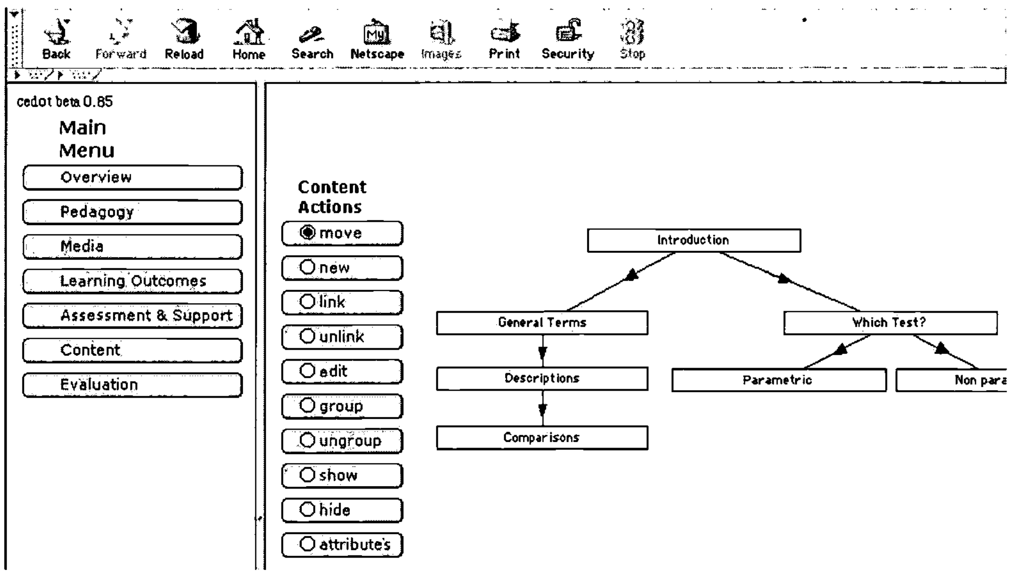

Figure 2. A browser view of the Java version of CEDOT in concept-mapping mode.

Selecting one of the items in the Main Menu allows a top-down approach to be taken to module development, whereas the concept-map approach enables a more granular, content-focused approach. Whilst it is possible to begin the design at the top level, the map must be used at some point. However, the reverse is not necessarily true, because groups of nodes may be allocated to a learning outcome, to an assessment instrument and to a resource requirement (such as a lecture room or a laboratory).

During development all changes are held within the server-based database. At any time during development a report can be generated that compares the structure of the working document against the University's module template DTD for compliance. Once this is satisfied an XML file is created for storage centrally. Further development to this software will focus on the integration of many module descriptions into a full course curriculum description.

Outputs from CEDOT

The outputs of the system include:

- documentation that describes the course and its various components,
- documentation that logs the process of course creation and development,
- a report on the degree of compliance between the current structure and the University's definition of a module template,
- a web deliverable that consists of a fully linked site but contains only node descriptions,
- a web deliverable that consists of a fully linked site and contains all content and linked graphics, applets etc
- The automatic generation of course guides, student handbooks and similar documentation that can be distributed to students.
- Version control throughout the development process and for the creation of new instances of the course design for future use.

These outputs are in XML or ASCII text, and we assume the development of both university wide systems that employ XML for data interchange and the existence of XML web browsers. The power of XML to enable the interchange, re-ordering and re-configuration of data will be of particular significance as substantial numbers of curriculum descriptions are generated.

CEDOT is addressing real academic needs in a way that will help faculty to design courses in a more collaborative, transparent and supported environment.

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Evaluating the impact of multimedia learning environments: visit to a virtual primary school

Fiona French, Univ. of North London, UK; Ian Cumpson, Univ. of Greenwich, UK; Ruth Wood, Kingston Univ., UK

As recent advances in technology enable combinations of media to be delivered rapidly via networks, so more colleges are including online multimedia applications as part of their repertoire of learning resources. Some of these applications have an in-built feedback mechanism for the users, while others may demand a more interpretive approach. One focus of this session is on considering suitable methods for evaluating media-rich applications.

The session will showcase the recently developed prototype of a multimedia application used in teacher training, giving participants the opportunity to engage with the software and discuss the design issues. The application is a virtual primary school, intended as an interactive, immersive, learning environment for trainee ICT coordinators in the final year of an Initial Teacher training course. The prototype includes video interviews with members of staff, virtual classrooms to explore and relevant paper documentation.

This is an ongoing project that we hope will extend beyond the classroom, providing a computer-mediated support facility for professional ICT coordinators. Our initial evaluation is being carried out in April 2001. Results will be presented at this session, which we anticipate to be of interest to teachers, staff developers, researchers and multimedia designers.

Quality in Web-Supported Learning

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Abstract: Are we meeting the needs of our learners? Are we fulfilling our vision of excellence in learning? How do we marry the theory of Quality Assurance with the service we offer, with particular reference to the Web-supported courses we design, develop and deliver? The Department of Telematic Learning and Education Innovation was established at the University of Pretoria in 1997. The Department is confident in the knowledge that it has the support of top management and from small beginnings is now becoming a showpiece of the University. Concomitant with such responsibility and visibility is the necessity to produce results, not just in the quantity of telematic courses developed and managed, but also in the quality thereof.

Introduction

Our Department embarked on a research project to explore and document the concept of Quality in telematic learning, with particular reference to web-supported learning. Without a Quality Plan in place, we found that different perceptions and expectations on the part of academic staff and students led to differing levels of satisfaction with our telematic learning offerings. Our approach is to begin with the immediate and real needs experienced within the University, but also to work towards accreditation with national and international standards bodies.

Evaluation of Courseware

Those of us who have been involved in the field of Instructional Systems Design (ISD) know that one of the vital steps in any Instructional Design model is Evaluation. Whether one follows a traditional linear Instructional Design model, or perhaps an R2D2 spiral model (Willis & Wright 2000), no one disputes the fact that an essential step somewhere along the line (or around the spiral) is Evaluation - formative evaluation, summative evaluation, ongoing review and maintenance of our courseware offerings. But what do we do with these findings? Do we plough them back into continuous improvement? Do we use them to eliminate faults, to streamline the instructional design process in future, to guarantee greater customer satisfaction and enhanced competitive advantage? What is the connection between the notions of Evaluation, Validation, Standards, Review, Quality and ultimately Return on Investment?

Quality Action Plan

Define Quality

In trade and industry, the notion of quality is relatively easy to grasp, in that one is dealing with products and services. In higher education however, it is not easy to discern well defined end products since it is a process which continues to make an impact on people's lives long after the completion of a formal study program.

In order to come to grips with the elusive notion of Quality, we begin by considering Quality in general and discuss the following hierarchy of definitions: Quality; Quality Control; Quality Assurance and Total Quality Management. We explore the notions of Quality as exceptionally high standards, Quality as efficient production and Quality as transformation in the sense of adding value to the learning experiences of students, particularly those from intellectually impoverished backgrounds.

Define our processes

We discuss the definition of a process and the implementation of processes and procedures in our department. Our E-education Instructional Design Kit includes a Service Level Agreement signed by the Project Leader, Roles and Responsibilities, A Project Timeline, a Six Star Course rating system (adapted from Merrill 2001) and Minimum Requirements for Web-supported courses.

Develop data collection tools and techniques

It has been said that "Quality has no meaning, except as defined by the desires and needs of customers" (Gabor 1990). Our two customer populations are lecturers and students. The advent of web-supported learning necessitates changing roles for both lecturers and students. We describe the lecturer training program and student orientation sessions we offer. We have developed a lecturer questionnaire, as well as a pre-course quiz and a post-course survey to be completed online by students.

Case Study

We use as a case study the MBA (Master of Business Administration) Program at the University of Pretoria. This program is a high profile one, and it is critical that it be viewed as a highly effective combination of web-supported learning and contact sessions. The interesting opportunity that presented itself is that a colleague, who is a Professor of Computer-Integrated Education, is registered as a student on the MBA program. With his cooperation, we have the unique opportunity for peer review, expert review and student review all in the form of one individual.

Conclusion

Quality is an all-encompassing guiding light, which impacts on courseware development, staff development and training, student orientation and daily practices and procedures. We need to ensure that quality E-education programs result from our combined efforts, which impact positively on the global reputation of the University and on the ongoing lives of our students.

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The Application for Hand-written Recognition in order to Search on Electric KANJI Dictionaries for Non-Japanese Learners

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1. Introduction

Due to increasing internationalization, more and more people are trying to learn Japanese. In spite of a lingering recession, Japan has a strong influence in economic and technology areas. Many students in the Asia region or other countries learn Japanese as a foreign language. Also in Japan, a considerable number of students from overseas have been studying Japanese.

For people speaking one of India-European language family, the Japanese language is one of the most difficult languages to master. Especially it is much harder for Japanese beginners to use a Kanji dictionary than for English beginners to look up a word on an English dictionary. An English word can be found through the knowledge of 26 letters of the English alphabet and its order however, to search for Kanji on a dictionary is not as simple. There are three keys for looking up a Kanji character. These are; "reading" or "number of strokes" or "root". They are all too hard for Japanese beginners to know.

Hand-written recognition systems used on PDA or others are designed for Japanese. Most of them attach importance to stroke order for the purpose of realization of better correctness and high-speed recognition. It is useful for native Japanese and middle or higher-level Japanese learners. However, for Japanese beginners, it is difficult to write unfamiliar Kanji characters in the right stroke order.

This paper provides a new method for looking up a Kanji on an electric dictionary by using handwriting recognition for Japanese beginners.

2. Our algorithm for a searching system

We tried to design a Kanji searching system for absolute Japanese beginners. Users input what she/he is looking for by dragging the mouse. It is easy even for a beginner to copy what he/she sees from a newspaper or textbook.

We gave priority to following points:

A) Fast response

B) Not depending on stroke order.

C) Not requiring too strict correctness because the system can also show 5 or more alternatives and users can select the correct Kanji character.

Details of the algorithm are followings.

2.1 Normalization

To obtain a more accurate recognition, input data is normalized before searching. The middle point is obtained from its height and width, and the input character is moved

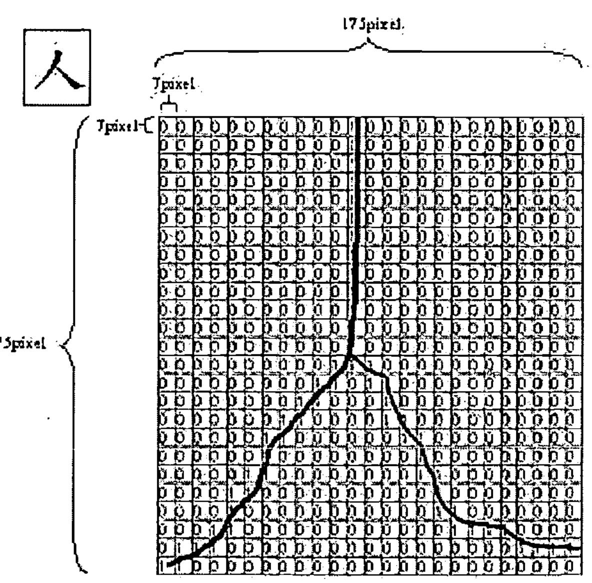

Fig.1 Example of inputted data

parallel. Next, the character is stretched to 175 pixel * 175 pixel. "175" do not have special meaning here.

2.2 Data Format

175 pixel * 175 pixel square are divided by 7pixel * 7pixel of small squares into 25th*25th squares. If one or more black pixel is in the 7*7 square, it's data is "1" and if no black pixel inside, data "0" is stored (see Fig.3). Next, database has the place of value "1".

2.3 Matching

Inputted data is compared with example data preferred before and similarity "S" is calculated by the next expression.

S=(the number of matching "1" between input and example)/(the number of "1" in example data)

The system shows 6 or fewer candidates in the order of descending similarity.

3. Examples

We made test version of this system and following is the result from test use.
This test system has 320 samples of Kanji. Test Machine's spec is as follows:
CPU: Celelon 433Mhz Memory: 64Mbyte OS: Microsoft Windows 98

3.1 Success Examples

Fig.2 is example of success. Searching time was about 9 or 10 seconds. It was much faster than using a paper dictionary.

3.2 Failed Examples

Fig.3 is failed examples because the input data was too small.

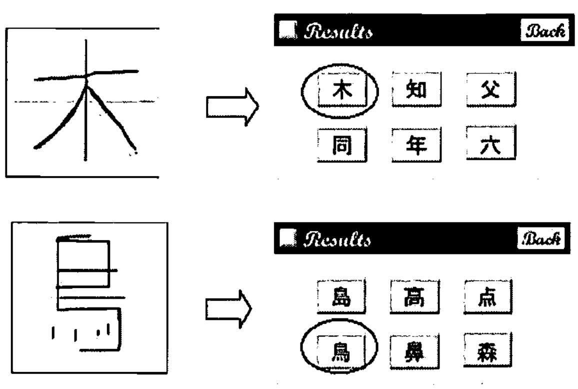

Fig.2 Examples in success

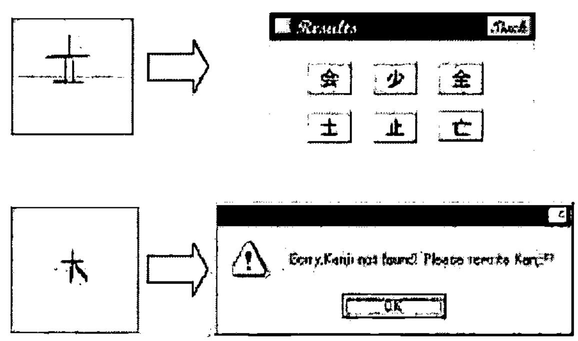

Fig.3 Examples in failed

4. Conclusion

Dictionaries are essential for language learning. However, Kanji dictionaries are too hard for Japanese beginners to look up using conventional methods.

In this paper, we showed a new method utilizing handwriting recognition to search for Kanji using online systems and developed a test-system and could get a result that was effective.
We have already developed a Multimedia dictionary and we had a presentation on ED-MEDIA 2000 (see reference). Now we are joining this searching method to the Multimedia dictionary and will show them in the next time.

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Learning Data Mining – A Tool for Understanding Knowledge Discovery and Qualitative Data Analysis

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Abstract: This paper reports the development of a system for learning data mining and multivariate analysis methods. A work-in-progress developing tool deals with one procedure for qualitative data analysis such as Web access data or online discussion logs. Learners can experience data mining for hypotheses formulation which helps the understanding of variation from multivariate analysis. The support tool uses the natural language processing system for the analysis of on-line text data.

Introduction

Information interface is rapidly progressing even in our common computer environment. We can find answers to research and reference questions using several different types of information resources, e.g., subject guides, search engines, and specialized databases. Furthermore, we have focus on large-scale data not for understanding of millions of cases but for providing summaries and generating reports with the help of statistical techniques. This approach is known as knowledge discovery in databases (KDD) or data mining (Fayyad 1996a). The results of data mining acted as a sophisticated query for further data analysis such as multivariate analysis. Preceding research deals with the undergraduate data mining as information seeking skills can be found (Anthony 1998). The target of this work-in-progress study is to develop learning support tools for providing data mining experiences and to have practical opportunities for learning statistics. Learning the process of KDD gives an accessible approach to finding information on the World Wide Web and the Internet, and it helps students to try research issues. The support tool uses an existing technique, the natural language processing system (Kurohashi 1999) for the analysis of on-line text data. More detailed research is necessary, but the author outlines the study hereafter.

Knowledge discovery in databases and its method

Knowledge discovery in databases (KDD), or data mining, is a process for extracting useful knowledge from volumes of data. Meaningful knowledge is not derived from simple methods or techniques of KDD, but repeated inquisition procedures to find certain data patterns from less useful and condensed data. Some portion of its method is automated with the computer, but most of that is the so-called "trial and error" process.

The outline of the data mining method has the follow phases: 1) **Statistical sampling** for grasping a whole tendency, 2) **Data inquisition** for finding association or sequential pattern of whole data, and for directing the course of the analysis, 3) **Data handling**, e.g., summary data extraction, merging into a single database, or exclusion of erroneous data, 4) **Model development** for inference with a generalized linear model, regression model, neural network, or decision tree analysis, 5) **Model assessment** for inference model evaluation.

For example, a World Wide Web (web) server retrieves access log of the web site. The access log consists of the IP address of the accessed computer, access time, URL of watched web page, URL of referred web page, and so on. The active web site has an enormous log file. When the result of data mining detects that a certain two pages are being watched together by same person but they are not linked, the web site designer can continue to inquire the relationship of the two pages, and can link both two pages for their convenience. In this way, hypothesis formulations by data mining lead to the interface support for web design.

Data Mining Learning Tool

The author has developing a learning support tool for KDD and multivariate analysis methods. This PC-driven learning application software consists of: 1) a database development module, 2) a relation rule browsing module, 3) a statistics application learning module. The author will describe there in detail.

Database development module

This learning environment can handle both "Web site access logs" and "Mailing list messages" as sequenced text files into a database automatically. In case of Web site access logs that are recorded in the standard form of Apache HTTP Server (ASF 1996), they are converted to SQL-driven database tables with apportion between items. In the event of mailing list messages, firstly, the morpheme analysis system JUMAN (Kurohashi 1999) detects nouns in the each message. Secondly, the nouns of each message are collected into SQL-driven database table. According to my previous investigations (Fujitani 2000a; Fujitani 2000b), the set of nouns in mailing list messages can adequately be used for summary sentences extraction of on-line discussions.

Relation rule browsing module

Learners use a web browser to observe correlation rules in database. When permutation and combination rules can be found at a fixed rate of data, the module detects them as "associations" and "sequential patterns". This module uses the index of the rule known as "support", "confidence", and "lift" (Fayyad 1996b). The module calculates the indexes and sorts the correlation rules in descending order. The learners are able to change the arrangement to which index they give more weight. Most data inquisition from databases is cut-and-try basis. Hence the proposing module can handle databases in various ways.

Statistics application learning module

With reference to the relation rule tables, the learners will approach a statistics application learning module. This module is used as on-line courseware for statistics application software. In the data mining sequences, the learners will develop mathematical models for inference. The module describes the characteristics of models such as regression models. The module calls the on-line help of statistics application software SPSS (SPSS Inc., 2000). In conformity to the important items on which the learners need to focus, the learners will choose the appropriate analysis methods by the courseware. To prevent overfitting and assessing statistical significance, part of data is retained for the cross-validation scoring phase.

Conclusions

The author has developed a learning support tool which deals with data mining and multivariate analysis methods. a problem yet to be solved in the future, we are interested in examining the effectiveness of the tool for practical use for freshman at college in the Department of Business Administration.

Acknowledgement
Our special thanks are due to Prof. Paul Gilbert, Mejiro University, Tokyo Japan, for reading the manuscript and making a number of helpful suggestions.

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Distance Training as part of a Distance Consulting solution

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Abstract: *Distance Training* models, when integrated in a more complex framework, such as a *Distance Consulting* model, present specific features and impose a revision of the strategies commonly adopted in distance training experiences. In this paper we report on the distance training strategies adopted in an European funded project aimed at defining and developing Distance Consulting services for SME's located in inland areas of Sicily. A distance consulting environment has been developed by integrating telematic tools which allow the consulting center and the enterprises to, respectively, develop and access both *Synchronous* and *Asynchronous* consulting and training activities.

Introduction

The continuous and rapid changes in the economical and technological factors behind the Information Society (development of the net-economy, the globalization of businesses, the macro changes in industrial and market structures, and so on) represent one of the most pressing challenges for Enterprises. Specifically, by looking at the New Economy sector, new terms appear everyday in order to describe how the traditional business activities are more and more moving towards ICT-based solution: *eWork*, *eBusiness*, *eCommerce*, *Digital* Economy, *Global Market* are only a few examples of this new emerging world.

However enterprises, especially Small and Medium-Sized Enterprises (SMEs) in Europe, still need strong support in order to cope with the challenges raised by ICT and exploit the potentials offered by them. In particular, training and re-qualification is essential for enterprises for affording a constant adaptation and modification of their businesses and securing their competitive market position; therefore, training concepts should be part of the culture of any company. At the same time, accessing training modules is still considered by SMEs a costly and time-consuming process, which is very difficult to conciliate with production timetables; in addition, there is not a strong culture of retraining and lifelong learning amongst SMEs. *Distance Training* shows huge potential as an effective solution to the needs of training and re-qualification in SMEs, by overtaking many of the obstacles to the activation of training processes in a company.

Consulting centers are in the right position to promote both the use of ICT in production activities, and specially the culture of training amongst the SMEs. Support to training activities will become a more and more important role of the consulting centers. In addition, the consulting centers themselves can exploit the potentials offered by ICT, and offer *Distance Consulting* services.

At the Italian National Research Council, we have designed and leaded an experience of *Distance Consulting*, an ICT-based approach to consultancy, which systematically provides companies with information, communication and training services in an effective way. In this paper we analyze in depth the training model that has been adopted in a European funded project, called *SOLARE* (Support On-Line to Regional Enterprises), together with the technological solutions we have developed for the training activities. Because of the strong and systematic integration of the Distance Training model in a more general one (the Distance Consulting model), the training process has shown specific features which have in turn imposed a revision of the strategies commonly adopted in distance training experiences.

The SOLARE project

The SOLARE (Support On-Line to Regional Enterprises) project has been carried out in the framework of the European ADAPT initiative. The main objective of the SOLARE project is allowing a group of SME's located in the inland areas of Sicily to benefit from consulting services through an innovative on-line cooperative environment that has been defined and developed at our Institute. Twenty enterprises have been connected, through telematic channels, to a consulting center, to a technological institute of the Italian National Research Council and to the Department of Economy of the University of Palermo. This network, named the SOLARE *laboratory*, has initially identified needs, constraints and objectives of the project, and then it has monitored the development of the activities of the project.

Starting from the specific needs of the involved enterprises, we have carried out consulting activities through a communication environment based on Information and Communication Technologies (ICT). There is not a generally accepted definition of *Distance Consulting*, and for our purposes we consider it as an ICT-based approach aimed at providing enterprises with information, communication and training services in a systematic way.

The methodology adopted for the SOLARE project starts from the use of a business check-up through which the consultant can understand the techniques of management of each enterprise, its culture, the followed politics, and so on. Actually, the check-up aims at analyzing the main activities of the enterprises: customer management, financial needs management, personnel management, investment decision, information system, and so forth. The analysis of the check-up results provides the consultant with the strengths and the weaknesses of each enterprise involved in the SOLARE project; according to this information, the consultant plans the activities to be carried out in order to support the enterprises in solving their weaknesses and improving their strengths. The intervention is based on a mix of traditional activities, strongly integrated with distance consulting activities which take place through the Net; traditional and distance activities are aimed at acting on the daily work of the entrepreneur. Examples of activities which have been carried out during the SOLARE experience are: seminars on specific topics, production of consulting materials, specific courses on the introduction of new technologies and new management techniques to increase business competitiveness, promotion of the use of multimedia and communication technologies for the acquisition of advanced services.

The distance consulting environment has been developed by integrating telematic tools which allow the consulting center and the enterprises to, respectively, develop and access both *Synchronous* and *Asynchronous* consulting activities.

The first form of activity is based on the use of real-time communication tools to make the different subjects communicate instantly: the consulting company and the entrepreneurs cooperate through a synchronous environment in which it is possible the activation of different work tools: Audio/video tool, Textual communication tool, Resource exchange tool, Whiteboards, Application sharing tool. This technological environment allows the creation of a direct channel of communication between the consulting company and the entrepreneur through which it is possible to co-operate without the need to move from a place to another one. This introduces a high degree of flexibility in the organization of the consulting activities as compared to traditional consulting processes; network-based meetings can be scheduled in order to discuss a specific topic or to arrange the documentation for a project, the complete a marketing plan marketing, and so forth. The software used for the synchronous consultancy activities is MS Net-meeting and its functions for the audio/video transmission, the textual communication, the exchange of resources; the remote control function has been used to guide the enterprises in carrying out specific activities and, more generally, for cooperative work activities.

Systematic provision of ICT-based:

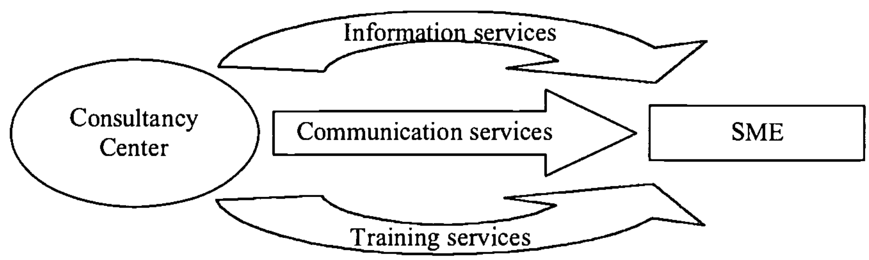

Fig. 1: the Distance Consulting Model: a new kind of cost-effective continuous support to SME's.

The asynchronous consulting activities have been carried out by means of the *Asymmetrix Librarian* system. The system has allowed the organization of the documentation according to areas of interest and their association to group of enterprises with common training needs. The system has provided a high degree of flexibility in planning and organizing information: it has been structured trough specific paths according to the SME's requests and the objectives of the consultancy. The client/server architecture of the system, based on the protocol HTTP and Java, has allowed an effective development of asynchronous consultancy by means of: the setting of enterprises groups; the setting of focus groups on specific topics; the production of consulting and training material and its organization in small modules; the association of the modules to the groups of enterprises; the production of reports on the access to information, for the evaluation of effectiveness of the whole process of consultancy. The enterprises get access to the material in a simple way: by means of a web browser they can go to the home page of the consultancy environment (specific to the group the enterprise belongs to); afterwards, they can: visualize and access the content (information on specific subjects, texts, lessons, seminars,..); stop and restore the lecture; share activities and communicate with other users. The consultancy material has been developed and organized according to the web hypertext model. Access to the material is password protected; we have assigned different work areas to each group of enterprises; in some work areas it is possible for the enterprises to put and share information of public interest. This sharing area and the news area have been very useful for the users, e.g. to exchange opinions about some practical aspects of the application and interpretation of laws in particular contexts, thus encouraging a peer-to-peer training strategy.

The Distance Consulting model

Our definition of *Distance Consulting* focuses on the systematic use of ICT-based solutions aimed at supporting enterprises; specifically, the systematic approach foresees the integration of ICT-based *information*, *training* and *communication services* which -in the whole- allow consulting companies to give a *continuous support* to their customers *with cost-effective solutions*, activating *new kinds of consulting* based on specific ICT features [Fig. 1]. Following, we analyze some of the most common ICT-based services that could be included in a Distance Consulting service.

Information services
One of the most impressive feature of the Information Society is the rapid growth of information made available through traditional and new communication technologies (cable TV, Satellite TV, Internet, and so on); this is particularly true in the new economy context, where the information is more and more global, it is highly volatile, it is produced 24 hours a day; in other words, the risk of information overwhelming is really serious.
As a consequence, the Distance Consulting center can support customers through important added-value services concerning the information; amongst the others: brokering of information: search about specific requests in Internet or in traditional material; providing information structured according the enterprises needs: highlighting news, most important topics, deadlines, and so on; this means that the same information could be organized and shown in a personalized way, according to company typology, market sectors, and so on; publishing / broadcasting newsletters on specific economic topics; establishing Web portals.

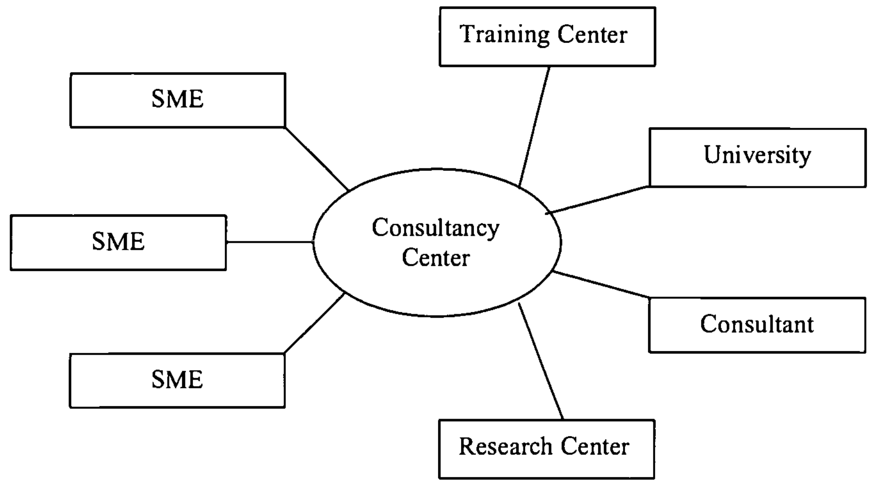

Fig. 2: The Consultancy Center organizes training processes according to the specific needs of the SMEs.

Training services

Nowadays, it is extremely important to provide companies personnel with a continuous training (Lifelong Learning); it should be noted that sometimes it is not easy to distinguish between "traditional" consulting services and training services. On the other hand, ICT provide the Distance Consulting centers with important opportunities to activate training services for their own customers in an innovative way. Amongst the training services a distance consulting center can provide: organization of distance courses and seminars according to customers needs, by also asking enterprises for their specific needs; inviting experts from University, Research Institutes, other enterprises as "speakers" in seminars and courses; activation of "training on job" services, thus supporting enterprises in the application of contents of seminars and courses or supporting enterprises in the use of specific software.

Communication Services

New communication technologies can improve the communication between the subjects of the consulting process and, at the same time, widen the opportunities of relationships between them; as a consequence, the role of the consulting center changes, since it has the opportunity to improve communication with its own customers and, at the same time, it can provide them with the necessary ICT-based communication services. Amongst the services: activating effective electronic communication channels with its customers; widening the number of subjects connected through the network, such as enterprises, banks, universities and research centers, the distance consulting center itself, and so on; establishing communication channels among enterprises belonging to the same area of business and facing specific common problems. In such a way, entrepreneurs and managers have the possibility of discussing on common problems, according to a "peer consulting" model, and they can share experiences. Of course, this is quite possible for very general questions; on the contrary, very specific topics require the direct intervention of the consultant.

Distance Training as part of the *Distance Consulting* process

As told before, Distance Training in SOLARE is part of a more comprehensive model, the Distance Consulting one. As a consequence, the Distance Training process in SOLARE has very specific features:

- there is not always a clear distinction between the Training processes and the Consulting ones;
- as a generalization of the previous point, there are very weak borders between the three aspects of the Distance Consulting model: information services, communication services and training services. Getting access to information can be considered as a specific activity in a training process, and similarly communication services can be effectively used for training purposes;
- it is not a "general-purpose training", as the one offered by many training centers, but it is a training strongly focusing on the specific needs of the beneficiaries;

- the consultant is also the promoter and the organizer of the training services: he knows very well the target of the training process, and can arrange the whole training process [Fig. 2];
- the consultant can analyze the training needs of several enterprises, so organizing courses involving employees and managers from different SMEs.

Some consequences of the features of the Distance Training model in SOLARE as stated before are here reported:
- the training process is strongly tailored to the needs of the beneficiaries, for two reasons: from one hand the consultant knows the company quite in depth; on the other hand the companies have the opportunity to, implicitly or explicitly, declare their own training needs;
- the companies play an active role in fixing the training modules, since the very initial phase of the whole establishment procedure; not only do the companies influence the decision on the content of the training, but also the same methodological and technological aspects of the distance training process: the distance training provider, in strict cooperation with the consultant, can take in account the technological infrastructure and skills of the beneficiary company, as well as the organization aspects in the company (e.g.: the number of people who will follow the distance training course, their position in the company, the time allowed to each person to participate in the training process, and so on), since the consultant knows the company very well, especially if they are very small companies, such as in the SOLARE project. This is very different from traditional training courses offered on the market, which are characterized by general technological and, sometimes, fixed time schedules, and it is up to the participant to the training course to make arrangements in order to be able to get access to the distance training module;
- the role of Training–on–job practices becomes more and more important (and more important than in traditional settings); actually, the training process, as part of the distance consulting approach, is to be brought inside the company, in order to better solve specific problems of the enterprise;
- through the Distance Consulting environment, SMEs get access to a continuous flow of updated and specific information offered by the Consulting center; in such a way, the management of the company receives continuous stimuli to re-qualification, thus undergoing a continuous training process (as far as the access to information is concerned). Generally speaking, Distance Training is a continuous process since it is integrated in a continuous Distance Consulting process;
- the Distance Training process can benefit from the communication services integrated into the Distance Consulting model, and enable company managers to discuss and cooperate on common problems straightforwardly. In such a way, peer-to-peer training strategies are encouraged;
- the evaluation process of the training plays a completely different role as compared to more traditional training contexts: firstly, the consultant has direct control of the training process, since s/he can verify if the training goals have been achieved during his normal professional activities (e.g. by meeting the entrepreneurs or the management of the companies). In addition, evaluation can be supported by the analysis of the communication flow through the discussion groups associated to the training topics (as it will be described in the following session).
- the costs of distance training courses can be optimized, by involving participants from different enterprises with the same needs;
- the consulting center can manage the search of training resources (teachers, on line courses, experts, and so on) starting from the needs of updating and re-qualification of a group of enterprises; the consultant and the teachers can organize new model of training, leading the enterprises towards an exchange of experiences. This aspect is particularly important in putting into practice new know-how acquired during the courses (for example in courses about the application of new laws, when enterprises in the same economic sector could face the same problem to apply the law in their context). In this case the exchange of experiences, with support from the expert, can be extremely effective;
- when the consulting center is also a support for the introduction and the development of ICT in the enterprise, it becomes the training center for ICT. In this case the courses are very specific and flexible at the same time, thus achieving high quality results.

Conclusions

In this paper, we have presented an experience of distance training as part of a Distance Consulting process. Distance Consulting is a new way of providing consulting services, as compared to more traditional approaches; a lot of consultancy services can use information technologies in order to improve their effectiveness; in addition, new services based on technologies can be developed. In particular training processes, when analysed in the context of a Distance Consulting model, change their traditional role and can benefit form the use of ICT. One of the most significant benefit we have experienced in the SOLARE project has been the possibility of providing consulting and training services in a continuous way by means of: information areas, the exchange of experiences among enterprises facing the same problems, the training on job to put into practice the concepts acquired during the lessons. Moreover, the role of the Distance Consulting centre has become important also for the promotion, organization and delivery of distance training courses; in this way several enterprises with similar needs can share training materials and experts' support, cutting down the costs.

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A Generator and a Meta Specification Language for Courseware

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Abstract: Courseware has to reflect the learning situation coined by contents, learning goals, characteristics of the learner, technical conditions etc. The efficient creation of appropriately designed courseware relies on flexible representations of reusable instructional material and learning circumstances.
Contradictory approaches of different instructional design schools give little advice in case of design alternatives: The support gap for justified design decisions ranges from underlying instructional theory to ergonomic layout. Therefore, we separated factors influencing courseware design from design parameters and present the Instructional Material Description Language IMDL for their respective description.
A simple rule language serves to express dependencies between influence factors and design parameters. Rule sets represent prescriptive design statements based on instructional design theory which are open for validation.
A toolset enables efficient courseware production based on IMDL, e.g. an interpreter engine for rules produces complete courseware specifications and a generator outputs source code for specified courseware based on a framework of instructional Java-Beans™.

Introduction

The shift to the information or knowledge society is accompanied by the need for continuing education. The corresponding need for courseware grows with the gap between demand and otherwise deliverable supply of education. The efficient development of courseware is thus an important goal. Proprietary multimedia authoring tools like Authorware™ or Tooolbook™ have been extended to meet the specific needs of courseware authors, but we don't think that WYSIWYG-editors provide an appropriate methodological support for the systematic development of courseware. WBI (Web-based instruction) is taken for another remedy because it makes development faster for a wide area of applications. The simple and standards-based technology of the WWW has proven fruitful and is easily to learn and implement when persisting bandwidth limitations don't obstruct its use. However, our point of view is that they may help non-programmers to build multimedia applications but tend to distract their attention from didactic and content related aspects. The first problem is thus lacking instructional design knowledge and tool support. Furthermore, attractive courseware that supports learning on demand has to be modular and designed to meet the targeted learners' needs and thus requires even more complex engineering models or methodologies like the ones arising from the area of knowledge management.
Instructional System Development (ISD) is concerned with the former mentioned problems. We interpret the term "instructional system" as any system to foster learning, whereas our work is concerned with development of instructional software only. ISD consists of the phases planning, development and implementation (use and evaluation) where we focus on the development phase that in turn consists of design and production. A pragmatic definition of *Instructional Design* (ID) that we agree with is given by Lowyck & Elen (1993) who say that ID is a discipline that connects descriptive research findings with instructional practice by (1) identifying design parameters based on results of basic research from cognitive psychology; (2) instruments these as rules, procedures and methods and (3) provides prescriptions for the development of instruction to optimise teaching and learning. The most ambitious approach to put this definition to practice probably is the automation of ID that Tennyson & Baron (1995) or more recently Spector & Muraida (1997) give a survey of.
Approaches from Software Engineering and Knowledge Management resulted in courseware standardization efforts like the *Architecture and Reference Model* by the *Learning Technology Standards Committee* of the

IEEE [http://ltsc.ieee.org]. Its working group for *Learning Objects Metadata* develops a metadata standard to describe learning resources. A meta modelling approach to the development and management of teachware based on re-use of contents and structure that uses metadata as a foundation of adaption is the *Passau Knowledge Management System* PaKMaS (see Brössler, Freitag & Süß, 1999). However, PaKMaS is not out to produce courseware but is a management system that transforms IM-models into hypertexts. On top of that, the modelling is done without didactical guidance or ID advice. Murray (1996) suggests *"ontology objects, which allow for the creation of representational frameworks tailored to classes of domains or tasks (...)"* for *Intelligent Tutoring Systems* (ITS).

We took up this approach and have built the *Instructional Material Description Language* (IMDL) based on XML. This multi-layer specification language consists of three parts to enable generic descriptions of courseware. IMDL-subsets serve to describe influence factors, design parameters and there dependencies. Base specifications of IMDL then simply describe actual material in terms of relevant influence factors (like content, structure, targeted learner and so on); complete courseware specifications become possible by the addition of a set of elements to describe design parameters. Elements of both subsets describe well-understood parts of the domain, whereas controversial aspects are ontologically separated; author-specific extensions. ProfiL, the *„Produktionssystem für interaktive Lernsoftware"* (German for "Production system for interactive courseware") first transforms base specifications into complete courseware specifications according to author-formulated dependencies (design rules) and finally generates according courseware based on a framework of instructional JavaBeans™.

In the following section aspects of courseware are analysed and summarized distinguishing between influence factors and design parameters before our approach to explicitly represent instructional design axioms is presented. Afterwards, the XML-based implementation of the approach as IMDL is roughly sketched. Another section addresses the architecture of ProfiL after clarifying the roles and relations of documents and document type definitions. The final section provides a brief summary, our conclusions and an outlook on future research and development.

Aspects of Courseware: An Analytical Approach

The description of courseware is not yet comprehensively possible due to its interdisciplinary and complex character. After all, various sets of metadata for learning resources can be found in the literature some of which (e.g. Learning Objects Metadata, IMS [http://www.imsproject.org] and ARIADNE [http://ariadne.unil.ch]) are standardized. None of these approaches provides vocabulary to describe didactical aspects, instead they are extensible for that purpose. We are convinced that this lack of common vocabulary indicates the general state of instructional design research, that is characterized by Seel and Dijkstra (1997): *"An analysis of traditional ID demonstrates that it is not possible to map results of empirical research on learning onto instructional planning in a one-to-one manner, but rather the transformation of a descriptive knowledge base into a truly prescriptive instructional theory seems to be still in its infancy."* The situation is rather characterized by anecdotical results that are hard to compare or to integrate within a sound theory of ID as concluded in Kerres (1998), Mandl & Reinmann-Rothmeier (1997) or Schulmeister (1997).

For that purpose we tried to approach these problems in a bottom-up fashion: We first analysed the state of the art of ID and current trends of courseware engineering to identify influence factors and design parameters of courseware. The latter have then been considered as dependent variables with respect to the former. In the following, we want to distinguish instructional material (IM) from courseware: IM are self-contained units of learning content, that are also called knowledge objects (e.g. by Merrill, 1997) or conceptual units (Brössler, Freitag and Süß, 1999) in the literature. Absent contextual embedding and functionality make the distinction between the two. Based on this preliminary remark we can now take look at the influence factors of courseware design.

Influence Factors of Courseware Design

The inherently interdisciplinary development of courseware requires to take into account various different aspects. ID usually distinguishes between didactical assumptions (based on learning theory, media didactics, software ergonomics), contents and technical aspects. We pragmatically adapted this view by subsuming contents and learning objectives under instructional material. IM is thus particularly characterized by contents that we model as concepts, that are initially independent and that can be annotated with arbitrary learning objectives, e.g. according to Bloom, Ausubel or Gagné. Our focus is on cognitive and motivational affective objectives, since we don't expect computers to be universally appropriate, e.g. for psychomotoric training.

Further aspects of IM are its mediality and granularity whereas its state (with respect to certainty or consensus about contents) and difficulty can be coded as metadata.
Structure of IM is another essential feature that we model as concept net. Link types can be added based on their graph-theoretical properties. The overall complexity can be expressed via metadata.
Learner properties are treated in such a heterogeneous way in the literature that an exclusive commitment would be pointless. We thus realized a common and flexible division into a (domain) knowledge model and a learner attribute model. The former is implemented as simple overlay model, whereas the attribute model is made up of descriptive primitives, among which appropriate subsets can be selected according to the learning situation. If patterns within the space of possible instantiations should be re-used this can be achieved via specific extensions. Overlay-learner-models can be re-used in the same way, e.g. by approximatively characterizing a pupil with respect to his previous knowledge by his grade. Further primitives are dedicated to media preferences (verbal – textual or auditive - or visual type), motivation (high, medium, low) computer literacy, availability (in terms of time to learn), environment, age, cultural predisposition (that sometimes insinuates analytical or synthetical learning preferences) and further learning styles, e.g according to Kolb or Keirsey.
Another important component of most learning systems is assessment. Its application ranges from self control over feedback and adaption to certification. Authoring appropriate tests is a complex subject matter on its own that goes beyond the scope of this article. To automatically evaluate tests and integrate them into courseware, at least goals (e.g. as a threshold for variants mastery and normative) have to be specified as metadata.
The sketched selection of influence factors is not complete and doesn't take into account important aspects like multilingualism, handicapped learners or psychomotoric learning objectives. The building of this ontology of influence factors certainly is a process that can hardly ever be considered to be completed.

Design Parameters of Courseware

This section presents design parameters of courseware that exist dependent on or independently of the above influence factors. Attention is also paid to possible ranges of values for these influence factors. We have derived an abstract generic model of courseware from a survey of available products and research prototypes. In addition, this model tries to integrate results of multimedia software engineering (see Gaede & Schneeberger, 1998) with the domain of Intelligent Tutoring Systems (ITS) and learning theory. Multimedia software should be built in a modular fashion that separates structure, contents, layout and functionality. ITS research contributes the separation of domain, learner and didactical module as well as user interface. Learning theory and media-didactics don't actually propose a specific courseware architecture but the latter offers (partially general) rules to select, arrange and layout media. Learning theory with respect to instructional design is considered in the next section.
On the basis of this model we have localized possible differences and identified them as variables with exemplary values. These design parameters are related to all aspects of courseware again, which are: content, structure, learner, tests, and beyond this, to functionality. Additionally, metadata can be used according to specific requirements or established standards. The multi-layered specification design based on learning theory and media-didactics shall be outlined next.
From a didactical point of view, macro- and micro-strategies can be distinguished. Macro-strategies apply to sequencing of units and, in a more abstract way, to types of courseware (presentation, drill & practice, tutorial, and so on). Navigational options like a given degree of freedom or generally available access variants (sequential, hierarchical, guided tour or explorative) also belong to this sector. Micro-strategies relate to the selection of components (e.g. definition, explanation, summary, example, analogy, hint, feedback, question, answer, task) depending on their type and function. Selection of media and feedback variants plays another important role in this connection.
The design options with respect to contents are mainly made up of further selections. For example, the choice of IM can be done with respect to its difficulty or to previous knowledge of the learner.
The technical perspective is the easiest to handle though lots of factors play a role. Access (online/offline), if applicable bandwidth, target platform and many others fit in here. We tried to respond to related problems by choosing the largely platform-independent programming language Java and alternative generation of HTML code. However, the selection among different media representations can be made dependent on such aspects.

From Learning Theory and Didactics to Prescriptive Design Axioms

Now that we have presented primitives to describe influence factors as opposed to design parameters, it is quite straightforward to define design instructions in terms of relations between values of the former and the latter!

Nevertheless, it remains problematic to completely specify such dependencies, first, because of the obvious combinatorial explosion; and second, because of the mostly anecdotical research that can hardly be called empirical. The first can be tackled by abstraction, when describing primitives are hierarchically synthesized. The latter is a long-term goal of our approach, by making the usually implicit assumptions of ID explicit in terms of rules, that can be compared and evaluated.

Advocates of the trce main trends in learning theory, behaviourism, cognitivism and constructivism, have different views of learning (processes) from which again different design instructions for courseware are derived, not to mention the varying terminology across and within the ID schools. The at present prevailing constructivist community remains (like its elder relatives) vaguc in its conclusions. So states Gruender (1996): *„However, contrary to the claims of constructivism, nothing follows from this theory about what the best educational methods might be to help people to learn."* The ProfiL-methodology thus enforces the formulation of detailed, specific design rules by courseware authors. Subsets of corpora of such rules can be pooled and arbitrarily named. In doing so, a number of rules that describe courseware design according to Ausubel (1960) could be organized as set of prescriptive axioms and be given a namc like 'Ausubel_for_Hypertext'.

A Specification Language based on XML: IMDL

We have chosen the platform-independent meta document description language XML *(Extensible Markup Language)* for the implementation of the specification language because of the standardization efforts and the promising development of the WWW. It enables extensible language definitions using DTDs *(Document Type Definitions,* whereas XML-Schema definitions offer extended possibilities but still have the state *W3C Working Draft)* and thereby meets our requirements. The expressiveness of DTDs is similar to formalisms like EBNF although certain aspects are complicated to represent. The following three sections give an overview of IMDL, the *Instructional Material Description Language,* by sequentially presenting its subset to describe influence factors IMDL-I together with the subset for design parameters IMDL-D, their respective extensions IMDL-IE and IMDL-DE, and the IMDL-R to build rules based on the former subsets. The layered architecture of IMDL further distinguishes between layers for core-, strategy-, model-, component- and layout-specification but is suppressed here for clarity and brevity.

We present the higher levels of both descriptive languages. IMDL-I consists of five modular parts to describe learners, learning-objectives, domains, reusable media-units and reusable framework components. Details are hidden in the files for the different modules. IMDL-D contains elements and attributes to specify didactical objects and structures and is extended by elements to describe abstract software components and layout.

Whereas we tried to identify and name influence factors and design parameters at a fine-grained level, we have to provide the means to efficiently use them in an author-specific way. Authors aren't forced to explicitly use primitives but may use or add their own hierarchical language extensions for further use. One example is given to illustrate this for each, IMDL-IE and IMDL-DE: When previous math knowledge of a 7th class pupil is modelled once with IMDL-I, the extension '7th_class_pupil' could be added to IMDL-IE and then be used instead. If a design pattern of IMDL-D consists of information presentation, a test and depending on its result repeated presentation or presentation of another topic and the author wants to re-use this pattern he can introduce a language extension called 'Drill&Practice' and in future use that element of IMDL-DE instead. These examples illustrate, that a set of best-practices of language extensions might be agreed upon by author communities and thereby result in a kind of standard representations of instructional patterns.

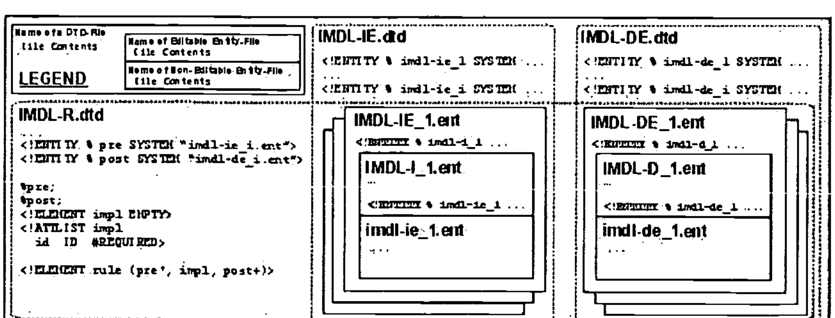

Figure 1: Relations of Document Type Definitions and Entities for Specifications and Rules

Language extensions are added in separate files and included into the common 'root file' via entities (see **Figure 1**). This has been necessary to avoid editing of the fixed language parts IMDL-I and IMDL-D. The root file isn't edible either and contains only entities to include these constant parts and entities to include the variable parts edited by the author. All language extensions are done by the help of DTD-editors that will be extended by more specific tools to support this task. Authors can thus access and re-use all elements and attributes of included entity files.

Prescriptive Description of Design Rules: IMDL-R

Given the XML-based IMDL, the Extensible Stylesheet Language (XSL) and its part XSLT (Transformations) would be the obvious choice to describe design rules. XSLT is a language for transforming XML documents into other XML documents. It uses patterns and templates for conditions and actions respectively. However, the way rules are processed by so-called XSL-engines is deterministic whereby application of a set of rules to a specification (an IMDL-IE document) yields exactly one target (IMDL-DE) document. Since our goal is to generate alternative variants in case of under-specified influence factors, we defined the (trivial) rule language IMDL-R and implemented an according interpreter. The DTD for the rules allows for elements of IMDL-IE as pre- and elements of IMDL-DE as post-conditions.
Inclusion is done via entities again, because the XML standard and according tools don't make it possible to include complete DTDs (i.e. with header). Therefore, the root-elements of IMDFL-IE and IMDL-DE are eliminated and the thus truncated rest is included unchanged.
We alternatively consider language elements as terms and work on a pre-processor that transforms specifications into first-order logic. Thereby, specifications of IM are to be seen as sets of facts whereas design rules become axioms. This enables the use of efficient theorem-provers instead of simple interpreter engines and lets sets of rules be checked for consistency and redundancy.

Architecture of ProfiL

We want to begin by illustrating (in **Figure 2**) the relations of the documents and document types described above before we sketch the architecture of the entire ProfiL-system. The DTDs IMDL-I and IMDL-D define how influence factors and design parameters are described at the lowest level respectively. They thus define the core language of ProfiL. Each of these two is included (1.) into the respective author specific DTD file IMDL-IE and IMDL-DE. IMDL-R lays down the syntax of rules to describe dependencies among them, what for essentially only variable symbols, quantifiers, sets and an implication symbol are introduced and the elements of IMDL-IE and IMDL-DE are assigned the role (2.) of pre- and post-conditions respectively. The IMDL-R.dtd is not editable but all elements an author added via extensions in IMDL-IE and IMDL-DE are available within rules.

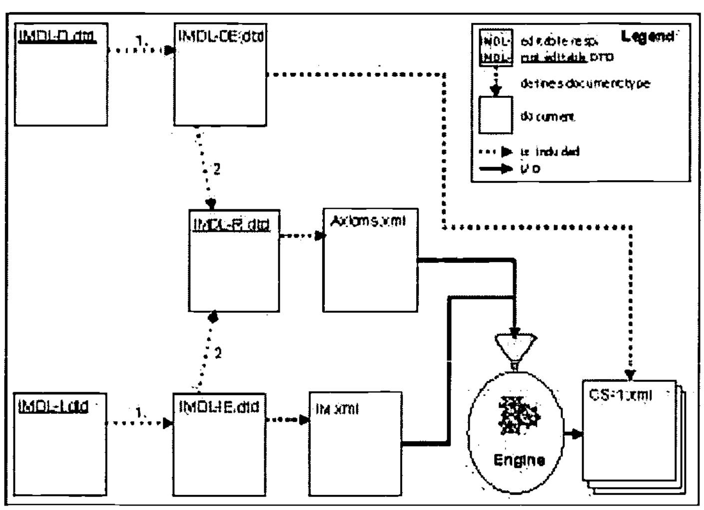

Figure 2: Relations of Documents for Specifications and Design-Rules

The document „Axioms.xml“ is written by an author or a group of authors. It lays down in the rule language IMDL-R specific design rules to be applied on specific conditions. The example document „IM.xml“ in turn describes actual IM with respect to contents and other influence factors. Both documents together are processed by the interpreter („Engine“) resulting in different variants of complete courseware specifications, here called „CS1.xml“ and following. To keep the illustration clear we have suppressed the multi-layer structure of the specification languages. Actually, language elements are distinguished as belonging to a core-, strategy-, model-, component- and layout-layer. Rules are accordingly applied in a multi-phase process.

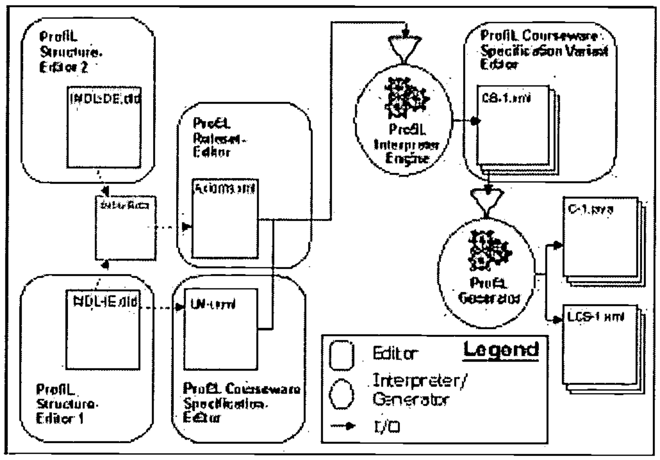

Figure 3: Tools and Document Flow within ProfiL

We are now going to consider the roles of documents within the overall architecture of ProfiL as illustrated in **Figure 3**. A standard editor has been integrated to edit the extensible DTDs IMDL-IE and IMDL-DE; for clarity we labelled it „Structure Editor 1“ and „Structure Editor 2“ according to its use. The non-editable DTD IMDL-R parameterizes the „Ruleset Editor“ that serves to author instructional design rules. The same XML-Editor (now labeled „Courseware Specification Editor“) is used to author specifications of IM when parameterised with the DTD for IMDL-IE. The interpreter known from **Figure 1** then generates several variants of courseware specifications („CS-1.xml“ and others) that can again be manually edited with the XML-Editor in the role of a „Courseware Specification Variant Editor“. This allows for review and selection of individually preferred variants and for individual design changes (exceptions) that shall not persistently influence the rules. Finally, the „ProfiL Generator“ is invoked with the selected specification(s) and produces Java source code („C-1.java“) that can be compiled into a executable application. The documents depicted below are called „LCS-i“ standing for *„Lazy Courseware Specification“*. The files contain either parts of the influence factor specification that haven't been fixed at design time or dynamic parameters that are expected to change during courseware use. By analogy with partial evaluation, these parts aren't evaluated immediately (during generation) but at runtime. An obvious example for this case is a learner's domain knowledge model that of course has to adapt to the extended knowledge during learning. If this is impossible or not sensible, several alternative variants are generated.

Summary and Outlook

The separation of influence factors and design parameters and the explicit description of their dependencies is an essential prerequisite to consolidate instructional courseware design. The use of the ProfiL-toolset and the proposed methodology enforces courseware authors to make assumed dependencies explicit. This enables validation and comparison of didactical alternatives. The framework-based generation approach makes use of the extensible specification language IMDL. This results in modular and re-usable instructional material leading to more efficient courseware production. The final fully automatic generation of source code based on instructional Java-Beans in compliance with ergonomic and didactical aspects results in further savings. The implementation of the presented system is almost complete; all components have already proved to work as prototypes.

However, there remain problems: The use of our tools is not yet easy enough (e.g. compared to the tool described by Ainsworth & Grimshaw, 1999) and abstraction via extensions alone doesn't seem to make

authoring easy enough either, though we expect improvements by collaborative ontology engineering as described by Staab (2000). Supposing that universally valid terminology is neither near nor realistic, partial domain- as well as pedagogical ontologies (see Mizoguchi Bourdeau, 1999) have already proven fruitful. The collaborative management and construction of ontologies by means of namespaces might thus help to ground courseware design in the spirit of Hannafin (1997). Another shortcoming of ProfiL is the renouncement of runnable domain models that make up the power of ITS but it is certainly possible to integrate such features after revising the framework that underlies the code generation. The actually implemented structural model already enables the automatic generation of simple tests. The lacking store of experience and the tedious initial specification of IM and design axioms are critical and at present prevent us from evaluating the authoring process let alone subsequent courseware use. It thus remains in question whether representing ID-knowledge as rules is acceptable to courseware authors. Early attempts towards programmed ID couldn't prevail, but we attribute this to lacking increase in value (e.g. the advice system of Elen & Stevens, 1993) that multimedia courseware has overcome. Moreover, these approaches where often committed to a single instructional theory like Frank's (1991) system ALSKINDI, that solely realized programmed instruction according to Skinner.
The quality and efficiency of courseware development according to the ProfiL-methodology can be further increased by preceding measures related to the authoring of instructional content. Guidelines for the didactical text production can help domain experts with this task. Templates can result in better structured content and can easily be added to the IMDL. Very important is the improvement of the graphical editors that are refined at the same time the example specifications and axioms are further developed. We thereby try to directly take into account specific requirements. The integration of theorem provers is only loosely coupled with the rest of the 'roadworks' but we expect the additional generation of explanatory documentation of it: Tracked chains of applied design rules promise to provide justifications for produced courseware.

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New Media in the Design of a Learners' Dictionary

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Abstract: In this paper we present an interdisciplinary research project which aims at developing an electronic vocabulary acquisition system for the German and the Italian language (ELDIT). The basic dictionary will be enlarged with text and exercise units in order to support a systematic approach for studying and practicing the vocabulary. To ensure maximum effectiveness of the learning process, modern psycholinguistic methods are applied alongside with new media and technologies including adaptive hypermedia. The system is implemented as an adaptive hyperbook and runs on the WWW.

1. Introduction

Recent research in the field of computer assisted language learning (CALL) shows that multimedia and hypermedia teachware seems to be effective and motivating for language learning (Egert 00). Such technologies open new doors for the presentation, maintenance, and dissemination of complex knowledge and information units. However, students who are less experienced in the use of information technologies may get into trouble and lose control over the system, especially if they are expected to work independently of a teacher or a tutor. Adaptive systems cope with this problem by maintaining a model of each individual user, which helps the system to prepare individually designed pages and to guide the users according to their personal learning goals.

Until now, such systems have mainly been developed for teaching natural science and computer science (Nejdl et al. 99, De Bra et al. 98). We are currently investigating the use of adaptive systems in the domain of foreign language learning. In the ongoing research project ELDIT we are developing an electronic vocabulary acquisition tool for the German and the Italian language. Modern linguistic and didactic issues are considered in the design of the system. It will further contain a model of each user, adapt the content to the individual needs and preferences of each user, and guide the user through a systematic but individually shaped vocabulary acquisition process.

The paper is structured as follows: In section 2 the concept of learners' dictionaries is introduced. In section 3 the ELDIT dictionary is described in detail. Section 4 provides an overview of how we intend to enlarge the basic dictionary to an adaptive vocabulary acquisition system. In section 5 we discuss related work.

2. Learners' Dictionaries

Vocabulary acquisition is an important part of foreign language learning. To support this difficult task, lexicographers designed a special kind of dictionary, so-called *learners' dictionaries.* A learners' dictionary serves both as a reference book to decode what the learner does not understand and as an instrument which supports text production (Aarts 99). Word definitions are simpler and might be supported by pictures. Carefully selected examples are very important for the illustration of the meaning of words, as well as typical lexico-grammatical patterns, etc.

Figure 1 shows the entry of the word „Fenster“ (English *window*) in Langenscheidt's learners' dictionary „Deutsch als Fremdsprache“. In a printed dictionary space is limited, information is structured in a linear manner, and a lot of abbreviations are used. Therefore it is difficult to get an overview of the provided information, to understand which information is provided in detail, and where particular information can be found. Moreover, it is impossible to directly access semantically related words, except derivatives which, according to their usual lexicographic order, are physically close to the word under consideration.

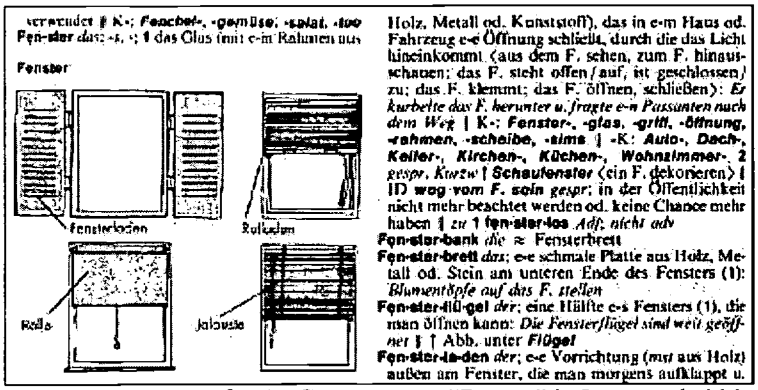
verwendet ‖ K-: **Fenchel-, -gemüse, -salat, -tee**
Fen·ster *das*; -s, -; **1** das Glas (mit e-m Rahmen aus Holz, Metall od. Kunststoff), das in e-m Haus od. Fahrzeug e-e Öffnung schließt, durch die das Licht hineinkommt ⟨aus dem F. sehen, zum F. hinausschauen; das F. steht offen / auf, ist geschlossen / zu; das F. klemmt; das F. öffnen, schließen⟩: *Er kurbelte das F. herunter u. fragte e-n Passanten nach dem Weg* ‖ K-: **Fenster-, -glas, -gritt, -öffnung, -rahmen, -scheibe, -sims** ‖ -K: **Auto-, Dach-, Keller-, Kirchen-, Küchen-, Wohnzimmer-** **2** *gespr, Kurzw* ↑ **Schaufenster** ⟨ein F. dekorieren⟩ ‖ ID **weg vom F. sein** *gespr*; in der Öffentlichkeit nicht mehr beachtet werden od. keine Chance mehr haben ‖ *zu* **1 fen·ster·los** *Adj*; *nicht adv*
Fen·ster·bank *die* ≈ Fensterbrett
Fen·ster·brett *das*; e-e schmale Platte aus Holz, Metall od. Stein am unteren Ende des Fensters (1): *Blumentöpfe auf das F. stellen*
Fen·ster·flü·gel *der*; eine Hälfte e-s Fensters (1), die man öffnen kann: *Die Fensterflügel sind weit geöffnet* ‖ ↑ Abb. unter **Flügel**
Fen·ster·la·den *der*; e-e Vorrichtung (*mst* aus Holz) außen am Fenster, die man morgens aufklappt u.

Figure 1: The entry for the German word “Fenster” in Langenscheidt’s learners’ dictionary “Deutsch als Fremdsprache”

Modern hypermedia and multimedia technologies allow to address a lot of these problems by providing new ways for structuring and presenting complex information. An overview of English learners' dictionaries available on CD-ROM is given in (Nesi 99). Cambridge Dictionaries Online provides web-access to a range of English learners' dictionaries (Harley 00).

3. The ELDIT Dictionary

At the European Academy Bolzano we are currently developing an electronic learners' dictionary called ELDIT (Elektronisches Lern(er)wörterbuch Deutsch ITalienisch). ELDIT can be used both as a monolingual and as a bilingual dictionary. Currently we are implementing ELDIT for the German and Italian languages, but the software could easily be adapted to different language pairs. The following sections describe the system in more detail by concentrating on different aspects of content and design.

3.1 A Sample Dictionary Entry

Figure 2 shows a screenshot of the dictionary entry for the German word "Haus" (English *house*). The information is presented in two different frames. The left-hand frame shows the lemma "Haus", a loudspeaker-button which on activation plays a sound file with the pronunciation of the word, and different meanings of the word. The right-hand frame shows various pieces of information about the word, which are collected in different tabs. Some of these tabs can only be activated once a specific meaning of the word is selected. In figure 2 the first meaning of the word "Haus" is actually selected, and the right-hand frame shows the collocation tab, which contains a list of the most frequent collocations together with their translation and an illustrative example. ELDIT contains a large number of patterns for word usage (collocations, idiomatic expressions, constructions) in combination with a translation of the patterns as well as illustrative examples. These data are presented in the tabs „Verwendu

According to Aitchinson (Aitchinson 94), people not only remember words in a possible context, but group the words in their minds into multidimensional word nets. Several word nets are visualized in ELDIT, among them the semantic field which groups words by synonymy, hyperonymy, antonymy, etc. and can be accessed by activating the tab „Verwandte Wörter“.

Chapelle stresses the importance of drawing the users’ attention to linguistic characteristics of a specific language (Chapelle 98). ELDIT uses footnotes to inform learners about particular differences between the two languages. Clicking on a footnote opens a small window, where linguistic difficulties are explained (see figure 2). A summary of all difficulties related to a specific word is shown in the „N.B.“ tab. For a more comprehensive description of these features in ELDIT see (Abel 00).

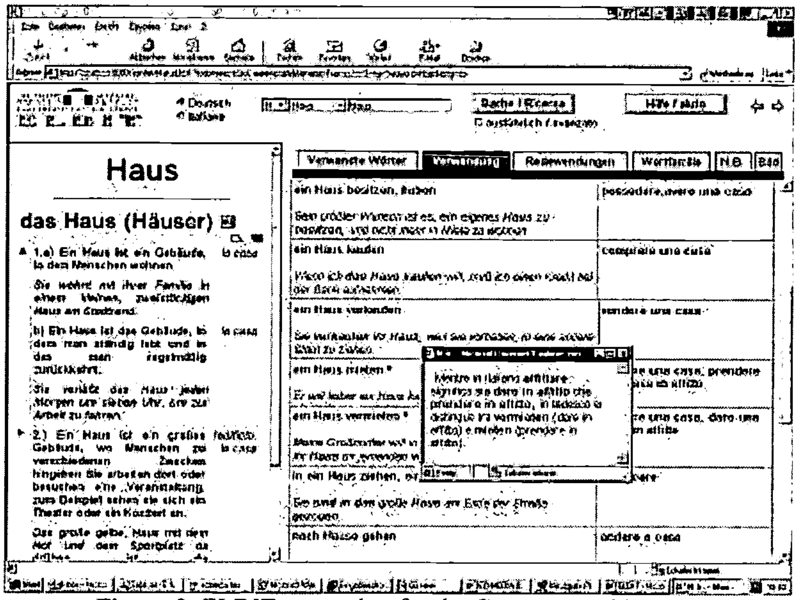

Figure 2: ELDIT screenshot for the German word "Haus"

3.2 Vocabulary Coverage

The ELDIT system should support learners of the German and the Italian language to prepare for the exam of bilingualism which is required for all employees at public institutions in South-Tyrol, a bilingual region in the North of Italy. For the selection of the vocabulary included in ELDIT the following considerations have been taken into account. The so-called basic vocabulary of a language consists of approximately 3,000 words and covers about 95% of the words in a normal text (Lewandowski 90). For both the Italian and the German languages an intersection of different basic vocabularies has been built. The two resulting vocabularies have been adjusted to each other in order to avoid big differences between the two languages. Finally, the two vocabularies have been enlarged by some frequently used words in South-Tyrol such as "farmer“, „wine“, etc. The resulting vocabularies cover standard German and Italian with focus on the language variants spoken in South-Tyrol.

3.3 Searching the Dictionary

One of the most obvious advantages of electronic media over print media is their possibility to provide fast and efficient search capabilities. In ELDIT, the user can search a lemma directly or by one of its declined or conjugated forms, e.g. „ging“ leads to the lemma „gehen“. The learner can also search more complex expressions such as collocations and idiomatic expressions, e.g. „aus dem Fenster schauen“, by simply typing the whole expression into the search field. Furthermore, the user is allowed to omit some problematic parts of an expression and to replace it by wildcards, e.g. „Geb*de e*ichten“ results in the collocation „ein Gebäude errichten“. Finally, ELDIT can detect spelling errors in the search expression and provide alternative propositions.

3.4 Data Model

Figure 3 shows a simplified version of our basic data model represented in an extended entity-relationship notation with generalisation/specialisation. The main objects in our domain are word entries, which are further classified into nouns, verbs, adjectives, and structure words (articles, prepositions, etc.). Every word entry is associated with various pieces of information. A distinction is made between information concerning the word itself (mainly lexical information) and information concerning a particular meaning of the word (mainly semantic information). The former class includes the lemma (e.g. "Haus"), morphological information (a word completed with article and plural form, e.g. "das Haus, die Häuser"), derivations (e.g. "das Häuschen" and "häuslich"), idiomatic expressions (e.g. "jemandem ins Haus platzen"), and footnotes. The latter class concerns information about a specific word meaning and includes compound words (e.g. "Hausfrau"), collocations (e.g. "in einem Haus wohnen"), a list of adjectives which typically go with this noun (e.g. "baufällig“, „renovierungsbedürftig“), constructions which describe the use of a verb together with a noun or a preposition, and a picture. Words will be grouped into associative and semantically related word fields. These fields will be visualized as interactive graphs, where nodes represent the words (word entries) and edges are annotated with information explaining the difference between related words.

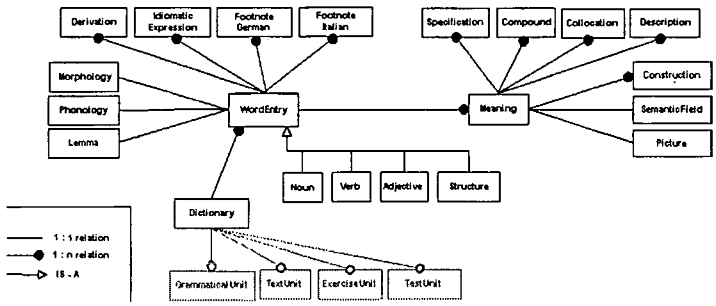

Figure 3: Data Model

Most of the above mentioned pieces of information are complex units each of which might be composed of a definition, a pattern, a translation, examples, explanations, and comments. For instance, a collocation consists of a pattern, a translation, and an example (see figure 2).

The basic data model will be extended by several new classes of information units: extensive grammar units will provide grammatical background; exercises, tests, and text material will allow the learner to practice the acquired vocabulary and to train both reading and writing skills (gray part in figure 3)

4. Towards an Adaptive Vocabulary Acquisition System

In this section we discuss two extensions of the basic ELDIT system: adaptation to individual users and systematic vocabulary acquisition. We are currently implementing these features, an evaluation remains future work.

4.1 Adaptation of Information Presentation

A great advantage of hypermedia systems is their ability to be combined with adaptation techniques. This allows to adapt the system to individual users and to provide each user with the content which best fits his/her needs and wishes. Various user features have been identified to which the content presentation of the ELDIT dictionary should be adapted.

First of all, the user's language skills and knowledge should be considered. A novice should not be faced with too many different word meanings; collocations and difficulties concerning specific words are much more helpful. An advanced learner wishes a more comprehensive picture of the language and needs more word meanings as well as a precise definition thereof, free combinations, and lots of idiomatic expressions.

The second idea of adaptation concerns language for special purposes. The current version of ELDIT covers standard German and Italian, which is sufficient in many cases. However, people in South Tyrol are more and more required to use the second language at work, which means that professional terminology becomes increasingly important. Therefore, ELDIT should support the learning of languages for special purposes, e.g. by adapting the examples to the individual user's background, occupation, business, or interests.

There are several meaningful ways to adapt the presentation of the information to user preferences. Different users might focus on different pieces of information when they access a new word. ELDIT can record each user's actions. If certain preferences are observed, the system shows the preferred information immediately, e.g. if a user almost always listens to the pronunciation of a word, the sound-file can be activated automatically every time the user accesses a dictionary entry.

Another user feature for adaptation is the possibility to use the ELDIT system both as a monolingual and as a bilingual dictionary.

4.2 Systematic Vocabulary Acquisition

We will now describe our ideas concerning the extension of the basic dictionary to a tool for systematic vocabulary acquisition. In order to retain the acquired vocabulary, „the learner needs to have opportunities to produce target language output" (Chapelle 98). ELDIT will be enlarged with text units for studying and practicing the vocabulary. The words in the text units will be linked to the corresponding dictionary entry, and the vocabulary to be trained will be highlighted, as it was successfully done in Ridder's study about reading and incidental vocabulary acquisition (De Ridder 00). Each text contains a couple of questions. The learner has to answer these questions in his/her foreign language, which serves as an indication whether he/she has understood the text and whether he/she is able to use the vocabulary.

Furthermore, all word entries in ELDIT will be categorized in various groups. Such groups are, for example, the words belonging to a particular text or a specific domain, semantically related words, or the associative field. The ELDIT system will then support the following approaches:

- *Vocabulary acquisition by word groups*: The user can study a group of words and afterwards practice the acquired knowledge with a text.
- *Vocabulary acquisition by texts*: The user can choose a text, read it, check the meaning of unknown vocabulary in this particular context, try to answer the questions, and finally systematically explore and memorize the meanings, the usage, and the context of the unknown vocabulary.
- *Repetition of vocabulary*: The user can decide to repeat the formerly acquired vocabulary and practice it with a text.

In every situation the user can ask the system to choose an appropriate vocabulary group or a text that matches best. When choosing a text the system takes into account the frequency of known and unknown words within the chosen text as well as additional data stored in the user model.

5. Related Work

A large number of CD-ROMs and web-based tools for language learning are available, but very often these tools are just one-to-one copies of printed textbooks. Only a few systems exploit the potential of modern hypermedia technologies in a meaningful way (Gamper et al. 01). Closest to our work are the vocabulary acquisition system CAVOCA (Groot 00), the dictionary Alexia (Selva et al. 97), and the adaptive language learning program CASTLE (Murphy et al. 97).

ELDIT provides more possibilities to apply, practice, and repeat the acquired vocabulary than CAVOCA. With approximately 3000 words our system contains far more dictionary entries than the monolingual system Alexia, which contains about 200 word entries. Regarding the design, both Alexia and ELDIT visualize related words as interactive graphs. ELDIT is a bilingual system and covers two languages not yet covered by the other two systems. Furthermore, the inclusion of adaptive components is planned.

CASTLE (Murphy et al. 97) is one of the few adaptive language learning programs. The traditional grammatical approach is combined with a more functional communicative approach. ELDIT mainly differs from this system in its systematic approach to vocabulary acquisition, communicative components are provided as short dialogues which are included as illustrative examples.

6. Conclusion

In this paper we presented an ongoing research project concerning the development of an adaptive vocabulary acquisition system. The system consists of a learners' dictionary which contains about 3,000 word entries for the Italian and the German languages. The design of the dictionary is motivated by modern psycholinguistic theories - such as the mental lexicon – which help the learner to remember more easily the acquired information. The basic dictionary will be extended with texts and exercises, and a systematic vocabulary acquisition process based on individual user interests and guided by the system will be provided.

New media are explored in various ways in order to support information access and presentation. Hypertext and multimedia features allow new ways for structuring, linking and presenting complex knowledge and information. Word entries as well as the various pieces of information composing a word entry can be organized, connected, and grouped in a non-linear way, which brings different views to the world of words in a dictionary. The presentation of the information can be tailored to the individual user needs. Visual and acoustic elements support knowledge transmission. Electronic search features provide a fast and efficient access to the information, which is a very important issue in dictionaries.

Future work includes the extension of the basic dictionary with text units and grammatical units as well as a systematic and comprehensive evaluation of the system.

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In Search of a Web Course Management Tool: Selection and Evaluation of web course management tool

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Introduction:

With the Internet's rapid growth, the web has become a powerful, global, interactive, dynamic and democratic medium of learning and teaching at a distance (Khan, 1997).
The significance of using the Internet for instructional purpose lies in its power to deliver large amounts of information, accessible to users worldwide in an open, non-linear way that provides alternative options during learning. The Internet's capability for real-time interaction makes distributed and distance learning, more viable for fulfilling education needs. This paper reports the findings of an extensive evaluation of web course management tools. The purpose was to determine the best use of these tools to facilitate the creation and administration of online educational environments for higher education.

Background:

Higher education institutions are experiencing an increasing demand for technology-mediated learning. Reduced costs and increased functionality are allowing more and more academic decision makers to justify technology-mediated learning initiatives. One of the fastest growing areas in the technology-mediated educational arena is the use of the Internet by colleges and universities to enhance face-to-face courses with online components and to deliver some courses completely online.

The purpose of the evaluation was to help Syracuse University (SU) make informed decisions with regard to how best the university can support the development and deployment of web-based courses and support materials for courses. This research study helped to identify a robust set of features that support teaching and learning online. The Technical Issues Subcommittee of the Online and Distance Learning Study Committee at SU examined a number of web course management systems and tools (altogether 12 systems were demonstrated and considered). The committee then evaluated three leading Web Course Development Tools to determine the extent to which each one of the three packages provides the desired features.

Method:

Three vendors were invited back for more detailed development demonstrations and tryouts using a standard test course resource module. Vendors were given one week to develop a course prototype based on the test resource module. A representative student population evaluated materials developed by vendor representatives because we wanted to include student reactions and impressions as part of our evaluation. We were especially interested in faculty reactions and impressions because successful integration of such materials depends on faculty perceptions and support. For that reason, faculty were asked to develop a course framework and materials for the elaborated lesson in order to find out how well they think these tools might be used to support their teaching and how easy they were to use.

We selected a resource module that would be easy to understand, that could reasonably involve a variety of media and file formats, that would involve a variety of learner interactions, and that would have no particular bias towards any school or department. A course entitled "Working at Syracuse University" became the test course with a lesson on "Parking at SU" as the elaborated lesson to be developed within that framework using the candidate tools. The Technical Issues Subcommittee developed the materials in the resource module.

A survey was developed and administered to gather reactions both from faculty and students. It included specific questions regarding the candidate tool in terms of:

- Planning and Design;
- Management;
- Customizing and revision;
- Levels and variety of interactivity;
- Administrative features;
- Student support tools;
- Multimedia support; and,
- Other related online course development and management issues.

The specific purpose was to exercise and evaluate the capabilities and features of an environment for hosting web-based course materials. We did not expect any single environment to provide all of the functionality required for all learning needs nor did we expect any single system to satisfy all the users in the institution. We proceeded on the assumption that many web-supported courses and lessons will involve many of the same characteristics introduced in this sample lesson. The point of this exercise was to evaluate a web course management tool - not to evaluate the content or pedagogy in the resource module. We were interested in faculty and student reactions to using the tools, especially with regard to those aspects and capabilities they found easy and worthwhile and those that caused difficulty and were not meaningful.

The innovative aspects of this evaluation schema relate to its user-centeredness. The criteria, nominations and the overall evaluation plan were solicited from the users. The evaluation was in depth and was designed to provide an outline of activities that exercise desirable features of an idealized product. The was achieved by:

1) a scripted demonstration of the courseware product presented by the product vendor;
2) A hands-on evaluation by faculty and staff members who also used the system to prepare and present a sample course with the assistance of experts from each vendor; and
3) A hands-on run through by students to simulate the actual presentation of the course as it might be presented over a term.

Conclusion:
This paper has reported an extensive evaluation of various web course management tools and technologies. The evaluation included structured tryouts with a representative faculty group as well as student evaluation of a number of different learning environments. While some tools were easy to use they were overly restrictive. Others were very flexible but more challenging for novice users. Paradoxically, the focus shifted from tool capability to a much wider context.

The university technical sub-committee recommended an integrated approach to developing a campus-wide learning environment for supporting and maintaining high quality online courses and course materials. The focus was not on a single web course management tool, although several are now centrally supported. Rather, the focus ended up being on flexible processes and procedures for designing effective online courses.

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The on-line course will get better!
How to minimize critical success factors for on-line courses

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Abstract
The results presented here are part of a larger study, organized in the Department of Post-Graduate Studies at the University Anhembi Morumbi, Brazil, that investigates and defines the borders, models and didactic strategies of a ciberpedagogy for on-line courses. I highlight cases of on-line student performance and the difficulties encountered being in large part due to individual profiles and the ability to adapt to the context of virtual learning. I propose a customized process for the development of online courses, trying to include individual elements to minimize critical success factors for distance learning.

Why do we have to think about this?

Sophisticated systems of interaction and of content development, games, colorful, atractive and fun interfaces have been coming onto the virtual learning scene more and more.

In our courses there is a difference in the way interfaces are treated and the attention given to teacher-student communication. Virtual learning environments, where on-line courses and educational virtual activities occur, must be different in a way that they are distinguished from simple pages or standing information pools, in order to yield a good pedagogical outcome.

This is accomplished primarily by the current Internet interactivity facilities. In order that interactive tools effectively implement communications and involvement with reflection and shared activities, some skills are required as related to the way subjects behave when facing such environments and interrelating peers and tutors.

The objective is not only to catch the students eye, but also to keep him going in the course after his initial desire to participate in an online course. We notice that such resources and visual stimuli make the job of teaching easier, but are not enough to make learning really effective. Therefore it would appear necessary to create a stricter relationship between the graphic interface and methodology of human communication of the course and the personality of the student. As well as these, other factors to be taken into consideration are the student's notion of what it is to learn on-line, his ability to adapt to the virtual universe and his expectations regarding his personal performance in the course.

In a paper presented by Moore (2000), she writes about not so good results of on-line courses: "many major investments in technology-based learning have not been used as planned

- 25% of users abandoned training after registration
- 75% participated actively at the beginning
- 85% did not complete the course" (see Moore 2000)

So we can not stop thinking about this problem.

The argument

What could be proposed is the development of more specific and coherent teaching methodologies, which bring interactive and multimedia resources together with a sensitivity towards the student's learning profile. In this sense we could be heading towards a future context of customized courses, where success would depend upon the harmony between the content and resources and the student's psychological profile and his adaptation to the virtual surroundings. I base my suggestions in the observation of student performance in post-graduate courses in the fashion department, throughout all of brazil, which demonstrate particular needs regarding the attention given to students, needs beyond the mentor's performance.

Students can be:

- more proactive or more dependent on orientation;
- more interactive or less interactive;
- more cooperative or more individualistic;
- more apt to research on their own or to more stationary learning;
- more likely to take decisions or not;

What should we do?

The students would be put together in groups using different profiles, and from there the class activities would be based on these profile groups.

Activities can be structured to:

- use more problem solving ability or less problem solving ability;
- be more spontaneous and intuitive or more target-oriented
- be more communicative and collaboraation-based, or more individual
- use more simulation devices or more research based activities
- develop more strategical thinking or to give directives;
- be more productive or observational;
- be visually more attractive or sparse use of graphics
- be based more in the exchange of ideas and debate or based more in individual capacity for production

Last considerations

Learning goals must be defined with human intervention. The role of mentor must mean a management attention like a value-adding activity. The mentor of online courses must domain interpersonal sensitivity, and teamwork organizational sensitivity. Thus through written communication the mentor can manager virtual group dynamics and build credibility for distance activities.
Therefore in the development of online courses what should prevail and help to minimize the critical success factors is the presentation of a variety of different activities which attend to the different needs of the students.

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Virtual tutor training – The JOB Experience

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Abstract: The JOB project (JOB, 2000) was a European funded programme run between January 1998 to June 2000. This involved a consortium of partners in Birmingham, UK, and a network of transnational partners across Europe (GATE, 2000). The aim of the project was to develop remote vocation guidance to disabled people in their own home, fully utilising computer mediated communication. One of our concerns was about how to prepare tutors to work remotely, through Computer Mediated Communication (CMC) and as a result we developed our own Virtual Tutor training within JOB. This was accredited through the Open College Network of the West Midlands, and consisted of 5 units up to level 3.

Since 1998, over 120 Virtual Tutors have now been trained. Learners have been recruited from Higher Education, Further Education, Adult Education, health and social care and some unemployed people from disadvantaged groups. This programme is accredited and is delivered remotely using Computer Mediated Communication. Our evaluation indicates that this has been a positive experience for the learners even though, for some, it has been a steep learning curve particularly around mastering technology. In this paper the key issues for learners are described.

Introduction

The JOB project (JOB, 2000) was a European funded programme run between January 1998 to June 2000. This involved a consortium of partners in Birmingham, UK, and a network of transnational partners across Europe (GATE, 2000). The aim of the project was to develop remote vocation guidance to disabled people in their own home, fully utilising computer mediated communication. Partners in Italy also worked on developing tele-guidance, partners in Italy, Spain and Finland worked on aspects of tele-training and partners in Finland, Spain and Italy also focused on tele-work opportunities.

Across Europe we were bound together by our user group (people with disabilities) and our use of Information & Communication Technology to enable people to access services where and when they wanted to.

In the UK one of our concerns was about how to prepare tutors to work remotely, through Computer Mediated Communication (CMC). The steering group had all been previously involved in a CMC programme and had completed remote Computer Mediated Tutor training at a London University. This training was focused on the need of lecturers in Higher Education and it was felt that as we were working with a very different client group our needs, therefore, were significantly different. Thus we developed our own Virtual Tutor training within JOB. This was accredited through the Open College Network of the West Midlands, and consisted of 5 units up to level 3.

Since 1998, over 120 Virtual Tutors have now been trained. Learners have been recruited from Higher Education, Further Education, Adult Education, health and social care and some unemployed people from disadvantaged groups. This programme is accredited and is delivered remotely using Computer Mediated Communication.

We have feedback from 47 learners (37%), requested halfway through the programme and at the end. The evaluation documents have been reviewed and key features extracted from these. Additional material has been extracted from the archived on-line study rooms of each of the groups.

The Virtual Tutors programme:

'CMC has a lot going for it as to when I work, reflection time on what I post, I can change my work as many times nt, I don't have to join in with everything that is going on. The atmosphere is relaxed, I don't feel pressurised to compete.'

Aim of the programme:	*To facilitate the transfer or adaptation of teaching and learning skills to a Computer Mediated Communication (CMC) environment and to enable the development of new skills required to work effectively within an electronic campus*
Objectives	*Include gaining experience as a learner within CMC: identifying benefits in education and training: exploration of teaching and learning styles and adaptation to a CMC environment: curricula development: explore confidentiality, student support, engagement, copyright: working without the benefit of non-verbal communication.*

The Virtual Tutor programme runs over a 15-week period and learners are expected to study for 3 to 4 hours a week. This is a remote programme and tutors work in the same virtual college as the JOB students – their future potential clients. The Virtual College was designed to accommodate a Computer Mediated Communication (CMC) methodology and was built using Lotus Notes. The Virtual College consists of a study room per group, common room and library. Each of the learners have a copy of the Virtual College on his/her own desktop. The is a collaborative programme (each of the learners starting, and working through, the programme as part of a group), but this is set in an asynchronous medium thus giving people the opportunity to work when they want or were able to.

The Virtual College was designed to extend the learners *possibility space*. *Possibility space* is a space where all our ideas live before we bring them into being (Battram, 1996). When we explore ideas we explore possibility space, which is indeed in our mind. We do this using language because, according to Battram, the world we inhabit is constructed in language. Ones own *possibility space* is very small in the scale of things, but joined to other peoples *possibility spaces* we can create a massive expansion of views (and visions?). We have all experienced at some time the 'buzz' of exploring an idea with a group of enthusiastic people, and this idea turning into reality made possible by the joining together of different perspectives built on different experiences.

How do we join together our *possibility spaces*? For this we need a *search space*. This is an environment that allows people who would otherwise never meet to get together and discuss common issues. This can be in a face-to-face environment but applies favourably to the context of a CMC environment – our virtual college.

Technology:

Not all learners on this programme were introduced to the concept of CMC in the same way. The range of help in getting started ran from being sent an installation manual and a CD to attending a Induction session and being helped to load the technology. In addition, learners recruited to this programme were found to have a range of Information & Communication Technology (ICT) skills, knowledge and experience (from no experience to very experienced). The 2 extremes are demonstrated by the following quotes:

A learner with no *'Well I have to say that I have amazed myself.... I have been such a technophobe*

prior experience: *for years and I have really enjoyed getting to grips with this machine!'.*

' I started the course as a disgruntled sceptic – I thought the programme looked a bit tacky (I am one of those sad individuals who goes for flash over function) but as time progressed I grew to develop a mild fondness for the simplicity of the programme'. **An experienced user:**

Each of the extremes brought different issues to the delivery of the programme. For the learner new to ICT some of the introductory activities created difficulties in themselves. Changing symbols to text (in order to demonstrate that computers don't always receive messages as we have sent them) is a good example of this. One learner wrote *feel sufficiently frustrated to think about why I was doing all this; and then when others showed me the way through by their understanding or accidental discovery of the 'answer', I learnt something I wont forget!* Others write about the positive aspects of the programme compensating for the steep learning curve required in mastering the technology.

The technical difficulties, writes one learner, appear to be at the beginning when people are stressed. Once that is over 'the programme seems beautifully simple when used for discussion, and quite effective in learning ICT skills off other participants'. However, for some rising to the challenge of the technology in order to engage in study may not have been worth the perceived gains of succeeding in the programme of learning. This may be why we saw a relatively high dropout rate during the first 2 weeks of learning.

Can we apply theories of compliance to this problem? Compliance in medical terms is about patients following a prescribed treatment. 'Compliance denies the right of a patient to be heard and freely decide that he would rather accept his disease than the tedium of taking his medication and suffering the side effects, which on occasions may restrict the patients life style more than the disease itself' (Henry, 1985). This can equally be applied to learning. ***The challenge of becoming competent within a CMC environment may, for some people, be worse than not becoming knowledgeable about the subject area of the learning programme.***

For those who were experts or skilled in the use of ICT, the tutor felt that the issues were to do with trying to get the learner to **change the focus** from the medium onto the curriculum. Many were able to do this but unfortunately a few were not. Of course other variables come into play here, not in the least the existence of any pre-course teacher training and subject specialism.

Getting Started:

As already discussed, learners had a varied introduction to the virtual college, CMC and the technology. The most a learner received in the way of induction was a 3-hour session where we discussed the principles of CMC, talked about the programme, guidelines for being an on-line learner and demonstrated the system. No learner was given 'hands-on' experience at this point. Some learners received nothing other than the handbook and software.

One of the big issues at this time is lack of prior knowledge or visualisation of what on-line learning means to the learner. It is difficult to imagine how 'it' works or what is required. Therefore the expectations of learners are not well formed and generally, in this programme, were about finding out what on-line learning was about and experiencing it. This led to the need to lead, advise, encourage learners through the programme until they were responding speedily to activities, and each other, and had picked up techniques for working effectively in this medium. For all groups progress into a 'comfort' zone was at different rates. Some groups 'gelled' early while others didn't 'gell' at all. The factor that considerably affected this *appeared* to be the combination of personalities within the group.

Most learners in the review expressed the desirability of meeting face-to-face early on, even though some people had a really good experience and very much enjoyed the programme having never physically met the facilitator or the other learners within the group. However, many also identified the need for programmes to be delivered totally on-line, without dependency on initial meetings, for the sake of inclusion of the people from disadvantaged groups or who lived to far away.

Group size and other practicalities:

The group size: The majority of learners felt that a group of 10 was a desirable number to work with in CMC. This is small enough to keep up to date with all entries and get to know fellow learners. Smaller than this and learners commented on feeling exposed (as happened in peak holiday periods) and more than this and it would be difficult to get a feeling of group cohesion. In addition, nearly all recognised the pressure of work that bigger groups would create for a tutor/facilitator working in this methodology.

When learners engaged in the programme: The majority of the learners on this programme were working full time. Nearly all reported working late at night and for some this was really good in that they could settle down and relax while engaging in the programme. For others who worked up until 9 p.m. at night (for example those employed in Adult Education), sitting down to study when they came home was seen more as a chore and learners felt less able to give of their best. Replication data indeed shows that the most popular time for learners (and the tutor) is between 9 p.m. and 11 p.m. and daytime Sunday.

How long learners worked every week: Learners were asked to work for 3-hours a week over the 15-week period. The majority of learners reported working for up to 10 hours a week and reasons for this was the amount of reading and responses required, the time it took to formulate responses when keyboard skills were not well developed and, most importantly for some, the enjoyment factor.

Theories of *flow* may contribute to the time learners spent in study. According to Csikszentmihalyi, (in Jenson, 1995), optimal learning requires a state of consciousness known as *flow*. This is where one loses oneself in performance and where time passes very quickly because one is absorbed.

Group work and Collaboration:

Collaboration appears to be a double-edged sword! This programme was seen by the developer as one way of enabling busy people to access learning when able to. It is designed to fit around social, work and family life and accommodate fluctuations in health and availability etc. Indeed the majority agreed that this was one of the great advantages of CMC.

However, one learner writes: 'One problem is that the need for collaboration enforces the need for everyone to work at the same rate for the success of the learning to occur.' In addition, when learners were absent for any period of time through going on holiday, pressure of work or ill health, they often found the amount of discussion to catch up with was considerable. Even ignoring the unread documents in favour or joining the new activities made learners feel anxious as the unread entries constantly showed up in the system in another colour – a constant reminder of what had been missed.

In spite of this, the majority of learners were very positive about the group and collaborative nature of the medium. One learner writes *'I have found the collaboration/communication issues particularly challenging (and quite* and another *'Being put in such a diverse group has been a great experience, differing perspectives have broadened my considerations'*.

Further advantages appeared to be seen as *'Loads of space for individuality and time to hide behind someone else sometimes while you think things through'*. A great advantage!

What do learners need in order to be effective within a collaborative environment? Harri-Augustine & Weble (1995) believe that learning operates on the 'edge of chaos' which sits between 2 states known as **order** and **chaos**; two extremes of behaviour. In **order** we demonstrate predictability and don't adapt to change. We use the same pattern of responses over and over again. We are complacent and unresponsive. The opposite of this is **chaos**, which is a system of **disorder.**

Between **order** and **chaos** we find **complexity**. This is a state now recognised as allowing information to organise and reorganise itself to increasing degrees of sophistication. This is the state that allows a person to construct new and more complex meanings.

What meaning does this have to CMC learning? The approach used in the asynchronous, collaborative on-line learning environment is one of constructivism. Within this the learners are facilitated, through on-line activities, to collaborate towards a shared goal. The learners themselves are viewed as the greatest resource, each bringing skills, knowledge and experiences that are used to formulate differing perspectives, influences and approaches to the activities. Thus learners organise and reorganise information, or in other words, construct new meaning.

Jenlink & Carr (1996) would also argue that the discussion used within collaborative environments had to be *design conversation*, as opposed to discussion. This is defined as being goal related and focusing on creating something new. It facilitates contributors to extend their capacity to hear and inquire into other peoples perspectives.

Tutor / Facilitator:

This programme has been heavy on tutor time with, on average, the tutor being available for 5 hours a week. This has been more at the beginning of each programme and less towards the end as learners develop skills in collaborative practice. The majority of learners have made comments about this (both within the programme and during reviews). The majority has appreciated the constant feedback and encouragement given by the tutor and this has appeared to be a big factor in retention of learners.

Many learners have also commented on the tutor as a good role model. However, this has also led to many concerns that the learners had about being able to replicate this role, partly because of time constraints. Concerns were also expressed about whether or not Organisations and/or managers would allocate the right amount of tutor time to development and delivery on-line. The reality of embedding this methodology within mainstream services has always been a concern for learners within the programme.

'I have not particularly missed face-to-face – but I think this is because the tutor is quite a good responder and you always feel she is there.'

Learners tended to like the time limits set for each activity (posted on a Sunday with a deadline of the following Friday). A range of styles was used from individual activities, discussions of a collaborative nature that were summarised by a learner, group product development and small group-work. Although the small group work was the most unpopular (mostly because of the time it takes to form into groups) a lot of learning took place overall from this (often negative) experience.

Finally:

'I feel as though I have learnt as much, if not more, on this course than if I had worked on a face-to-face basis. This may well be due to the time for reflection and the fact that I have been able to read everyone's c

For those who completed the programme there is a sense that this has been a positive experience even though there have been steep learning curves for some, particularly around mastering the technology. Learners have used the words 'positive' and 'challenging', as descriptors of the programme in general but the authors would also add 'fun' and 'enjoyable' as a further two descriptors. Humour has been used to motivate and further engage learners and learners have responded well to this.

Some really serious issues have been discussed in this programme, and these have included current practice around copyright. This has been a big issue when applied to on-line learning and a surprise for many that such tight boundaries exist. In addition, several learners have been keen to debate the cost of on-line learning for Organisations and the issues around how funders view this methodology. Finally, on-line learning assessment has been widely debated and interesting perspectives have emerged for further consideration by all.

This has been a very positive experience for the learners, tutor/developer and managers. The programme is now available within the mainstream services offered by the originating College of Further Education and in demand by those who see the changing face of education and training within the developing new age. The final words we leave to a learner.

'..this is a new methodology and we have a ground floor opportunity to help with getting it right. I hope that between us we can help, if only in a small way. It has helped me, certainly, through a changing time in my life. Not only have I made new friends, but I have also learned a tremendous amount, not only general knowledge but about myself. I have moaned a lot, but hopefully for the right reasons and in a constructive way, because I would like to be part of it'.

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Further Information:

http://www.learn-net.co.uk

The Necessity of Considering Cultural Influences in Online Collaborative Learning.

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Abstract: This paper utilises a model of technology-mediated interaction to highlight the importance of social interaction in the construction of a collaborative online learning community. Learning communities are built around relationships. There are many factors that impact on the ability of social interaction to create social comfort and the capacity for mutual consideration in an online learning community. This paper will address the importance of understanding the impact that cultural influences have on the creation of a positive and successful learning community. An understanding of cultural influences has the potential to alleviate some of the misunderstandings and misinterpretations that can occur through such lack of knowledge. Through consideration of cultural influences, social interaction can increase the potential for collaboration and successful attainment of quality learning outcomes. Knowing this, how can we accommodate these differences into our courses?

Introduction

The potential of the Internet to enhance learning through online collaborative learning communities is partially constrained by our understanding of cultural influences that support a framework for ensuring effective collaboration. Research, by Kirby (1999) and Hiltz (1998), clearly points to the value of interactivity and collaboration in any learning community where the exchanges are not only active but also interactive. Three essential attributes of an effective learning community are active learning in construction of knowledge, positive interpersonal relationships and rich discourse among participants in promoting their learning. The online learning environment through the use of appropriate technologies provides an opportunity for interaction and collaboration, which can lead to quality learning outcomes. The technologies that can mediate communication in order to develop such attributes must have a global reach. The effective online educational environment of the future will need to contend with audiences of diverse backgrounds and particularly audiences from a wide variety of cultures.

Literature Review

Although as human beings, we communicate with others in many ways and across many mediums, communication is not always easy, even when we feel we know the other person. Cultural influences are often at the root of the communication challenge (DuPraw & Axner 1997) where misunderstandings and misinterpretations occur. Interaction and collaboration become much harder when communicating with total strangers in the online environment. With our first utterances online we all experience fears of being judged and misunderstood. As well as this we bring our prejudices and biases with us into our discussion. Our cultural background can shape the way we participate in discussion, how we understand the world and how we may approach problems. A key component of effective collaborative efforts is social interdependence when individuals share common goals and each individual's outcomes are affected by the actions of others (Johnson & Johnson 1989). Positive interdependence is at the heart of any learning community where learning is as much based on relationships as it is on intellectual discourse (Johnson & Johnson 1998). Exchanges at a social level provide the foundation on which relationships can be built and determine how individuals will interact with each other. This emphasises the importance of gaining some knowledge about the other participants in the learning environment. We need to feel socially comfortable and develop the capacity for mutual consideration in order to become actively engaged in collaboratively supporting each other to develop skills in reasoning, critical thinking, hypothesis formation and reflection. Such social comfort may be achieved by providing time in the course where students can share aspects of their cultural background.

The amount and quality of interaction in a student-centred environment play a key role in the learning process as well as having a significant impact on the learning outcomes. When focusing on pedagogical issues, much has been written about the value of fostering collaboration and cooperation (Agostinho Lefoe & Hedberg 1997). Communication technologies are providing the opportunity to connect people and to foster collaboration and discursive exchanges on a vast array of topics. They are used to build relationships and to provide the scaffolding that guides, supports and develops the construction of knowledge leading to quality learning outcomes.

Johnson & Johnson (1996, 1998) have provided a strong theoretical basis for cooperative learning as outlined in cognitive developmental, behavioural and social interdependence theories. A pedagogy engendering cooperation might require students to work on an agreed, explicit, common goal, which is then sub-divided into component tasks on which the students will work individually until completed. The result is a combination of the individual efforts. Collaboration goes a step further where there is continual interaction and discussion related to the goal. Individual tasks may be relegated and distributed according to abilities, but the goal requires that individuals cooperate and construct shared understanding and knowledge. Through constant interaction, individual efforts are merged resulting in the culmination and achievement of a common and explicit goal. Collaborative interactivity is a combination of collaboration over learning tasks and rich discursive interaction.

Students learn best by interacting with others, rather than working in isolation. Wittrocks' generative learning theory, now popularly termed constructivism, also attempts to add support by explaining that people learn best when working together (Susman 1998). Students motivate and encourage each other to remain focused on the task. The resultant interactivity leads to knowledge building, which requires "articulation, expression or representation of what is learned" (Jonassen 1999). Such thinking is aligned with current conceptions of constructivist learning. Out of the notion of discovery and exploration has emerged research on interactive and collaborative learning around meaningful activities. Of particular interest in this paper is the social interactivity that underpins collaborative efforts.

Model of Technology-Mediated Interaction

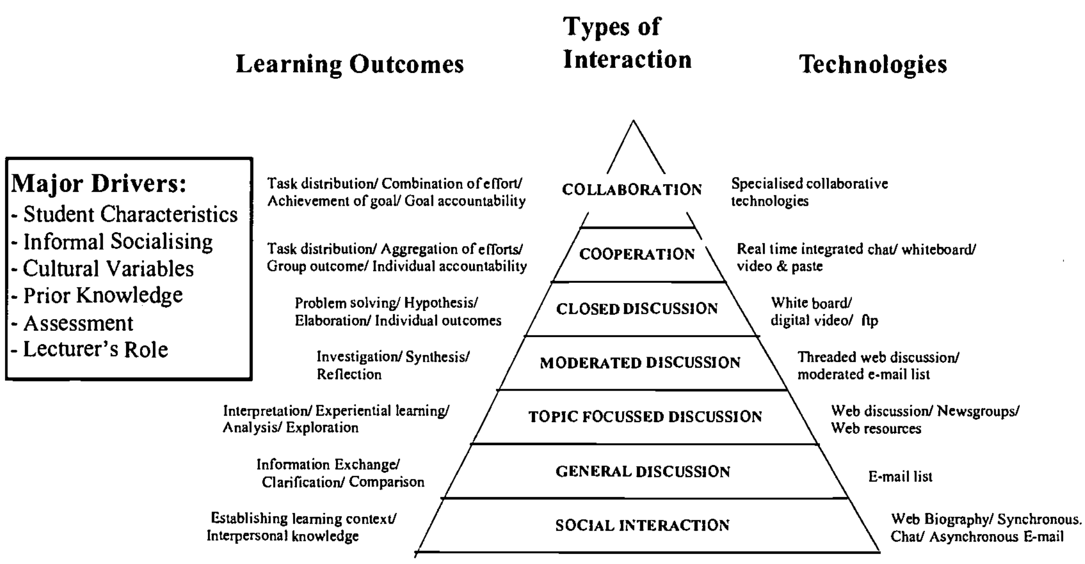

Figure 1: This model of technology mediated interaction indicates the hierarchies of interaction, technologies and learning outcomes, together with the influential drivers affecting learning outcomes.

The Model

There are many external factors or drivers that can impact on the effectiveness of collaborative interactivity and associated learning outcomes in the online environment where time and place are no longer prescribed. These drivers can include cultural variables, student characteristics, informal socialising, prior knowledge, assessment, the available technologies and the lecturer's involvement. The model, (Figure 1), has been developed in order to explain the relationship between the types of interactivity that can occur and the suitability of various technologies to support interaction. The term "technology-mediated" has been used to characterise interaction through the use of Internet technologies. It also is an attempt to describe a progression of learning outcomes achieved through interaction that show a shift from surface to deep learning (Ramsden 1992).

The model is portrayed in the shape of a pyramid with a series of levels building on from each other and leading to collaborative interactivity at the apex. It is expected that the higher the level, the greater the quality and frequency of interaction that will occur. Collaboration is surmised as currently providing the highest level of meaningful interaction and engagement through the use of sophisticated and often specialised multimedia communication tools. It is not expected that every course will incorporate all levels of the pyramid. However it provides a conceptual framework in which you can identify the entry point of the type of interaction required, utilising the various technologies that support such a level and ensuring that relevant learning outcomes are being achieved.

The Importance of Social Interaction

Social interaction forms the foundation on which all other levels of interactivity are dependent. Web biographies, synchronous chat and asynchronous email can be used to provide opportunities for self-disclosure, an understanding of social behaviours and the capacity for mutual consideration. Interpersonal relationships are critical in a collaborative learning community, as the more individuals care about each other, the harder they will work to achieve a mutual sense of accomplishment. Many of the studies on interpersonal relationships in collaborative learning environments come from the traditional face-to-face framework where socialisation has its place outside of the classroom. As this is not possible in the online environment, social interaction must be built into the course design. Informal or social exchanges have the potential to alleviate some of the misunderstandings and misinterpretations that can occur from the lack of social cues and face-to-face interaction. Informal exchanges help students get to know each other. The view is held that unless opportunities are provided for participants to engage in this type of social exchange that interaction will only occur at the lower levels of interaction and learning will be impeded in achieving the higher learning outcomes. Unless we cater for social interaction as we move up to levels of collaborative interactivity, the pyramid will not be supported. Sophisticated technologies will be unable to support the higher levels of the pyramid without the foundations established for interaction.

Social interaction helps to create a positive online learning environment, by fostering trust and respect amongst learners. Social exchanges help to overcome some of the awkwardness and the reticence that learners feel in communicating with unfamiliar persons on a more formal basis (Romiszowski & Mason 1996). The social community that is created during the learning process can impact on the nature of the learning activities and the learning outcomes (McLoughlin 1999). Information about other learners in the group help to create solidarity, understanding, trust, respect, commitment, and develop standards of group conduct. Instructors are recognising the value of incorporating a communication space into the design of their courses to facilitate interpersonal exchanges, and increase the comfort of students in their exchange with other students. Muffoletto (1997) used web chat to combat feelings of isolation. Hughes & Hewson (1998) and Hiltz (1998) recognise the value of informal socializing and have created the notion of a "Coffee Shop". There are numerous factors that can impact on how learners interact and relate to each other. They include learner characteristics, demographic details, prior knowledge or education level, technical skills, literacy level, verbalisation and cultural background.

Cultural Factors

An appreciation of cultural differences can assist the process of social comfort and respect of others. Students of different cultural backgrounds may have different attitudes about and knowledge of the technologies, cross-cultural communication patterns and learning processes when learning in the online environment (Freedman & Liu 1996). Different cultures generally have different rules and norms. Through interaction we seek to reduce anxiety and uncertainty about other's attitudes, feelings, behaviours and beliefs (Gudykunst & Kim 1995). DuPraw and Axner (1997) have identified a number of fundamental patterns of cultural differences:

Different communication styles
Verbalisation is an essential skill and active participation tends to be restricted to those who are literate and are able to express themself through competencies in language and rhetoric. Many learners from non-English speaking backgrounds can have difficulties in understanding some words and phrases as well as struggling to express themselves in a foreign language. Even native English-speakers can experience difficulties as some English speaking countries can give different meanings to the same words or phrases; for example, the meaning of "yes" can vary from "possibly" to "definitely". Where language is a problem, learners find it easier to communicate in written form rather than orally. The Internet offers learners the opportunity to reflect and formulate their response, alleviating some of the difficulties experienced by non-English speakers.

Different attitudes towards conflict
Some cultures view conflict positively encouraging discussion and debate around the various viewpoints, while others go out of their way to avoid it. In many Eastern countries differences are best worked out quietly as open conflict is considered embarrassing or demeaning (DuPraw & Axner 1997). Japanese are generally reluctant to debate in an argumentative fashion in public forums (Rheingold 1998). Chinese educated in Confucianism are taught to respect teachers as ultimate authority figures whose opinions should not be challenged. Hence anyone considered to have some authority would not be questioned and students would feel nervous about interacting with him or her. "[One] student found his learning attitude affected by the look of his tutor, [and stated that] after seeing her picture [I thought] she looked like a teacher. Then I started to feel nervous while writing formal letters to my teacher" (Cifuentes & Shih 1999). Titze (2000) in her discussion on issues relating to efforts to aid foreign teaching assistants at the University of Utah noted that they are trained to have total respect for their instructors and are discouraged from asking questions in case the teacher does not know the right answer and hence would lose face. This hinders the willingness to exchange ideas and the development of competing or opposing ideas.

Different approaches to completing tasks
Cultures can differ in the value they place on task completion, how relationships are built and how they collaborate together. DuPraw and Axner (1997) in their study found that Asian and Hispanic cultures attached more value to developing relationships at the beginning of a shared project and more emphasis on task completion toward the end, whereas European-Americans tended to focus immediately on the task at hand and let the relationships develop as they worked on the task. Shive & Row (1999) in their study found that Hong Kong students took the assignments more seriously than their American counterparts.

Different decision making styles
The individual roles that learners may play in the collaborative group will vary from culture to culture and personality to personality. Southern European and Latin American cultures place a strong emphasis on having decision-making responsibilities, whereas the Japanese prefer to have consensus. The willingness to initiate ideas will be more prominent in some cultures than others and so interaction and collaboration will be more natural for some groups than others.

Different attitudes towards disclosure
People differ in what they feel comfortable revealing about themselves. Some learners have found they can disclose more online than they would in a face-to-face classroom. Blum (1999) found that female students included more personal information in their messages than males. Self-disclosure can overcome some of the awkwardness that students feel in communicating with unknown persons. A student once sent me the following e-mail; "the fact that I was expected to comment on other's work when I would not know of their situations in work or life ... nor would I appreciate anybody commenting on my work when they have no idea about my life and work". The student recognised the importance of having some knowledge of the other group members in order to be comfortable with discussion around issues in the learning environment.

Some instructors have encouraged the use the pictures so that learners have a visual image of other participants when they communicate. This strategy has been successful in a number of courses at the University of Waikato, New Zealand. On the other hand others may feel very self-conscious about displaying a their picture. Those who do not have their pictures displayed, may sense some exclusion from the discussion. Instructors need to be sensitive to culturally different attitudes to personal photographs.

It has also been argued that the anonymity of the Internet can be a real advantage. A person's age, gender and economic status can be masked within online environments and this may be a positive aspect that ensures equal participation. The benefits of online anonymity for teaching and learning have included increased equity and higher participation rates (Hartman, Neuwirth, Keisler, Cochran, Palmquist, & Zubrow 1995). On the other hand antisocial behaviour has been suggested as a consequence of anonymity (Rheingold 1994).

This conflict in determining how much should be disclosed, challenges instructors to be flexible in attaining a level of comfort for the students. In some cultural groupings extended disclosures and self-evaluations may sit comfortably with all, while in other groups learners may feel inhibited in providing more than a basic introduction. This illustrates the strong need for consideration of cultural differences and the need for flexibility in catering for the various groups. It is crucial for instructors to have some background cultural knowledge about the learners in their courses so that they can accommodate these differences through flexible approaches.

In referring back to the model, it may be important to increase the height of social interaction and allow more time for certain groups to feel comfortable with each other, while for other groups tension may be apparent in the time spent initiating social interaction and the desire to meet course expectations. The amount of time spent ensuring social comfort and mutual understanding will be dependent on the type of interaction and its related learning outcomes.

Different approaches about knowing
DuPraw and Axner (1997) identified the following differences as occurring among cultural groups. European cultures tend to acquire information through cognitive means, Africans preferred an affective way of knowing while Asian cultures tended to emphasise that the validity of knowledge was gained through striving towards transcendence. The Hmong culture has historically been about traditions of knowing rather than questioning. It is considered better not to try a particular skill and save face, just in case you fail (Freedman & Lui 1996). Understanding the learning processes used by students will assist instructors with their instructional design of the course. This knowledge is possibly best acquired by experience rather than reading a book.

Conclusion

An understanding of the culture of the learners and an appreciation of the patterns of cultural differences is important in helping instructors ensure meaningful learning outcomes for all students. Generalisations about cultures however should be avoided, as there are numerous variables within each culture. Such knowledge will provide guidance in determining the extent of social interaction needed for learners to move from more generalised discussion to more topic focussed discussion and task orientation. Consideration of cultural differences is critical at the higher levels of the pyramid in relation to the increasing complexity of the technologies, their associated learning outcomes and the necessary negotiations for successful collaboration.

The availability and complexity of multimedia technologies assist learners to move through the various levels of the pyramid. With further developments in technology, cultural specific overlays on design and language translation, may lessen the impact of cultural differences in a learning environment. However for the moment the instructor will continue to face cultural challenges in an effort to improve learning outcomes through collaborative interactivity.

This paper has attempted to identify the various cultural influences that can impact on creating a collaborative learning environment. It has not been able to provide a generic recipe of solutions for this problem. Considerable effort is needed to ensure social comfort, particularly where there might be open conflict between cultures.. Everyone brings with them cultural baggage, including the educator. We must identify methods that recognise and value the cultural differences rather than trying to discount them. Many of our educational systems are basically western, and the expectation is that other cultures adapt to the system. It becomes important to try to deconstruct the system to accommodate the cultural diversities. Awareness, adaptability and sensitivity will ensure that students feel comfortable working together in this environment. Students are more likely to be sensitive to cultural differences with increased knowledge about group members. Smallen and Leach (1999) argue that "successful collaborations are built on a foundation of respect" where respect is about building on the strengths and compensating for the weaknesses. Through an awareness of cultural influences, social interaction can increase the potential for collaboration and successful attainment of quality learning outcomes.

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Learner Led Learning in an Online Community

The central role of the learner and its benefits

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Abstact: Roles in online learning environments are changing towards leading learners or demand based learners if you wish. Learners do take ownership of their own learning process, and do take an active role in collaborative knowledge construction and knowledge sharing.
Main questions:

- How to re-engineer the learning activities in such a way that the student become a self-regulating learner, takes the lead in information gathering, uploading new information, discussions and giving feed-back to other learners and the teacher?
- What are the new role definitions and task specifications needed for both students and teachers in online learning environments?
- Is a competency-based learning approach appropriate for those students who can be given their own responsibility for proving their competencies, thus actively contributing to the assessment?

The panel will raise a discussion about the above questions among the audience and will give input and answers based on their experience.

Tasks panel members:

- Audience: input and questions on the learner led learning or self-regulating learner approach
- Prof W. Veen: lead the panel, introduction, summary

- Prof B. Collis: pedagogical changes involved with learner led learning: old ideas in new forms or something new?
- Prof S. Santema: changes in the role of teacher, the use of content and the benefits for the course caused by the use of learner led learning
- Ralph Genang: changes in the role of the students and the benefits for the course caused by the use of learner led learning

Background and input of the panel members:

Prof. Dr. Wim Veen

Background: Wim Veen roots' are geography teacher in secondary schools. He has been working at the Institute of Education of Utrecht University since 1978 where he started as a teacher trainer for initial as well as for inservice training. He has been a consultant for educational institutions and for private companies and governmental authorities.
Wim Veen is now leading the Centre of Educational Innovation and Technology at Delft University (DUT). This centre provides professional development in the field of teaching in higher education, and consultancy in curricular change and innovation for faculties.
He has been involved in a number of IT projects related to the implementation of computers in schools, the development and translation of courseware, the uses of telecommunications and policy and planning issues with respect to support of telecommunications in education.
He is currently leading an institution-wide initiative for implementing ICT in education at DUT. His work as a researcher is strongly related to the pedagogy of online learning environments.

Input to panel by Prof Wim Veen: Prof Wim Veen will draw his experiences from the online seminars he is leading for the European Schoolnet. The European Schoolnet, and other online activities within Delft University is in the process of creating virtual professional learning communities. Prof Wim Veen's contribution to the seminars aim at:

- Creation of virtual professional networks in which participants can learn and work collaboratively on educational issues related to their work as teachers, researchers and policymakers
- Building of expertise of new technologies for professional development at a European level
- Constructing of pedagogical models for effective way of collaborative learning in online learning.

He will mention the experiences and progress of implementing these ideas at Delft University of Technology. As program director of the bureau of ICT in Education, Wim Veen is responsible for the introduction of ICT in education at the TU Delft and is aware of all the problems and resistance against the increasing role of the learner in learning.

Prof. Dr. Betty Collis

Background: Since the beginning of the 1980s, she has been intensively engaged in the study of computers in education, and since the mid 1980s, of information and communication technologies in education. Prof. B. Collis is a researcher and evaluator of the impact and implementation of computer-related technology in education who also is a designer and developer of pedagogy and products making use of this technology; a theorist about technology who also teaches with the technology.

My major activity at the moment is being Chair of the TeleTOP Project,(http://teletop.edte.utwente.nl) in which my own faculty is re-designing its way of organising the learning process, through the use of a combination good pedagogy and innovative uses of technology. This initiative is particularly based upon our Faculty's experience with innovative uses of the WWW in our teaching since March of 1994; for example, see one of the courses for which I am the instructor, a course called Tele-Learning (http://education2.edte.98193524.nsf/framesform)

Input to panel By Betty Collis: Betty Collis will talk about the approach to pedagogical re-engineering, in which students are not only active participants but also contribute to the learning materials of the course.

She will enrich the panel discussion with her experiences on how student learning is evaluated at the University of Twente. Her knowledge as developer and user of the TeleTOP system - a system focused on extending the Faculty of Educational Science and Technology's innovative technological profile through integrating telematics applications in their own courses for more-flexible learning – will give input on how the University of Twente is re-using student contributions.

Prof. Dr. Mr. Ir. Sicco Santema

Background: As teacher of the Business to Business marketing classes at The Delft University of Technology, prof Sicco Santema started with Ralph Genang the B2B marketing development project on the use of ICT instruments in 1996. The first instrument was the use of e-mail as a means of interactive communication between instructor and learners. The second instrument, videoconference (PictureTel), enabled us to interact real time with learners on a remote basis.

In 1998, the use of real-media resulted in the first life online course (on the Internet) in the Netherlands. During the last three years we developed a third instrument: the learning environment. In the learning environment we created Bodies of knowledge. We divided the course material in 100 subjects. Each of the subjects represents a body of knowledge. We recorded a video clip for each subject where the instructor explains the subject in about two minutes, and we started building a database of related publications to the subjects. By the time our next course started in the spring of 1999, all the course content was available online in multimedia mode. Prof Santema did not teach in the classroom anymore. According to their own learning habits, students who use our online learning environment are free to choose the medium that fits them best, per body of knowledge and context. The content has become dynamic. The context has become dynamic. The learner has become self-regulating, self-teaching, his own communication creates his own solid foundation.

Input to panel by Prof. Santema: Prof Sicco Santema has a lot of knowledge and experience of the impact of Learner Led Learning on the teacher and the way it affected knowledge transfer in his marketing classes.

The introduction of Self-Directed Learning or Learner Led Learning did result in a spectacular educational reform. The multiple media based reform has resulted in better grades for our students as compared to the traditional classes. The commitment, time spend and the grades did statistically significant change with previous years.

Ralph Genang

Background: As developer of the online Business to Business Marketing classes of Prof Santema, Ralph Genang conducted research on the usage of online marketing classes. With a tracking and monitor tool Ralph could identify the different learning paths of each individual learner. He knew how much time students spend on the course site, how much questions they asked, how they used the answer and how the learners cooperated online and compared the results with learner paths in traditional teaching? To improve the learning efficiency and usage of online courses Ralph developed the bodies of knowledge and the dynamic content. In 2000 Ralph introduced Learner Led Learning. Next to teacher led and community led learning, learner led learning is a learning method where the learning has become a learner responsible and individual process in balance with cooperation in an appropriate context with other learners and a coach (teacher). This process is made possible through online communication in online learning communities.

Each year Ralph organizcs Ncw Media Tours to visit authoritative international Online Learning projects (universities and companies)

At this moment Ralph Genang has started a small research company in E-learning, Tri-L. He is still part-time related to the Delft University of Technology and continuing his Learner Led Learning research.

Input to panel by Ralph Genang: Ralph Genang will share his knowledge of and experience Learner Led Learning has on the student and the way it affected knowledge transfer in the classes. He created an online learning environment where students could lead in information gathering, uploading new information and discussions. The learners in this environment became each other's instructors.

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Teletop, http://projects.edte.utwente.nl

Rethinking Education: From Teacher led to Learner Led Learning

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Abstract: An educational situation implies presence of individuals, objects of knowledge, mediate and immediate objectives and methods or processes. We developed in our educational situation, the Business-to-Business marketing classes at the Delft University of Technology, a method: Learner Led Learning. In this method we challenge the learners to teach each other. We offer our learners a database with 180 subjects related to the course. The learners have to discover the mutual relationship of the subjects, they have to define their own learning path and share their ideas or knowledge with other learners and the teacher. This paper describes the process how communication of ideas and knowledge has changed in our courses from a teacher led approach to a learner led approach and the important roles of context and content in our Business-to-Business marketing learning community

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1. From Teacher Led to Learner Led Learning

In a period of three years we changed our course Business-to-Business marketing from a Teacher Led Learning environment to a Learner Led Learning environment. The change process was the result of a combination of using new media tools in our classes and monitoring the communication users (both teachers and learners) experienced and conducted through these new media.

Teacher Led Environment

This environment is also known as a lecture approach (figure 1 Gilbert Paquette, 2000). The heart of communication is the classroom. The content is fixed and preset. The Teacher leads the show. He lectures the course subjects at one place on specified times during the week. During the preset timeframe the course is given, the only continually available course material to the learners is the textbook and his or her personal notes. So the course content is limited to the book plus what the learner memorizes from the classes. The majority of learners are passive listeners. The learning path they follow is based on the index of the book and the index of the lecture given by the teacher (he most likely starts at chapter 1). This is an educational environment where education is limited in time, place, content and didactical format. There is no room for another context or no easy access for new content (notice the thick black border around figure 1). But at that time we were not aware of possible improvements until new technologies entered the classroom.

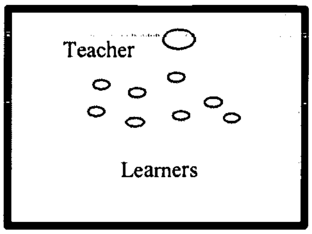

Figure 1 teacher led environment

Reason to change: Because of new technologies, new tools were introduced in educational environments. We name them community tools. Learners were able to communicate via e-mail outside class hours with their teachers. Internet gave them access to new sources of information (content). The teacher led classes were available online. Learners followed classes online from a distance and learners had a reference video of earlier classes. The community tools started to lead the learning environment: Community Led Environment (Figure 2). Slow learners and teachers got used to new technologies and used these technologies to improve their influence and "communicate" their curiosity. The thick border is gone (see dotted line in figure 2) and communication is open. Teachers can monitor how students learn, how much time they spend on certain packages; how many times individual learners ask a specific question or certain answers where understood. Since borders are gone, new content enters the course. The course site is also accessible for the industry. The industry reacts on events taking place in the classroom, the industry is invited to share the knowledge on subjects related to the course. The learners become active listeners; they give reflection and input to the teacher. For teachers the question remained: Do learners take over control?

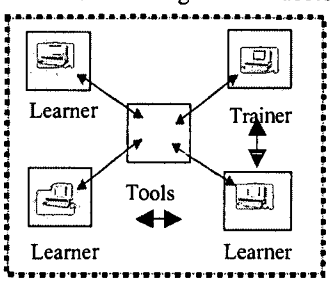

Figure 2: Community Led Environment

Learner Led Environment

This is a virtual learning environment where all the course material is available for learners at any time and any place (Figure 3). Besides that, learners have access to other sources of information. Knowledge widens and deepens as learners continually build links between new information (content) and experiences (context) and their existing knowledge base. Within Learner Led Learning the teacher does not give lectures anymore: Now the learners do, to each other and to themselves. The learners can (individually or in a groups) create meaningful, coherent representations of knowledge, knowledge they acquired through their

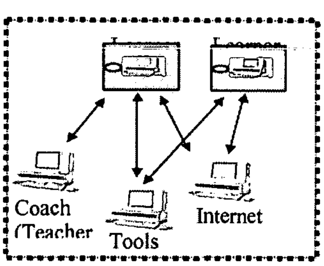

Figure 3: Learner Led Environment

own curiosity for information, knowledge they had to discover through research, curiosity, misunderstanding, understanding, mistakes and discussions amongst each other. They discovered knowledge through teamwork; joy because they found sole mates with the same curiosities and the same learning goals. A key element in the success of learner led learning is the individual learning goal. The learners are asked to describe their learning goals. What do you want to learn, how do you want to learn, how do you want to share your knowledge? The role of the teacher is to follow the learning paths of their learners and guide them if necessary. The teacher remains the responsible person for the course content. He will have to accept the situation that he could receive a question about any subject at any time. We even had situations where students found opposite theories from other marketing professors on the Internet and asked for an explanation.

The tools available in a Learner Led Environment are: textbook material on the subject, bodies of knowledge containing PowerPoint slides with streaming media explanation by instructor, with bullets on the subjects, articles (papers) on the subjects, streaming media (real media), video of last years lectures, news forums, where students can discuss a subject, cases, other subjects (if any), e.g. links to companies working in the field or famous for their marketing efforts, or links to other universities, monitoring tools for teachers, homepages for learners or groups of learners, in summary everything learners ask(ed) for.

2. The three C's in a Learner Led Environment: Communication, Content and Context

Three important aspects of Learner Led Environment are Communication, Content and Context (figure 4). These three C's make creation of new knowledge possible.

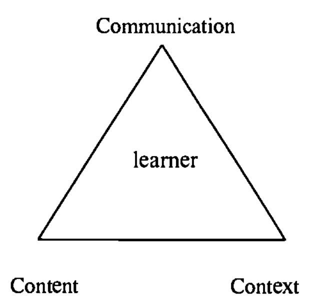

Figure 4: Three C's in Learner Led Learning

Communication, between learners through e-mail, forums, chat, workshops, f2f meetings and between learners and teachers, feedback, questions, exams, assignments. Sometimes the communication aspect is also called 'systems', especially when ICT support is needed to establish the communication.

Content, entertainment, video, text, bodies of knowledge, virtual trainer, etc. It is very important that the content or information is provided in such a format that it challenges the learners to investigate it, to explore it and to find its relations with other available information. The content should be presented as a hieroglyph, beautiful but with a lot of hidden information (Santema Genang Edmedia 2000).

Context, It is important to understand that knowledge is personal and related to the environment or the situation of the learner. It is crucial that this context information is recorded and included in the knowledge developed in this situation.

3. Conclusions

Paulo Freire had a message to educators: "I'd like to say to us as educators: poor are those among us who lose their capacity to dream, to create their courage to denounce and announce. Poor are those who, instead of occasionally visiting tomorrow, the future, through a profound engagement with today, with the here and now, poor are those who, instead of making this constant trip to tomorrow, attach themselves to a past of exploration and routine." (Paulo Freire). Learner Led Learning enables to teacher to listen to the learners and help them with support and instructional guidance to build their future knowledge. With Learner Led Learning we achieved a situation where former graduated learners come back to our environment, and help today's learners reflect their ideas on their current job positions. Borders are down. The participants build new (future) knowledge through dynamic content and build a sense of group identity, cohesiveness, and uniqueness; to encourage continuity and the integration of diverse curricular and co-curricular experiences; and exclude isolation that many learners felt before.

Our learning goal for this coming year will be a test environment where we can match learners with mutual interests and on the other hand match learners with different interests. We will try to match learners who are connected to our learning environment in complete different time periods. Questions we ask ourselves are:

Will this improve the quality of reflection and online discussions ?

Will this lead us to new insights ?

As the next experiments run until May 2001, we will be able present this results at Edmedia 2001.

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Ralph Genang

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Since learning is a habit learned in your first years at school, Ralph will focus on primary and secondary education as well.

Prof. Dr. Mr. Ir. Sicco Santema

As teacher of the Business-to-Business marketing classes at The Delft University of Technology, Prof Sicco Santema started with Ralph Genang the B2B marketing development project on the use of ICT instruments in 1996. The first instrument was the use of e-mail as a means of interactive communication between instructor and learners. The second instrument, videoconference (PictureTel), enabled us to interact real time with learners on a remote basis. In 1998, the use of real-media resulted in the first life online course (on the Internet) in the Netherlands. During the last three years we developed a third instrument: the learning environment. In the learning environment we created Bodies of knowledge. We divided the course material in 100 subjects. Each of the subjects represents a body of knowledge. We recorded a video clip for each subject where the instructor explains the subject in about two minutes, and we started building a database of related publications to the subjects. By the time our next course started in the spring of 1999, all the course content was available online in multimedia mode. Prof Santema did not teach in the classroom anymore. According to their own learning habits, students who use our online learning environment are free to choose the medium that fits them best, per body of knowledge and context. The content has become dynamic. The context has become dynamic. The learner has become self-regulating, self-teaching, his own communication creates his own solid foundation.

A WWW- Based Multimedia Framework for Medical Case Teaching

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Abstract: We describe a software- framework designed to build multimedia presentations out of typical medical cases. These presentations „simulate" the common clinical examination. Starting from a picture of a patient and his main complaints, the user can ask predefined questions and „carry out" examinations. Answers and findings are updated step by step in a patients history. The user can make a diagnosis and propose a treatment. Errors are corrected by the program. The case presentations are currently used in students education at University of Vienna as well as in continuing education of medical specialists. The software provides an easy-to-use interface to define the data-structure of a clinical case and to enter the data. The automatically generated presentations can be worked through either on the internet or on a CD.

Introduction

A great part of medical knowledge derives from and is thought by means of typical patient cases. Aim of this project is to provide a framework for clinical case teaching with emphasis easy but powerful input facilities for MD's and widespread access for students. Therefore WWW is a promising approach.

Methods

Case- Presentation (a teaching tool for students)

The main educational goal of this application is to present typical case reports. Possible users are students preparing for their examinations as well as medical doctors. Until now 30 case reports are in the system. Duè to the „easy to use"- case input interface (see Cap. 3) the number grows rapidly. This case- presentation is currently available in German (http://www.akh-wien.ac.at/augen/waf/cases/waf.htm) and in English (http://www.akh-wien.ac.at:8080/wafenglish/waf.htm , only few cases)

At the start of each case the patient's complaint is presented and the case history is empty.

The student may select different examinations to be performed with the findings be inserted into the patient record. (Fig.1.) If the user has acquired enough information, he may stop the simulated examination and proceed to the diagnosis section. where she/he is asked several multiple choice questions concerning the diagnosis. Upon completition of the diagnosis face a set of multiple choice questions concerning the therapy is presented, similar to the diagnosis face. Cases are selected so as to end up in an unique therapeutic intervention which must be selected to proceed. Finally the user is offered to monitor the follow- up therapy which completes the case report presentation of a single case

Entering the Patients Case History (the MD's point of view)

Developing this application, a great amount of work was put into building an „ easy to use", but powerful data input interface. The goal was to transfer the patients case history which grows during routine work unchanged into the system. To meet the demand of different fields of medical research, first the structure of specific cases histories has to be modeled within the system. Afterwards single case histories can be entered easily.

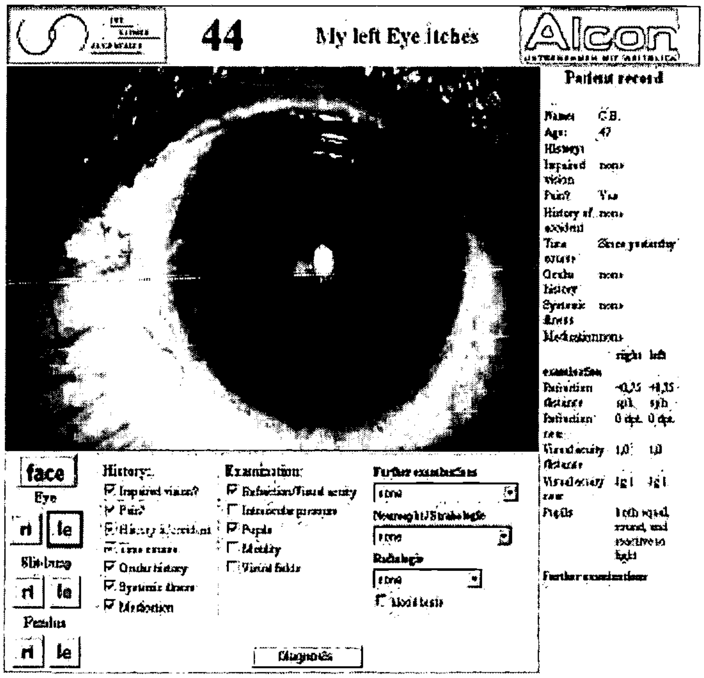

Figure 1 *Clinical Case Presentation*

Technical Environment and Database Design (the programmers point of view)

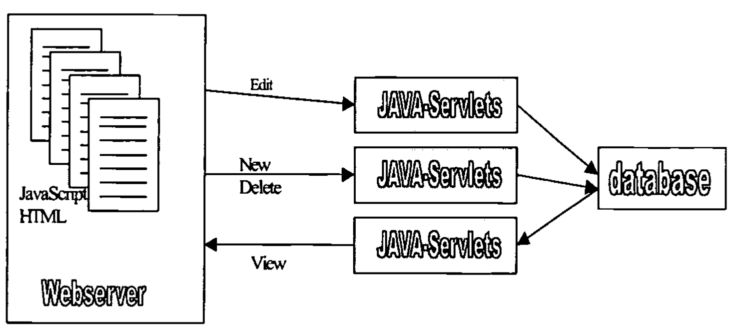

Figure 4 *Framework Structure*

Since the demands to contribute the case presentations also on CD's, we decided to programm all interactive parts in Java Script. So only a webbrowser is needed and the cases can be to worked through either locally (from a CD) or on the Internet.

Data structure and the actual case data can be entered only on the internet. JAVA-Servlets provide the communication with the SQL-database MySQL. Doctors can test new cases and if everthing is correct, a new case in HTML and JavaScript is generated by a servlet and stored in the webservers filesystem.

Discussion, Conclusion, Prospects

The program provides a rather poor simulation of a clinical examination due to the restrictions on JavaScript. No special clinical skills can be trained. On the other hand an effective training of clinical skills will be impossible without special computer hardware (models of patients..). The aim of this project to put a little interactivity to static case presentations. It is used currently in medical education at the Department of Ophthalmology, University of Vienna. Other departments (Radiology, Surgery...) are under development

"Do no Harm"
A First Measure of Effectiveness in Small Distance Education Programs

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Abstract: Records of 406 students registered in both traditional and distance classes over six semesters were examined. There is a small but significant difference between the mean grades earned in traditional (2.99) and distance (2.81) classes, but the group as a whole outperforms the college overall average of about 2.75. Performance in subsequent distance delivered courses was as predicted by performance in the traditionally delivered prerequisite course. We can conclude that we are "doing no harm" to the academic progress and success of distance students.

Introduction

Is distance education as effective as traditional classroom based education? This is the first question asked by opponents and proponents alike, and it is one of the major areas of research by those involved in distance education. Many studies (see, for example the California State University Special Projects, 2000) focus on learner outcomes, comparing the amount learned by a group of students using one mode of instruction with that learned by a group of students using a different mode. Numerous studies purport to show "no significant difference" (see the website by this name maintained by Russell) between the learning that takes place in traditional and distance settings. Criticism of such studies is common – the bottom line is that it is very difficult to control for all possible variables that may influence the outcome.

Small colleges and universities worldwide are quickly developing a presence in the distance education arena. While we certainly have an interest in the question, "is distance education as effective as traditional classroom based education", our concerns are more immediate and driven by rapid growth. We do not have the time or resources to perform large-scale, long term investigations to help us decide *our* most important questions: 1) Should we continue offering an increasing number of distance classes to an increasing number of rural Wyoming students without knowing for sure if these classes are as effective as traditional classroom based courses? 2) What is our measure for "effective as" traditional classroom based education?

Any measure we use not only has to comply with state and regional accreditation organizations, but also with the philosophy, mission and purposes of our institutions. The mission of Casper College, a comprehensive community college serving central Wyoming and the surrounding region, states that the college will develop and maintain educational programs appropriate to the needs of the communities served. In a statement of philosophy, the college supports the belief that equal opportunity for quality higher education should be available to all who can benefit. To fulfill this mission, one of the purposes of the institution is to provide innovative course designs, instructional methodologies, and delivery systems.

A college philosophy and mission statement in support of equal access to quality education and support of innovative course design and delivery systems gives us a starting point, but *does not* help insure that distance courses are as effective as traditional courses. We have chosen as our initial measure of effectiveness a concept borrowed from the medical profession, "do no harm." If effectiveness is measured in terms of access and numbers of students served, we are effective. However, our fear (and that of many faculty, administrators, and members of the public) is that distance students would not gain what they need in order to be successful in subsequent courses at our school and beyond, in traditional or distance delivery modes.

Distance students at Casper College are more likely to be non-traditional students that are female, older than typical freshman and sophomores, with family and work responsibilities in addition to school responsibilities. An analysis of a group of students taking both traditional and distance classes demonstrates what others have discovered: distance students are generally dedicated, hard working, self-disciplined, motivated, and they get good grades.

Results of the Study

We have chosen as our initial measure of effectiveness a concept borrowed from the medical profession, "do no harm." If effectiveness is measured in terms of access and numbers of students served, we are effective. However, our fear (and that of many faculty, administrators, and members of the public) is that distance students would not gain what they need in order to be successful in subsequent courses at our school and beyond, in traditional or distance delivery modes.

Records of 406 students registered over six semesters (fall 98-summer 00) were examined. To investigate our "do no harm" concept as an initial measure of effectiveness, we compared average grades within a group of students (n=406) who took both distance and traditional classes. There is a small but significant (á = .05) difference in this group between the mean grades earned in traditional (2.99) and distance (2.81) classes, but the group as a whole outperforms the college overall average of about 2.75.

As a second test of "do no harm" grades of students were compared by pairing courses consisting of a prerequisite and follow up course in mathematics or English composition. One of the pair was a distance class and one was a traditional class; in 46 of the 51 cases the prerequisite course was a traditional class, in 5 cases the prerequisite was distance delivered. Performance in the follow up courses was as predicted by performance in the prerequisite course. We found insufficient statistical evidence (á = .05) to rule out the hypothesis that the mean grade (3.12) for the prerequisite course was different than the mean grade (2.92) for the follow up course.

Conclusions

We cannot state that learning outcomes for distance classes are the same as for traditional classes, although we obviously suspect this to be the case. We *can* conclude that we are "doing no harm" to the academic progress and success of distance students. We should continue to develop our program because of the demonstrated increase in opportunity for access to education that it provides – the program is meeting the needs of the students.

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Improving Access Using Simulations of Community Resources

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Abstract: The Community Access Through Technology Project (CATT) is developing and implementing virtual reality software that persons with disabilities can use to experience a physical location prior to visiting it in person. A virtual scenario of one physical location has been developed, implemented, and tested, and work is underway on two others. Using a computer mouse or an adaptive device, individuals can "navigate" through various environments and view short movies of processes. Detailed maps and annotations about access issues are provided for each site. The premise that a facilitated virtual tour prior to visitation to a new site would reduce anxiety was supported by the data. In addition, the data supported the premise that a virtual tour would increase knowledge about the facility.

Introduction

The promise of virtual reality (VR) technologies to provide powerful and unique educational and informational experiences is well known (Heim, 1998). Unfortunately, the public has often turned away from these technologies when expectations went unfulfilled due to hyperbole on the part of the media. Despite setbacks, however, use of VR is growing and will soon become commonplace, according to some researchers (Von Schweber, 1998). Currently, researchers at Metropolitan State College of Denver are using VR to assist individuals with physical disabilities become more self-sufficient. Specifically, VR software is being used to model various public buildings and other sites that individuals with disabilities may want to visit. Therapeutic recreation specialists then use the software with patients to allow them to virtually preview sites that they may later want to tour in person. This approach may build confidence in the clients and may lead to greater independence once they reenter society. By enhancing this social self-efficacy, it is anticipated that carry-over will occur into employment, independent living, family support, and economic independence.

Review of Literature

One in seven Americans, or 35 million individuals, have a disability severe enough to interfere with life's day-to-day activities (Scherer, 1996, p. 4). Of those individuals, 305,000 reside in the City of Denver, Colorado (United States Census Report, 1990). Providing avenues for these individuals to maximize their full inclusion and integration into varied aspects of community life is essential.

Statistics support the need for inclusive, transitional services. Figures indicate that over 1,500 youth with disabilities are preparing for transition into the community from the public schools (Denver Public Schools, 1994). Furthermore, clinical agencies (e.g., rehabilitation hospitals) in the Denver Metropolitan area have over 1,600 new patients each year (Denver Parks and Recreation Special Needs, 1996), with over 200 referred to community-based services annually (Denver Parks and Recreation Transition to Recreational Activities in the Community, 1994, 1995).

Virtual reality literature discusses many benefits for patients. Rothbaum, Hodges and Kooper (1997) reduced the fear of heights in patients after virtual reality exposure therapy. Wilson, Foremen and Stanton (1997) demonstrated that spatial information acquired by physically disabled children from exploration of a virtual environment will transfer to a real-world equivalent environment; Ring (1998) has suggested that patients with disabilities can be trained with virtual reality to judge architectural barriers and tackle environmental obstacles. The researcher advocates the use of virtual reality as a significant assistive technology in the future (Ring, 1998). This clear support of technology deserves the opportunity for development, not just to provide individuals with simulated experiences but to use the technology for the integration of people with disabilities into society.

Methods

Subjects

Thirty-six subjects with physical disabilities were recruited through advertisements in local newspapers, and through direct mailing to local hospitals, community housing facilities, non-profit agencies, and disability advocacy groups. All subjects were initially screened to ensure that they met minimum guidelines for participation in the study, which included being age 18 or older, no prior participation at the 20th Street Recreation Center, no cognitive deficits, and having a physical disability that impaired mobility. Subjects were randomly assigned to one of three groups: control group, virtual reality treatment group (VR), or the leisure education-virtual reality treatment group (LE-VR). Thirty-four subjects, 21 males and 13 females, with a mean age of 47.5 years (range = 23 to 84 years) completed the study. Disabilities of the subjects were varied and included persons with Spina Bifida, paraplegia, quadriplegia, cerebral palsy, brain injury, and multiple sclerosis.

Instruments

Self-Evaluation Questionnaire

The State-Trait Anxiety Inventory (STAI) (Spielberger, 1983) was one measure used to assess anxiety. The state anxiety scale (Form Y), used to measure a temporary condition of apprehension, tension, nervousness and worry, was completed by subjects. The scale is comprised of 20 statements with a range of 4 possible responses to each. The STAI has been used more extensively in psychological research than any other anxiety inventory (Buros, 1978). Data indicate that the state scale of the STAI has reliability coefficients above .90 for samples of working adults, students, and military recruits, with a median coefficient of .93. Additionally, it is reported that alpha reliability coefficients are typically higher for the state-anxiety scale when given under conditions of psychological stress (Spielberger, 1983, p. 14). Extensive research into the validity of the STAI has been conducted, and it is reported that the state-anxiety scale repeatedly has demonstrated sensitivity to environmental stress. Furthermore, the STAI has been shown to have excellent psychometric properties for the assessment of anxiety in elderly persons (Spielberger, 1983, p. 20).

Visual Analog Scale (VAS)

Each subject was asked to perform a self-evaluation of anxiety at baseline and at the conclusion of their site tour. An 11-point Visual Analog Scale (VAS) (McCall, Fischer, Warden, Kopcha, Lloyd, Young and Schomaker, 1998; Vogelsang, 1988) was used. Lower scores (0-3) indicated greater comfort with the environment; middle scores (4-7) reflected moderate comfort, while higher scores (8-10) indicated severe discomfort.

Heart Rate (HR) Measurement

In order to assess physiological changes as a result of anxiety, heart rate data were collected. Heart rate data were recorded every 5 seconds and stored using a Polar Accurex Plus Heart Rate Monitor (Polar Electro Oy, Kempele, Finland). All HR data were downloaded from the HR monitor's wrist receiver to a computer via a Polar Interface Plus (Polar Electro Oy, Kempele, Finland). Each subject had his or her HR measured to establish (A) a baseline and again while touring (B) the 20th Street Recreation Center.

(A). Baseline

Heart rates were measured during an hour of "normal" daily activity while at home or in another "comfortable" environment chosen by the subject. An average HR was determined for this time period.

(B). 20th Street Recreation Center

While touring the 20th Street Recreation Center, the heart rate monitor was used to ascertain physiological changes due to environmental anxiety. Subjects completed 11 assigned tasks while touring the Center. The subject pressed an event marker on the HR wrist receiver while also identifying the task by talking into a voice-activated cassette recorder. This enabled the identification of a specific heart rate during a specific time interval.

Recreation Information Questionnaire (RIQ)

A 12-item Recreation Information Questionnaire (RIQ) was developed to ascertain the subject's knowledge of recreation-related information, frequency of recreation center use, and community independence. Composite scores were calculated by adding correct responses for each statement.

Technology Questionnaire (TQ)

A technology questionnaire assessed the subject's technology sophistication, such as their ability to utilize voice mail, e-mail, FAX machines, word processing, and search for information on the World Wide Web. This instrument was adapted from the Flashlight Project (Ehrmann and Zúñiga, 1997). Flashlight™ is comprised of various assessment tools useful in helping to answer questions about technology, and it has been subjected to content validity testing.

Demographic Data

Each subject was requested to provide demographic information that included their age, sex, ethnicity, disability, current employment status, living arrangement, health status, use of assistive devices, and methods of transportation.

Experimental Design

The 20th Street Recreation Center, a large multi-purpose facility operated by the City of Denver, Colorado, Department of Parks and Recreation, was created into a virtual environment that included photo-realistic panoramas of the facility, digital video of recreation equipment use, access annotations, and interactive maps of the facility. Potential subjects were initially screened to ensure meeting eligibility requirements and then were randomly assigned to either a control group (n=13), treatment group one that received virtual reality only (VR) (n=10) or treatment group two that received leisure education using the virtual reality scenario (LE-VR) (n=11). All subjects were pre-tested in their home or "comfortable" environment to determine baseline anxiety levels (i.e., Self-Evaluation Questionnaire, HR, and VAS), recreation knowledge (i.e., RIQ), technology sophistication (i.e., TQ), and demographic data.

Control group subjects independently toured the 20th Street Recreation Center, completing 11 assigned tasks such as signing up for a recreation center pass, locating specific exercise equipment, and viewing the swimming pool. During the tour, subject's HR was recorded and tour data noted on voice-activated tape recorders. At the conclusion of the tour, subjects were met by project staff to complete their post-evaluation questionnaires and paperwork for receiving a stipend for participation.

Similarly, subjects in the VR only treatment group and LE-VR treatment group followed an identical protocol for their 20th Street Recreation Center visit. However, the subjects assigned to the VR treatment group had an opportunity to view and "navigate" through the Center virtually prior to their actual on-site tour. Each VR only subject, either coming to a computer lab of the CATT project or by having staff bring a laptop computer into the subject's home, virtually toured the facility, navigating through the various rooms, examining equipment, and viewing the digital video clips. Staff had been instructed to assist subjects in using the computer only and not to provide explanation or information about the facilities.

Subjects in the leisure education-virtual reality (LE-VR) group also utilized the 20th Street Recreation Center virtual environment but had this computer tour facilitated by a certified therapeutic recreation specialist (CTRS). A leisure education program, created through a modified program planning process (Peterson & Stumbo, 2000), was used by the recreation therapist to assist LE-VR subjects in using the community facility. Content of the program included information about transportation, facility accessibility information, fees/costs for participation, equipment and adaptations available, and services provided through the Special Needs Program of Denver Parks and Recreation Department.

Results

The premise that a facilitated virtual reality tour administered prior to visiting the 20th Street Recreation Center would reduce anxiety, was supported by a difference in means from the STAI ($p=.104$).

The premise that a virtual tour prior to visitation to a new site would provide detailed, necessary information about that facility also was supported by the data. Analysis of data from the RIQ showed significant differences between both the VR-Only and the LE-VR treatment groups and the control group ($p=.003$).

The premise that use of a virtual tour alone prior to visitation of a new site would alleviate anxiety in subjects with mobility impairments, was not supported by the data. Subjects in the VR only group were administered three instruments, then provided the treatment of the virtual reality experience, and then measured again at the 20th Street Recreation Center location. Data indicates an increased level of discomfort, anxiety, and heart rate. While mean HR site data was lower for this group of subjects than for similar subjects in the control group, the range was much greater.

The Technology Questionnaire was administered to all subjects prior to site visitation. It assessed the technology sophistication of the subjects, including their ability to use voice mail, e-mail, FAX machines, word processing, and the World Wide Web. In order to determine whether an individual's knowledge of technology was a factor in levels of anxiety, a technology score was formed by adding together individual responses to technology questions. A significant negative correlation was found between technology composite scores and pretest anxiety scores. This would indicate that those who score higher in technology knowledge tended to score lower on self-reported anxiety in the pretest.

Future Research

Future research may attempt to recruit subjects with mobility impairments from rehabilitation hospitals that are involved in active rehabilitation. This population may include persons with more recent disabilities, and these persons may exhibit greater anxiety when utilizing community-based facilities.

Additionally, more analysis needs to be performed on the HR data since it is suspected that physical exertion at the site may result in increased heart rate in addition to anxiety. A second physiological measure, such as salivary cortisol, may be useful in measuring neuroendocrine responses to anxiety in a natural environment (Bandelow, Wedekind, Hüther, Broocks, Hajak, Pilz and Rüther, 1997).

Finally, the production technology used for the virtual reality experience was only marginally immersive since it relied on Hypertext Markup Language (HTML) and Virtual Reality Modeling Language (VRML). Newer, more immersive and interactive technologies may be more effective in reducing anxiety. The use of these technologies needs to be explored in field-based settings. In addition, the virtual reality experiences need to be more "user friendly" and easier to use for persons without extensive technological experience.

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A Project for Supporting Photonics Development as a Modern University Research Centre

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Abstract. The paper presents a programme that aims to prepare, by education and research activities, specialists with high qualification in the field of photonics. Within the context of a modern educational system based on internationally accepted standards and in close relation with other master and doctorate programs having a similar field of activity and profile, this programme will use computer, networking, hypermedia and multimedia facilities, designed to play a crucial role in this activity. A financial support from the National Higher Education Research Council and Mondial Bank is using for creating the base of this centre.

Introduction

According to the organising regulations, there are two important types of activities taking place into this Photonics Centre (PhotoCen "Focum")): postgraduate programmes and performant scientific research. Consequently, the main objectives are determined by the requirement of ensuring the conditions of a high quality activity in these sectors, contributing to the postgraduate programmes and scientific research development, as essential objectives for the Romanian education and research reform, as follows:

a) 1st Stage: Establishing and efficiently using PhotoCen "Focum".

The centre is established having given initial users and a large number of potential users, nationalwide: universities, research centres, manufacturing centres. International co-operation, computer and network based are constantly used. (Woltz et al., 1997)

b) 2nd Stage: Nation-wide development and use.

"Focum" is developing with a national base of teaching and research by increasing the number of the steady users to many universities and research institutes, based on conventions and contracts. Exchange with other units from abroad is also compulsory, in order to maintain the high level and to up-date the methods. Computer software, www sites and multimedia facilities have to be daily tools for all users. (Becker, 1996)

c) 3rd Stage: Improvement as nation-wide teaching and research base.

The centre-accessing program is improved together with the increase of the user number and an appropriate database is built. Constant advancing as modern teaching and research centre having possibilities of sustainability is required. One will constantly have in view international affirmation of the centre by participating to congresses, conferences, publications, etc. (Dumitru et al, 1994). Likewise, the centre Program will be initiated with the aim of supporting external teaching and research programs and capitalising the results of the own research. The whole activity has to be accompanied by computer, network, multimedia and hypermedia use.

Description of activity

Organising University is "Politehnica" University of Bucharest and other involved Institutions in Romania are Politehnica University of Timisoara, Tehnical University "Gh. Asachi" of Iassy, Technical Military Academy, University of Craiova, University of Pitesti; University "Valachia" of Targoviste; PROOPTICA - Research and Design Institute Bucharest; MATPUR - Research and Design Institute for

Semiconductors Bucharest, National Institute for Microtehnology, Bucharest. External relations and co-operation were established with Royal Inst.of Technology-KTH, Stockholm; Technische Hochschule Darmstadt, Univ.Paris, Univ.Sofia, Chalmers Inst. Göteborg, Politecnico di Torino, Abdus Salam Physics Centre Trieste, Lab. De Chimie Physique des Polymers et des Membranes, Lausanne, Univ. Grenoble, University of Aalbory - Denmark, Strathclyde University Scotland, University of Amsterdam. In the PhotoCen "Focum" team there are internationally recognised researchers, by their remarkable scientific work, published papers, active participating in international congresses and conferences, members of many scientific societies and committees, recipients of different awards and grants.

The program describes in details the centre organisation: management; didactic and research activities; organization and the coordination of mixed research collectives (teaching staff, researchers, Ph.D. students, master students, other students) as some interdisciplinary collectives; elaboration of on internal research plan connected to the research in the advanced countries; reference materials and publications (Ghelmez, 2000); laboratory equipment and experiments (Ghelmez, 2000); mobility and specialization; intensive lectures of foreign specialists in different fields of photonics and in applying computers in Romania.

We appreciate that at the PUB there are favourable premises for the development of the existing master and doctorate programs in the field of photonics. The photonics integrated laboratory is constituted of 4 operational units: Lasers, Optoelectronics apparatus and equipment, Photonic materials and technologies, Specialised computation technique. There are also a library and some mechanics, electronics and optics workshops. Concerning the specialised computation technique unit, it is achieved on the UNIX network installed at the Physics Department, with Internet accessing. We are using usual and specialised software, employed in researches using numerical analysis and computer experiments. Matlab, Mathematica, and Maple are currently used by students and teaching staff. Graphs and some calculations and processing the experimental data are made by using Excell, TableCurve3D, Microsoft PhotoShop etc. Interactive Physics, CUPS software, Work & Energy CAL, Bede Lab for Windows, Mouse-LCD, Reliable Energy, Optisk Data Lagring, Molecular Probes, etc are also used for helping the teaching and work in our field. Labview and PCTex programs were just now installed, together with other usual programs for use of the photonics' students. The present endowment, the equipment and installations has to be completed. Some examples of using such computer capabilities and obtained results at this stage are detailed in (Ghelmez, 2000), (Ghelmez et al, 1999).

The proposed program is related to the nowadays stage of development of the educational system in Romania, submitted to the reform process during latest years. In the top field of photonics, which has as main purpose the study of lasers and their interdisciplinary applications, the master and doctoral activity, rather restrictive or just inexistent until 1989, belong today to the most dynamically domain of modern science and technology, having an impressive affairs figure. Computer, networking, hypermedia and multimedia facilities are designed to play a crucial role in this activity.

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Distributed Cognitive Tools to Improve High Order Cognitive Skills such as: Argumentation, Negotiation and Restructuring of Knowledge.

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Abstract: Two problematic concerning information technologies and communication, one related to the new constraints of access modality, communication and organization of information on process of knowledge making. The second one more related to new cognitive skills required by the learning environments that integrate these technologies in order to understand and exploit all their potential. From concern we conceptualized a Pedagogical Mediation Structure (PMS) object. A set of pedagogical principles and strategies allowed us to elaborate a theoretical model and an operational model. The first prototype gathering nine cognitive tools, was accomplished in a partnership agreement with the company Novasys Inc of Montreal. This research focused on the skills related to the process of negotiation, argumentation and knowledge restructuring. We sought to make the theory of cognitive flexibility operational using cognitive tools that manage and organize the interaction process with the pairs within accessible information in a mediated and distributed learning space (MDLS).

Introduction

In the framework of this research, we were interested in the skills related to the process of negotiation, argumentation and knowledge restructuring. We sought to make the theory of cognitive flexibility operational using cognitive tools that manage and organise the interaction process with the pairs and with accessible information in a Distributed Mediated Learning Space (DMLS). This research supports the systematic reflections of the impact of a pedagogical intervention on the problems raised by using the new technologies in developing learning environments. We want to know by developing a PMS which relies on validated and imposed pedagogical principles, whether we can better exploit the new contexts of communication and exchange in (DMLE) for developing a high level cognitive skills. The purpose was, during students interaction with PMS's cognitive tools to observe the behaviours, the process and the strategies that were used and manifested related to the negotiation, the argumentation and the restructuring We also explored what comprehension the students make, if possible define it as flexible comprehension, knowing the context of socio-cognitive and meta-cognitive in which it is elaborated. The problematic that motivated us is centred on the difficulties of several research workers, on exploiting and integrating the potentials and possibilities that information and communication technologies and pretends to have on the learning. This research aims to observe, describe and analyse the effects of cognitive tools on skills and competence promoted in several rapport and recommendation in the educational domain.

Emergence of New Conceptual Framework

The new occupations offered in information era with the network technologies , cannot be learnt in working place, because they don't rely only on know-how of industrial society. They require relatively hard theoretical and practical training that brings a refinement and a new reflection on the definition of expertise. This kind of reflection emphasises on the definition of learning and the purpose of learning. Learning becomes consequently the use of knowledge that allows the learning capabilities to be expanded.

To establish this prospect, there are three approaches:

1. The first is inspired from the socio-cultural approaches and integrates the concept of learning, the concept of cognitive ecology (Bateson 1972) and the concept of cultural mediation of learning process (Vygotsky 1978;

Salomon and al., 1991). So, the learning spaces are promoted for providing the learner with a responsibility and allowing him to participate and be incumbent in a new social dynamic.

2. The second prospect, more constructivist, orient the research towards the conception and design of learning spaces that helps the learner to make and exploit them conform with his previous knowledge, his learning profile and his motivations (Linn and al 1998, Chan 1996).
3. The third prospect, allows adapting learning environment to learners' needs and expectations, by presenting interactive dimension, social and the inherent potential of environment in the interaction process (Salomon 1993; Brown and Campione 1986).

So, cognitive dimension apparently jeer more and more to social dimension for circumscribing a learning process that is more and more distributed and more complex (Salomon 1993; Chan 1996); whose reach relies on the appropriate arrangement of components of immediate context of the learner (learning task or activity, tool– artefact activity mediator, the partners or the community in interaction with the learner) (Salomon 1993).

Pedagogical Mediation Structure

The PMS relies on pedagogical principles, from theories of learning, communication, collaboration and interaction. It aims to support developing cognitive, metacognitive and socio-cognitive competencies and also aims to develop new knowledge in DMLE. More specifically, our theoretical framework is made around the concepts based on the theory of cognitive distribution (Salomon 1993) and intelligence distribution (Pea 1993), cognitive flexibility (Spiro and al 1991) and theory of epistemic games (Morrison and Collins 1995). The three theories specifically focus on the problematic of learning and knowledge acquisition, and they specifically focus on cognitive skills development within DMLE. By the means of pedagogical principles and strategies, we developed the operational the model of the PMS, this allowed us to make a prototype that includes nine cognitive tools. These tools allowed students to structure the messages during the interaction and to diversify the feedback and retroaction.

The validation of the prototype and conclusion

The functional and empirical test and pre-test sessions took place in the company's locals with participation of 22 university students and an observatory group for gathering the data. The methods and the instruments used to gather the data were computerised trace, verbal protocol, observation grid and semi-structured interview. A questionnaire for factual data was also submitted to the students.

To analysis the data, we used several descriptive scales, for the knowledge construction activity (Scardamalia and Bereiter 1991), and for the awarness level (Pontecorvo 1987) that allowed the analysis and the description of epistemic action and of cognitive involvement of students during their interaction with PMS. This allowed us to relate on the mechanism and the predisposition of how student face restructuring and refinement of knowledge. We used the coding system of intimate negotiation (Ting-Toomy 1982) and the strategies of communication of Wallace and Skill (1987) for the analysis and description of the student's negotiation processes. For the argumentation, we analysed as suggested by Toulmin and al. (1979) and Kuhn (1992), the elements of the argument that allowed to describe and to identify the nature of the argumentation process.

The analysis of the students messages allow us to observe the knowledge construction activity in which students were involved, it was mainly focused on inference process, new information seeking and interpretation with 56% on the category: "Explicit Knowledge Construction". The category of "Direct Assimilation Knowledge Construction" was less present (23%) and no indicators about "Sub-Assimilation" (Bereiter and Scardamalia 1991). The analysis of indices related with "Meta-Cognitive Reflection", shown a predominance of the "Level 3 of Awareness" (Pontecorvo 1987), which is related with knowledge epistemic value (65%). The observed indices of the argument within the student messages, clearly shown a predominance of the categories like "Opposition", "Response to Opposition", "Warrants". A deeper analysis of these categories, shown a predominant interaction among peers focused on "Parasupporting" of the person I am speaking to (justification/support), "Compromising" (negotiating deals, probing alternatives) among peers, "Agreement" (compliance, assertion) to the statement of the person I'm speaking to. The predominant category was the "Task Oriented Question" (48%) with the activation of strategies like argument assertion, question, counter-support statement.

The analysis of the indices related with to negotiation process (learner behaviour/strategy) shown three main aspects: first the presence of an integrative behaviour (Ting-Toomey 1982) with 42% of indices on negotiation process (confirming, compromising and agreement) (Oubenaissa 2000). Second, the predominance of categories focused on "Task Oriented Question" supporting the negotiation as goal-oriented process: rich an objective, achieve a task or state an agreement. The third aspect was the predominance of argument assertion, question, and agreement as communication strategies (Wallace and Skill, 1989) supporting "disintegrative behaviour" (23%) in terms of disagreement, and confrontation. These aspects confirm the student involvement in an argumentation process (Oubenaissa 2000).

Concerning with flexible understanding, all the results of the messages analysis, verbal protocols, interaction profile and use of the tools of PMS by the students, as well as the comments and perceptions gathered during the interview, allowed us to proceed with a conception of what could be the flexible comprehension like a learning product as defined in the new taxonomy of Jonassen and Tessmer (1997).

A deeper analysis of all indices related with negotiation process allowed us to show that students integrative behaviours focused the interaction on "negotiating alternatives" and the "support of peers statement", by justification, explanation and new information contribution. Concerning the disintegrative behaviour, the students not only reject the peer statement, but express their point of view making critics, attacking the consistency of the information received.

Finally, the data collected about the knowledge construction activity, awareness level, students negotiation strategies, as well as argument elements, clearly shown that the students were involved in a cognitive activity where argumentation and negotiation process were juxtaposed. These same elements are considered as indices of knowledge re-structuring activity in the learner (Chan and all. 1997, Hafner and Steward 1995).

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Media and Innovation Take Technology Off-campus: *The Institute for Technology Transfer*

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Abstract: Linking a university's computing technology resources with local businesses provides a win-win scenario for improving the technological life of both. The Institute for Technology Transfer, residing at the intersection of several traditional roles of the university, establishes this connection using the ideas of virtual workgroups, virtual workshops/courses, and virtual projects to bring both parties together. The result is an environment for outreach education in technology, professional certification for workers in technology, and technological consulting to the business community.

The Problem:

Businesses need technology professionals. The former Wisconsin Governor wants to double university computing graduates in Wisconsin's public universities to meet this need. However, even if this doubling takes places the need for technology professionals will not go away. Businesses need to upgrade and re-tool their current technology professionals both to retain these technology professionals and to stay competitive.

Pre-professional computing students need to be prepared to enter the business community. Traditional university curricula limit student horizons mainly to the textbook, and have few mechanisms for bringing the outside world environment into the classroom arena. Hence, many computing students enter the business community without a good understanding of the challenges and requirements of the job.

A Solution:

The Institute for Technology Transfer is a proposed organization (see graphic below) forging a special link between the University of Wisconsin-Stevens Point's Computer Information Systems curriculum, students and faculty, and the Central Wisconsin Business Community to improve the technological health of Central Wisconsin. In short, the Institute is a three-part enterprise. It is:

- ***an incubation center*** where business computing professionals, high achieving UWSP computing students and UWSP CIS faculty work together to solve computer technology problems important to businesses,
- ***a training center*** where computing professionals from the business community, as well as pre-professionals [UWSP students] can advance their knowledge and become skilled in the latest tools for software systems development and project management,
- ***a certification center*** that documents and recognizes the learning and productivity activities of Institute participants.

The Institute's design will:

- establish a program that reaches out to the Central Wisconsin Business Community ***with technology rich solutions to business problems***,
- have an ongoing ***outreach educational program,***
- have a certification program leading to a ***Bachelor's Degree,*** a ***Certificate Program***, and a ***Master's Degree*** in software development and management for both traditional and non-traditional students.

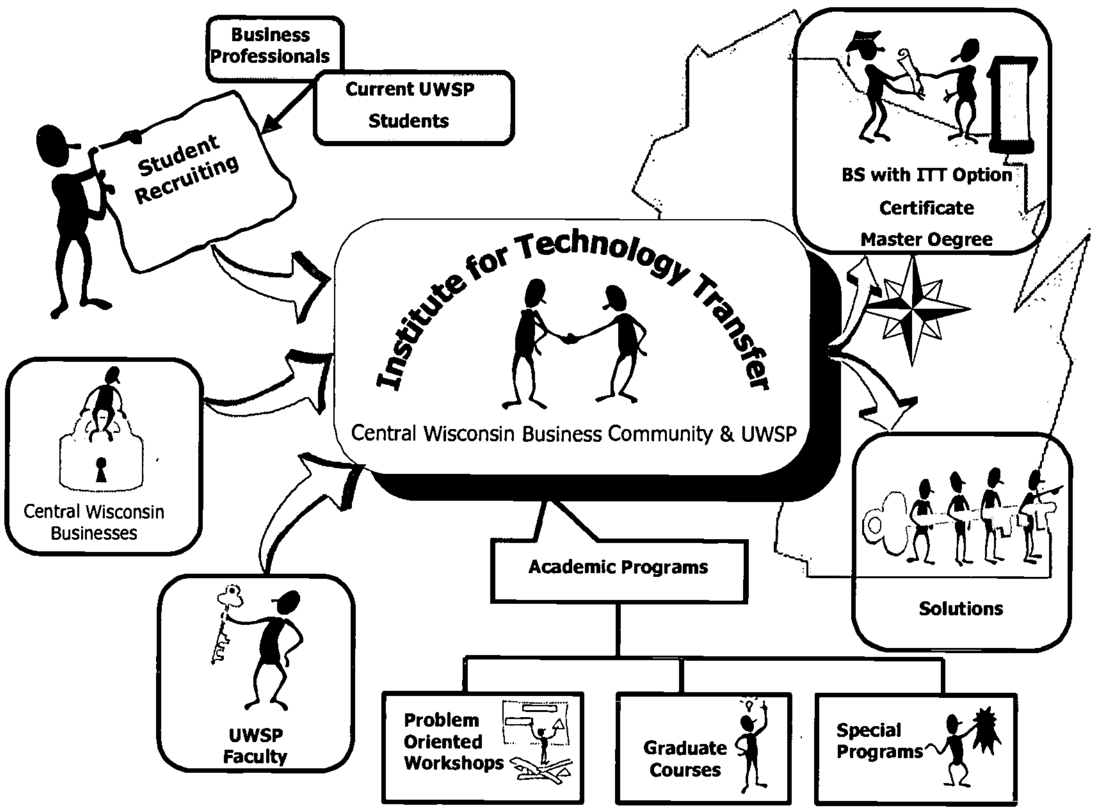

Figure 1: The Institute for Technology Transfer in Conceptual Form

The Strategy:

The virtual workgroup is the basic building block for all Institute activities. The workgroup will be composed of students and professionals working in both face-to-face activities and at a distance using synchronous activities of compressed video technologies and/or asynchronous activities over the web. Each workgroup will be guided and mentored by a faculty member. The focus of the workgroup will be an actual business problem from the professional's work environment. Just-in-time training using both face-to-face workshops and virtual classrooms will provide pre-professionals and professionals with skills to solve business problems.

For those businesses associated with the Institute but not involved in virtual workgroup activities, workshops, seminars and coursework will be provided using all available instructional capabilities.

A systematic collection of workshops, seminars and coursework will lead professionals to Certificate Programs and Master's Degree programs. The key to both certification activities will be a creative integration of existing curriculum coursework with Institute seminars and workshops.

PDAs: Learning in the Palm of Your Sweaty Little Hands

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Abstract: Personal Digital Assistants are small, portable, and inexpensive. You can surf the Web and have e-mail capabilities. Software is available and titles are growing because of the ease of development. PDAs will soon become commonplace in the world as well the world of education. Therefore it is important that educators and instructional developers look at PDAs and their operating systems as the newest medium of delivering instruction to the busy learners of the present as well as the future.

Computer and Internet Attitudes of Adult GED Students

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Abstract: This study measures the computer attitudes and Internet attitudes of adult General Equivalency Development (GED) students in the United States. Age, gender, education, location, income, computer/Internet experience and computer/Internet access are also measured to see if these factors effect computer or Internet attitudes. The instrument used to measure attitudes is the Loyd and Gressard Computer Attitude Scale (CAS). The CAS was modified to create an instrument to measure Internet attitudes. Both scales measure computer or Internet a) anxiety, b) confidence, c) liking, and d) usefulness.

Preparing learners for the General Equivalency Development (GED) exam has been the job of adult education centers for a number of years. These centers are usually open during the day, and several have classes available in the evenings and weekends for working people who are trying to get their equivalency diploma. If the pretests, practice exams, and instructional materials were accessible to students twenty-four hours a day, seven days a week, there is a strong possibility this would open the door to a diploma so more people could be served. Workers on a third shift at an industrial plant could practice their math skills during their breaks at 4:00 in the morning, long before the doors of a typical educational center opens. A parent who works could take a practice exam at midnight, long after the children went to bed. A person who has to travel for their job, could work from any location across the country. Not only could they solve problems and take exams, they could also have the benefit of immediate feedback on their work after each question or problem. People could work toward their diploma at their own convenience and schedule, not at the mercy of someone else's time clock.

Statement of the Problem

The instructional audience this study is seeking to serve and better understand is the GED candidate. To ensure successful design and development of web-based GED programs in the future, we must first see how the current GED students feel about computers and the Internet. More specifically, this study will measure both the computer and Internet attitudes of adult GED students in the United States. Other things besides attitudes will also be measured. In other words, does age, gender, education, location, income, computer/Internet experience and computer/Internet access effect the computer and Internet attitudes of these students? And finally, do the computer attitudes differ from the Internet attitudes of these students? All these factors are important to measure in order to better serve GED students in the future so that instructional materials and methods developed in the future can accommodate the learning needs of the GED student as well as other adult learners.

Questions to be Answered

Within the limits and range of this study, the following questions are answered.

1. What are the attitudes toward computers of adults enrolled in GED programs in the United States?
2. Are there any differences in these attitudes toward computers based on age, gender, education, location, income, computer experience and computer access?
3. What are the attitudes toward the Internet of adults enrolled in GED programs in the United States?
4. Are there any differences in these attitudes toward the Internet based on age, gender, education, location, income, Internet experience and Internet access?
5. Is there a significant difference between the computer attitudes and Internet attitudes of adults enrolled in GED programs in the United States?

Importance of the Study

The GED population has been typically understudied (Bates, Holton, & Seyler, 1996). Attitudes toward computers and the Internet are important areas of consideration for instructional designers who create instructional materials for GED students as well as other adults. Creators of computer-based technologies use information about user attitudes as well as demographic information to create computer or Internet-based applications. Therefore this study is important to increase the knowledge base in adult education, instructional design, and computer-based technologies.

Research

The research will be based on the initial questions posed by this study. Questions one and three as seen above, will be answered using the measures of central tendency and variability. Each participant will be administered a Computer Attitude Scale (CAS) or Internet Attitude Scale (IAS). Total scores will be computed for each participant. A higher total score corresponds to a more positive attitude toward working with and learning about computers and the Internet. Means and standard deviations will be computed for the total scores as well as the four subscales for both computer and Internet attitudes. Questions two and four will be answered using the measures of central tendency and variability as well as multivariate analysis of variance (MANOVA) procedures. Means, standard deviations, frequencies and percentages will be computed for each of the seven demographic areas: age, gender, education, location, income, experience and access. In the MANOVA procedure, the total score for computer and Internet attitudes will be the dependent variables. The independent variables will be age, gender, education, location, income, experience and access. Statistical significance of the demographic factors will be determined from the MANOVA. A level of significance of 0.05 will be accepted as the level of confidence. Question five will be answered using a t-test for independent samples. Total scores of Computer attitudes will be compared to total scores of Internet attitudes. A significance level of 0.05 will be accepted as the level of confidence.

Selection of Participants

The sample selection will be completed using stratified random sampling. To determine the sample sites, a current listing of all GED program centers for each state will be obtained. From this listing, two sites from each state will be chosen using a random number generator. The first site chosen will receive 10 Computer Anxiety Scale surveys and the second site will receive 10 Internet Anxiety Scale surveys.

Instrument

The instrument that will be used in this study is commonly known as the Computer Attitude Scale (CAS). Loyd and Gressard developed the CAS in 1984 at the University of Virginia and has been found to be a valid and reliable instrument. This scale is a Likert-type instrument with 40 statements representing attitudes toward computers. Participants must respond to one of four responses: a) strongly agree, b) slightly agree, c) slightly disagree, or d) strongly disagree. Four types of attitudes are measured with the CAS: 1) anxiety or fear of computers, 2) confidence in the ability to use or learn about computers, 3) liking computers or enjoying working with computers and 4) perceived usefulness of computers in current or future work situations. Permission has been granted to use the CAS scale in this study.

A new scale created by modifying the CAS to reflect Internet attitudes has been developed for this study. Permission has been granted to make the changes to the CAS. The same format and statements were used to solicit Internet attitudes. The word computer was replaced with the word Internet in the instrument's statements. For example, the statement computers do not scare me at all would be changed to the Internet does not scare me at all.

This study is a work in progress that will be completed by June 2001. Explicit details about the results of this study will be available on-line and will be presented in Tampere Finland at AACE EdMedia 2001 Conference in late June.

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Designing a Pedagogically Sound Web-based Interface: The Critical Role of Prior Knowledge

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Abstract: In this article we present our research and development efforts to design a pedagogically sound multimedia web-based learning interface. We take into consideration recent findings from the area of cognitive psychology regarding the use of text, animation and voice. The logic is based mainly on the presentation modality effect and the principles of spatial and temporal contiguity. We consider the state of the learner's prior knowledge to be of critical importance. We present a flexible user interface supporting the use of animation and voice as default modalities and the existence of text in the same interface as an essential part of the learning process. The SMIL language is used for the implementation of the Web-based interface.

Introduction

Recent studies have emphasized the significant implications of multimedia for the learning process. Even those researchers who take a less enthusiastic stand do not hesitate to assent that when blended with suitable pedagogical techniques and a proper design, the combined use of multiple media for the viewing and study of educational material can enhance the quality of the learning environment. In this article we discuss the theoretical background and the development efforts which have led us to create a flexible interface design that is used for a series of graduate and post-graduate courses.

We distinguish two stages in the learning process:

- the presentation of the instructional material, for which we can assume learners have no prior knowledge and
- that material's study and critical investigation

We seek to provide an integrated support for both stages via the same user interface which will combine the use of animation, voice, and text labels on the one hand for the presentation of the course material to the learners; and alternatively, the use of hypertext and pictures for its in-depth scrutiny. We analyze the reasons that have led us to the adoption of this particular interface design based on the findings of cognitive psychology studies. Commencing with the notion of working memory, we pursue ways to optimize its limited resources, in order to use them as guidelines for our design decisions. Understanding working memory limitations and sensory modality benefits is essential in order to create courses that may reduce cognitive load and enhance the learning process. To this extent, cognitive psychology theories such as Paivio's dual coding theory (1971, 1986, 1991) and Baddeley's model of working memory (1986, 1992) as well as recent evidence provided by cognitive load psychologists can serve as the basis for the instructional design of multimedia courses that will facilitate learning.

The flexibility of the user interface is a crucial matter. Learning outcomes can be increased by creating an interface that provides a combination of modes and modalities from which to select, according to the prior knowledge of the learner.

The Internet has been chosen as the implementation environment due to the additional capabilities it has to offer to the learner and SMIL has been selected because of its ability to synchronize and coordinate diverse multimedia elements.

Finding ways to overcome the limits of working memory

According to the traditional three-stores model of memory (Atkinson and Shiffrin, 1968), a way to conceptualize memory is the following: a) one part of memory, known as *sensory memory*, is capable of storing limited amounts of information for very brief periods of time b) a second component, *short-term memory*, is capable of storing information for somewhat longer periods of time but is also of relatively limited capacity and c) a final constituent, called *long-term memory*, is of very large capacity and capable of storing information for very long periods of time, perhaps even indefinitely.

Working memory is defined as being the part of long-term memory, which also comprises all the knowledge that has been recently activated in memory including the short-term memory. This implies that memory comprises three concentric circles, the inner one corresponding to short-term memory, the intermediate circle to working memory and the exterior one to long-term memory. Information resides within long-term memory, and, when activated, moves into long-term memory's specialized working memory, which will actively move information into and out of the short-term memory contained within it (Sternberg, 1996).

Many memory theorists have assumed that working memory comprises multiple memory systems, which most frequently are associated with auditory or visual processing. For example, one of the most acceptable models of working memory proposed by Alan Baddeley (1990) consists of at least the following: a) a visuospatial sketchpad, which briefly holds and deals with visual images and b) an articulatory (phonological) loop, which briefly holds inner speech for verbal comprehension and for processing verbal information. It is believed that the first two systems process their different types of information in a largely independent and parallel fashion.

In relation to the role and characteristics of working memory, our basic suppositions are the following: a) working memory has a limited capacity and duration, that is, we are able to hold and process only a few items of information at a time, b) working memory includes an auditory working memory and a visual working memory, according to Baddeley's theory, c) each system operates in parallel d) meaningful learning occurs when a learner retains relevant information in each system and is able to make referential connections between them (Mayer & Anderson, 1991).

Prior knowledge, Schema acquisition and Chunking

An average person can retain up to a few chunks of information at a time in working memory. Working memory is believed to be capable of storing seven plus or minus two chunks of information at a time (Miller, 1956). In other words, we can think about only five to nine distinct items at any given time. A general way to overcome the problem of limited capacity of working memory is by creating a schema. A schema is identified as a cognitive construct that allows us to treat multiple elements of information as a single element classified according to the manner in which it will be used (Bagui, 1998). Therefore, a schema puts less pressure on working memory, facilitating understanding. Schema acquisition is facilitated by the existence of prior knowledge. Learners who know a great deal about a subject have more well-developed schemata for incorporating new knowledge.

Dual coding and the sensory modality effect

With his dual-coding theory, Alan Paivio (Paivio, 1971, 1986, 1991; Clark & Paivio, 1991) suggested that information is processed through one of two generally independent channels, modes or codes. That is, our imaginal and verbal mental representations may be viewed as two different codes (analogue and symbolic), which organize information into knowledge. Learning is better when information is processed through two channels instead of one.

Connections can be made only if corresponding nonverbal and verbal information is in working memory at the same time. Information processed through two channels is called referential processing and has an additive effect on recall (Mayer & Anderson, 1991; Paivio, 1967, 1991; Paivio & Csapo, 1973). This happens because the learner is able to create more cognitive paths that can be followed to retrieve the information.

The research to date thus suggests that dual-mode input (verbal and nonverbal) helps people learn. But humans can also input information through various sensory modalities. Recent studies have addressed the problem of the combination of modes and modalities that should be preferred in order to promote meaningful learning. For example, should an animation (nonverbal mode, visual modality) be accompanied by an explanation presented as a narrative (verbal mode, auditory modality), an explanation presented as on-line text (verbal mode, visual modality), or by both of these forms of explanation simultaneously?

Drawing from Baddeley's (1992) theory of working memory and Sweller's (1988, 1989; Chandler & Sweller, 1992; Sweller, Chandler, Tierney, & Cooper, 1990) cognitive load theory, several researchers have shown that working memory capacity can be enlarged by using dual-modality presentation techniques (Mousavi, Low, & Sweller, 1995; Mayer & Moreno, 1998, 1999, 2000).

This evidence supports the view that instructional designers should not only be concerned about combining verbal and nonverbal information consistent with Paivio's dual coding theory; it is essential that they take into consideration the role of sensory modalities when designing multimedia presentations with pictures and words. Mixed modality presentations are superior to the most integrated text and visual presentations (Moreno & Mayer, 1999).

The contiguity principle

The contiguity principle was proposed by Mayer & Anderson (1992) as a way of increasing the effectiveness of multimedia instruction when words and pictures are presented contiguously in time or space.

They proposed the use of the term *spatial-contiguity effect* to refer to learning enhancement that results when text and pictures are physically integrated or close to each other rather than when they are physically separated. One interpretation of this result is that students might be missing part of the visual information while they are reading the on-screen text or, vice versa, missing portions of the text while focusing on the pictures. This forces the learner to search for relations between them. The cognitive load associated with this search is extraneous (Mousavi, Low, & Sweller, 1995).

Similarly, the term *temporal-contiguity effect* has been proposed for cases when visual and spoken materials are temporally synchronized resulting again in the enhancement of learning. In these cases, learners are able to hold a visual representation in visual working memory and a corresponding verbal representation in verbal working memory at the same time, allowing them to build referential connections between them, consistent with the dual coding theory. Therefore, differences in synchronicity between verbal and nonverbal materials that need to be integrated in a lesson also affect learning.

Evidence associated with the spatial contiguity effect is provided by several studies (Mayer, 1989a, 1989b; Mayer and Gallini, 1990).

Therefore, another critical aspect of designing instructional software, is to physically integrate the corresponding pictorial and verbal information in a multimedia lesson as much as possible, both spatially as well as temporally.

Two alternative combinations for presenting information based on the learner's prior knowledge

The previous discussion has led us to adopt two different and complementary approaches for presenting instructional material. We take into consideration two states of the learner's knowledge domain: a) no prior knowledge and b) prior knowledge.

There appears to be an enhancement in learning with multimedia, especially for learners with low prior knowledge for whom the rich multimedia environment may also positively influence motivation and engagement. Mayer (1993) believes multimedia information is more effective for learners with low prior knowledge or aptitude in the domain being learned because it helps them build a cognitive model or to connect the new knowledge to prior knowledge.

On the contrary, learners with high domain knowledge have a rich source of prior knowledge that can be connected to new knowledge. In other words, they can make referential connections or build cognitive models with text alone. Furthermore, it is also believed that for learners with prior knowledge in the domain being learned, textual information may force them to expend more effort to read and understand the information resulting in improved long-term encoding of the information (Najjar, 1996).

In the following sections we discuss the characteristics and advantages of each of the two combinations.

Hypertext and pictures

Reading text is a complex process. Learners expend more effort when reading, in order to understand information. This results in improved long-term encoding of the information.

In many cases, the use of text alone is not sufficient to help the reader understand concepts and ideas. It has been proven that by incorporating pictures within text, the learning process is enhanced. Visual illustrations make abstract ideas and complex information more concrete and easier to comprehend. Pictures seem to allow very rich cognitive encoding that allows surprisingly high recognition rates (Najjar, 1996).

The combination of text and pictures is effective because it allows for the concurrent coding of verbal and non-verbal information. There has been evidence to show that adding voice to textual presentation degrades learning.

Animation, voice and text labels

Voice is a more realistic and natural mode of presenting information than displayed text, because of the perception of the person behind the voice and the verbal loop (acoustic) we use to store information. Voice does not distract visual attention from stimuli such as diagrams, and is therefore more engaging. It is good for conveying temporal information (Shih & Alessi, 1996).
Despite the potential advantages discussed above, voice suffers from a) the problem of being ephemeral. Text remains in front of the eyes of the reader for a longer period of time. This makes it more suitable than voice when studying and critically analyzing the educational material. Voice lasts only for an instant in time and is more difficult for a learner to control and b) the problem of being difficult to search through for a specific piece of information, something with does not occur in the case of text. The above characteristics point to the view that text is more appropriate for the in-depth investigation of the educational material.
Animation is a motivational way to present information visually. Studies (Najjar, 1996) have shown that information presented in this form of animation appears to be more effective for learners without prior knowledge or aptitude in the domain being learned. In contrast, learners with high domain knowledge have a rich source of prior knowledge that can be connected to the new knowledge. In this case, we could exploit the advantages of combined text and picture presentation techniques.
By using text labels, we facilitate the creation of a schema by giving a cue to learners to focus their attention on the most important points during a certain portion of a narration. The combination of animation and voice is effective because we use non-verbal and verbal information through two sensory modalities.

The interface design

The above research has important implications for the design and practice of multimedia instruction and has served as the basis for the particular user interface design we have adopted. On the one hand, an effort was made to be consistent with the findings of previous studies of working memory resource limits and cognitive load principles. On the other, we have tried to create a flexible interface that can accommodate diverse learning preferences. Flexibility refers to the learner's ability to select a different presentation style from the one initially recommended.

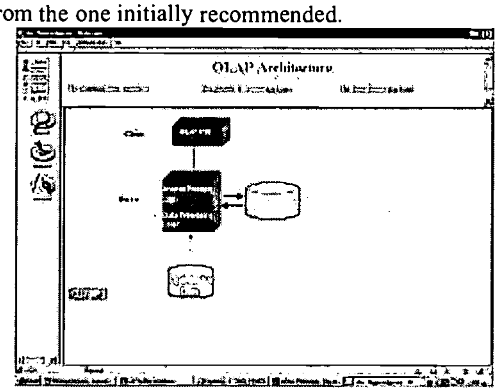

Figure 1

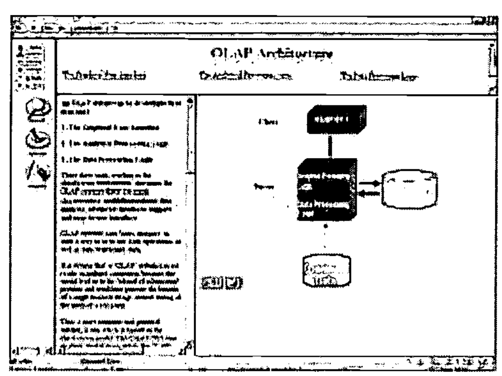

Figure 2

Figure 1 shows the default user interface displayed to the learner upon commencement of a typical instructional unit. The screen has been divided into three frames, one of which (the frame containing the text and static pictures) is not initially visible to the user. In trying to benefit from the processes of schema acquisition and chunking, we have taken care not to present learners with too many different pieces of information or ideas at the same time.
Each lesson has been divided into smaller chunks of related information called *instructional units*. The top frame contains the title of the lesson as well as links to associated chunks which comprise the particular lesson. The frame below the title contains the multimedia content including animation, explanatory text

labels as well as the accompanying auditory information. The explanatory text labels have been incorporated into the animation, in accordance with the principle of spatial contiguity, ameliorating the ephemeral characteristic associated with voice. This frame also includes buttons for controlling the flow of the presentation. For example, the learner can pause and restart the animation and voice, change the volume of the voice, etc. Links to related chunks of information are also provided through the use of hot spots (temporal or spatial links) on the diagram. This navigational feature is supported by the SMIL language (discussed below).

The learner can reveal the hidden frame, as shown in Figure 2. This allows for simultaneous viewing of on-line text and animation with the option of listening to the corresponding narration.

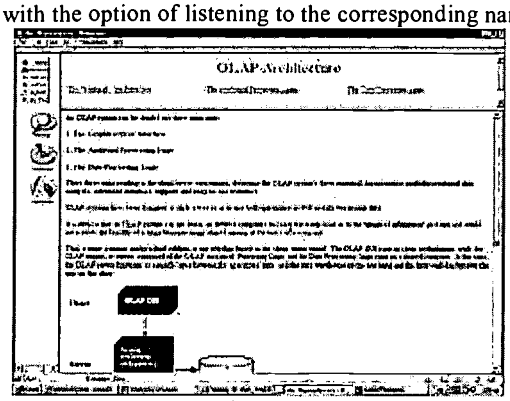

Figure 3

Figure 3 portrays an alternative presentation mode. After the learner has viewed the presentation once (the recommended but not obligatory viewing method), the animation frame may be completely closed so that the learner may study the material in the form of text together with accompanying static pictures.
This process is believed to:

- initially increase learner motivation and engagement during the first viewing stage when prior knowledge of the domain being learned is still nonexistent or at a considerable low level,
- increase learning outcomes during this first stage through a combination of animation and voice and,
- have a positive impact on understanding and retention of the presented material due to the use of text and static pictures in the second stage of its viewing.

Smil and other implementation issues

The implementation of the flexible user interface for the multimedia material is based mainly on the SMIL Language. Using SMIL, it is possible to define screen regions, associate media objects with the regions, and synchronize the appearance of media objects.
The main reasons that we selected SMIL were:

- it can integrate and co-ordinate many diverse types of multimedia information, synchronizing one or more animation files with voice and also text labels,
- we are able to define spatial and temporal links
- it can be considered as an "open", platform-independent technology based on W3C XML.

One of the fundamental problems encountered during the implementation of a multimedia, Web-based course is undoubtedly the limited bandwidth of the Internet. This is perhaps one of the main factors that justify the lack of extremely high-quality multimedia material. We use streaming technology to address this problem.
The product selected was RealServer created by Real Networks. The specific streaming technology makes use of the RTSP (Real Time Streaming Protocol) instead of the HTTP protocol. Figure 4 shows the architecture of the system. There are two servers: a Web server provides conventional html pages while a streaming media server supplies rich multimedia content to the learner.

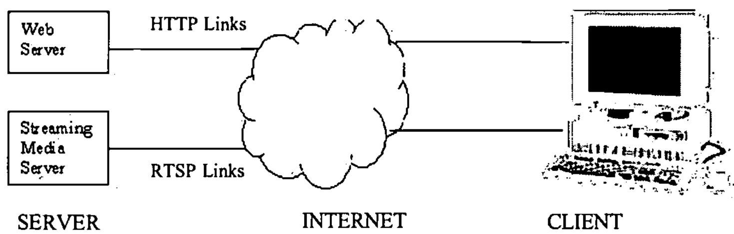

Figure 4

Conclusion

Until recently on-line courses available to university students worldwide were in the form of text-based material with static pictures.
Recent studies have provided evidence for the claim that multimedia has a positive effect on the learning process. However, we need to take into consideration many factors regarding the way learners receive, encode, store and process information. In addition, a central matter of concern seems to be the level of prior knowledge. Bearing this factor in mind, we have proposed a specific user interface design suitable for use through the Internet.

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Social Work Education, Teaching Pedagogy, and Computer-Facilitated Instruction in the United States: Results from a National Survey

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Abstract: This paper reports results from a national survey in the United States of the pedagogical practices used by social work educators who use and social work educators who do not use computer-facilitated instruction (CFI). Respondents completed three instruments that measured teaching styles, teaching goals, and instructional strategies. The primary outcome is the preliminary identification of the pedagogical activities of educators who used and who did not use technology in their teaching activities. Results provide information about a.) Educators' teaching styles, b.) Their perceptions of essential teaching goals, c.) The types of software applications currently used by these educators and the Level of CFI Use, d.). The effect of gender, rank, level of program in which the educator taught, and curriculum emphasis of the educator on the Level of CFI Use, and e.) The ability of teaching styles or teaching goals to predict CFI use.

Introduction

Students in today's colleges and universities face multiple learning demands in rapidly changing educational environments and educators are finding themselves moving quickly into uncharted territory to teach these students. Educators also face increased expectations to include computer-based technologies in their teaching activities. Roblyer, Edwards, and Havriluk (97) suggest that educators who lack a teaching model to support the integration of computer-based teaching into the curriculum frequently adopt computer-based teaching for reasons unrelated to sound teaching pedagogy. These reasons range from a desire to match their colleagues, enjoyment of a new activity, or because they 'feel pressured' to add some type of technology to their instructional strategy repertoire. The lack of an empirically supported educational technology model has led many educators to adopt a pragmatic or 'add and stir' approach. This often contributes to chaos, frustration and high levels of failure when using technology in the classroom. In addition, there is concem that educators who use computer-based instruction, because of the demands placed on them to learn, use, teach, and maintain the technology in their courses, may not place as much focus on the importance of teaching goals and course objectives as do their counterparts who do not use technology in their teaching and learning activities. The foundation for all teaching, with and without the use of computer-based technologies, should begin with an identifiable pedagogical teaching approach. In addition, this approach should support and inform educators about the use of technology for instruction, thus placing technology in the supporting role as an instructional strategy, not at the forefront of the pedagogical process (Florini, 89). In order to be better prepared for the integration of computer-based education, educators must increase their understanding of the best teaching practices for using computer-facilitated instruction in their teaching activities.

Literature Review

There are many models and multiple definitions for educational technology which is defined as the systematic application of processes and procedures for the development of instructional strategies using a comprehensive array of technology-based systems (Astleitner & Leutner, 95; Bell-Gredler, 86; Gagne', 77, 87; Heermann, 88; Jonassen, 1988; Laurillard, 93; Merriam & Brockett, 97; Reigeluth & Curtis, 87; Reiser & Ely, 97; Roblyer, Edwards, & Havriluk, 97; Romiszowski, 88; Sheckley, 86). However, educators are untrained in the field of educational technology and many have minimal contact with professionals trained in instructional design. Preparing educators to use computer-based technologies in their teaching activities requires knowledge about how educators teach. This requires that all educators possess knowledge about their teaching styles, teaching goals, and have access to a wide range of instructional strategies. This information is crucial for both educators who do not use computer-facilitated instruction and educators who do use computer-facilitated instruction in their teaching. However, very little information is available about the impact of CFI on the educator's teaching pedagogy; nor is there is much information about the specific teaching practices used by educators who integrate technology into their teaching activities. Thus, there is a significant lack of information to guide educators in the systematic integration of CFI into the curriculum.

Five terms are relevant to this research project: pedagogy, teaching styles, teaching goals, instructional strategies, and computer-facilitated instruction (CFI). Knowles (75) has suggested that the body of theory and practice on which adult leaming is based should be referred to as 'andragogy' (Bell-Gredler, 86; Merriam & Brockett, 97); thus, the use of the term 'pedagogy' to describe the teaching of adults in higher education may cause concem for readers. Pedagogy also describes the art and science of teaching, but its tradition is in the teaching of children. However, the term 'pedagogy' has long been associated with adult education. For this paper, the term pedagogy describes the process of teaching in higher education.

Teaching style is defined as the educator's patterns of beliefs, behaviors, and needs. These patterns when employed in the classroom can reflect the teaching pedagogy of an educator (Airasian, Gullickson, Hahn & Farland, 95; Axelrod, 80; Conti, 89; Grasha, 96; Singer, 96). Knowledge of their teaching style can make a difference in how educators organize their classroom, how they deal with learners, and how well their students do in learning the course content (Conti, 89). Two of the most widely recognized teaching pedagogies are referred to as traditional and constructivist teaching practices.

Teacher-centered instructional pedagogy is a well-known term for 'traditional teaching pedagogy' and is the most widely practiced teaching approach (Bell-Gredler, 86; Roblyer et al., 97). For this paper, the term teacher-centered pedagogy refers to this traditional teaching pedagogical approach. Many faculty in higher education are products of this teaching philosophy. This process is referred to metaphorically as the 'empty vessel' (Walz & Uematsu, 97) or the 'banking' approach (Freire, 93). The teacher-centered approach is a process in which the educator deposits knowledge into the student's head. As the recipients of this knowledge, students develop skills in receiving, filing, and storing this knowledge 'deposit'. The sharing of information is usually one-way, that is, from teacher to student, with the student acting as the passive recipient of information.

The second teaching approach, 'constructivist teaching pedagogy', is classified frequently in the literature as student-centered teaching. In this approach, the teacher places the student at the center of her or his teaching activities. For this paper, the term student-centered pedagogy refers to the constructivist teaching pedagogy. The often-quoted phrase "sage on stage to guide on the side" is an apt description of the philosophical differences in teaching concepts represented by these two theoretical practices (King, 93). Student-centered pedagogy reflects a constructivist perspective that explains how people come to know their world (Bruner, 66; Freire, 93, 94, 96; Knowles, 72, 75). Knowles suggested that it was "no longer realistic to define the purpose of education as transmitting what is known in a world where the half-life of facts and skill may be ten years or less, half of what a person has acquired at the age of twenty may be obsolete by the time that person is 30 (p. 15). Student-centered educators place the student at the center of their teaching and make use of available resources in the environment such as the student's knowledge and prior 'lived' experiences (i.e. the student's social, historical, personal, and community context). This teaching style benefits the student's capabilities for critical and creative thinking, for solving problems and for making decisions, and for the development of reflection skills (Schon, 91), analytic skills, and communication skills. This approach is particularly useful when teaching students to become self-directing and self-initiating learners and is particularly effective with students in higher levels of learning programs such as juniors, seniors, and graduate programs (Grasha, 96; Weston & Cranton, 86).

Teaching goals for all instruction are to develop and strengthen lower order and higher order thinking skills in the cognitive, affective, and behavioral or psychomotor domains of learning (Bell-Gredler, 86; Bloom, B. 56; Frayer, 97; Gagne', 77, 87; Grasha, 996; Heermann, 86; Jonassen, 88, Jonassen, et al., 93; Knowles, 75; Laurillard, 93; Merriam & Brockett, 97; Reigeluth & Curtis, 87; Roblyer et al., 97; Romiszowski, 88; Schon, 91; Singer, 96; Vayda & Bogo, 91; Wager & Gagne', 88; Weston & Cranton, 86). Teaching goals, in this paper, refers to activities directed primarily to the development of thinking skills within the cognitive, affective, and psychomotor domains of learning.

Weston and Cranton (86) define instructional strategies as the teaching methods, medium, or materials used in instruction. Computer-facilitated instruction (CFI) describes the merging of instructional processes and procedures with computer-based technologies and support systems to form an instructional strategy. For this paper, the term computer-facilitated instruction describes the merging of instructional processes and procedures with computer-based technologies and support systems to form an instructional strategy. Thus, CFI, in this research, refers to the act of teaching with and through computer-based technology rather than the act of teaching without the use of technology.

Method

This research used an exploratory survey design to identify the pedagogical and educational technology practices of undergraduate and graduate social work educations in the United States. Participants completed 3 survey instruments. These instruments were placed in a packet which incorporated suggestions by Dillman (83) to increase mail response patterns and contained (a.) a cover letter; (b.) an informed consent form; (c.) the Teaching Styles Inventory [TSI] (Grasha, 96); (e.) the Teaching Goals Inventory [TGI] (Cross & Angleo, 93); and (f.) the Instructional Strategies Survey [ISS]. The TSI measures attitudes and behaviors associated with five teaching styles: (a) Expert, (b) Formal Authority, (c) Personal Model, (d) Facilitator, or (e) Delegator. It is a 40 item scale which uses a seven point Likert-type rating which ranged from 1 (Strongly Disagree) to 7 (Strongly Agree). Teaching goals were measured using the Teaching Goals Inventory and results indicate the degree to which respondents perceive six teaching goals as essential in their instructional activities: (a) higher-order thinking skills, (b) basic academic success skills, (c) domain-specific knowledge and skills, (d) liberal arts and academic values, (e) work and career preparation, and (f) personal development. It is a 53-item scale and uses a 5-point Likert-type response rating ranging from 1 (Not Applicable) to 5 (Essential).

The Instructional Strategy Survey (ISS) identified educators' patterns of CFI use by asking respondents to describe their 'Levels of CFI Use'. The ISS contained a checklist using software categories adapted from Roblyer, Edwards, & Havriluk (97) which were integrated with Taylor's (83) tool, tutor, tutee taxonomy: (1.) Tool—using technology as a tool to present access, store, or disseminate information for use in my instructional activities. (2.) Tutor—using technology to learn new information or as drill & practice to develop skills in using this information. (3.) Author [tutee]—using this technology to author or develop course related materials. It also reported sociodemographic variables.

This research employed a two sample approach. Sample 1 was a national, proportionate, stratified random sample of undergraduate and graduate social work educators (N = 461) and who were mailed a pen and paper version of the packet. Sample 2 was a convenience sample of social work educators (N= 79) known to be interested in CFI and who completed an online version of the survey packet. Response rates of 45.55% (n = 210) for sample 1 and 64.56%, (n = 51) for sample 2 were achieved with an aggregated response rate of 48.33% (n = 261).

Data from both samples were aggregated for the statistical analysis and results were reported for the overall sample and for CFI Users and Non Users. Although the mail survey sample was a proportionate, stratified random sample, the electronic and online sample was a convenience sample drawn for their interest in computer-facilitated instruction. Given a possible bias effect, all parametric tests were computed for the total sample and for each of the two samples. Results are reported for the total sample for each parametric test and findings for sample 1 and sample 2 are reported only when significance was found. See Table 1 for descriptive data for the total sample and Table 2 for descriptive data related to CFI Users and Non Users groups. Sums for the Levels of CFI used as instructional tools, tutorials, and to author (create) projects/materials can be found in Table 3. The results from 'Levels of CFI Use' were analyzed, using Multivariate Analysis of Variances (MANOVA) to determine the effect of (a.) gender and rank and (b.) the level of social work in which respondent taught and the area of the curriculum in which the respondents taught on the 'Levels of CFI Use'. Table 4 contains reliability estimates for this administration of the TSI and TGI and Table 5 contains mean scores for the subscales for the TSI and TGI for CFI Users and Non Users. The extent to which teaching styles or goals predicted CFI use was examined with logistic regressions. Assumptions were tested using $p > .01$ and statistical significance for MANOVA and logistic regressions were tested at $p \leq .05$.

Results

Tables 1 summarize the sociodemographic data for the total sample of respondents. There were more respondents in ;public institutions, more female respondents, most were full time employees and most taught in combined (undergraduate and graduate programs). Respondents indicated that they averaged 13.81 years (SD 9.66; Range = 40.75) of teaching experience and their average age was 51.08 (SD 9.02; Range = 46).

Table 1
Sociodemographic Characteristics for the Total Sample (N = 261)

Institutional Affiliation (n = 243)	f	%	Gender (n = 244)	f	%
Public	187	77.0	Male	96	39.3
Private	56	23.0	Female	148	60.7
Employment Status (n = 245)	f	%	Level of Social Work Program in which Respondents Taught (n = 244)	f	%
Full Time	217	88.6	Bachelors	41	16.8
Part-time & Adjunct	20	8.2	Master's	37	15.2
Other	8	3.3	Combined	166	68.0

	Rank ($\underline{n}$ = 245)				
	f	%		f	%
Instructor	24	9.8%	Associate Professor	64	26.1
Assistant Professor	85	34.7%	Full Professor	59	24.1
			Other	13	5.3

Table 2 summarizes the data for CFI Use by institutional affiliation, gender, rank, level of program in which There were slightly more CFI Users (58.8%, $\underline{n}$= 153) than Non Users in this research; more were employed in public institutions, and there were more females than males who described themselves as CFI Users.

Table 2

Sociodemographic Characteristics for CFI Use ($\underline{n}$ = 261)

	CFI Use ($\underline{n}$ = 260)				
	Yes		No		
	f	%	f	%	
	153	58.8	107	42.2	
	Institutional Affiliation ($\underline{n}$ = 242)				
	Yes		No		% Within CFI Use
	f	%	f	%	
Public	107	57.5	79	42.5	77.0
Private	32	57.1	24	42.9	23.0
	Gender and CFI Use ($\underline{n}$ = 243)				
	Yes		No		% Within CFI Use
	f	%	f	%	
Male	58	61.1	37	38.9	41.7
Female	81	54.7	67	45.3	58.3
	Rank and CFI Use ($\underline{n}$ = 244)				
	Yes		No		% Within CFI Use
	f	%	f	%	
Instructor	11	45.8	13	54.2	7.9
Assistant Professor	47	55.3	38	44.7	33.6
Associate Professor	37	57.8	27	42.2	26.4
Full Professor	40	69.0	18	31.0	28.6
Other	5	38.5	8	61.5	3.6
	Level of Social Work Program in which Respondent Taught and CFI Use ($\underline{n}$ = 243)				
	Yes		No		% Within CFI Use
	f	%	f	%	
Bachelors	25	61.0	16	39.0	18.0
Master's	23	63.9	13	36.1	16.5
Combined	91	54.8	75	45.2	65.5

Table 3 summarizes the data related to the Levels of CFI Use and the categories of CFI Use. Interestingly, more females than males were using technology for all Levels of CFI Use: tools (58.6%, $\underline{n}$ = 78); tutors (58.2%, $\underline{n}$ = 78); and authoring agents (57.9%, $\underline{n}$ = 31). However, males were much more likely to report higher rates of CFI Use for each user at all Levels of CFI Use: tools ($\underline{M}$ = 2.09, $\underline{SD}$ = 3.36), tutors ($\underline{M}$ = 4.45, $\underline{SD}$ = 3.91), and authoring agents ($\underline{M}$ = 2.04, $\underline{SD}$ = 3.3). Proportionately, more respondents in combined programs used technology as tools (67.2%, $\underline{n}$ = 90), tutors (66.7%, $\underline{n}$ = 90), and authoring agents (66.4%, $\underline{n}$ = 89). Slightly more undergraduate (bachelors) faculty ($\underline{n}$ = 24) reported using technology use as tools (17.9%), tutors (17.8%), and authors (17.9%) than did faculty in stand-alone graduate (masters) programs. Despite the fact that fewer respondents from graduate programs were using CFI, these respondents reported a higher rate of use of technology as tools ($\underline{M}$ = 6.55, $\underline{SD}$ = 2.8), as tutors ($\underline{M}$ = 4.48; $\underline{SD}$ = 3.19) and as authoring agents ($\underline{M}$ = 1.9, $\underline{SD}$ 2.64) per user than any other group of respondents.

Table 3

Categories and Levels of CFI Use as Tools, Tutors, and Authors

Software/Applications	Tools	Tutors	Authors	Totals
Word processing	200	86	33	319
Graphics or Presentation	101	53	29	192
Databases or Spreadsheets	83	45	17	145
Statistics	95	80	20	195
Communications	229	148	49	426
Audio-Visual	19	11	6	36
Clinical software	7	5	3	15
Gaming software	2	4	1	7
Courseware	12	10	11	33
Web authoring	27	20	19	66
World Wide Web	135	108	38	281
Total uses	900	570	226	1696
Total users	143	120	56	

The contribution that the gender, rank, level of program (undergraduate, undergraduate, combined) in which respondents taught, and the area of the curriculum in which respondents taught made to the Level of CFI Use was examined. Neither gender nor rank had any effect for CFI Users ($p > .05$). Overall, it would appear that educators were not significantly different in their Level of CFI Use by gender or by rank. For sample 1 (mail survey), however, gender was statistically significant but accounted for only 8.2% of the variance in the Level of CFI Use (F = 3.048, Eta squared = .082, p = .032). Significance was found for the difference in means between males ($\underline{M}$ = 6.22) and females, ($\underline{M}$ = 4.5) at the tool (($\underline{M}$ difference = 1.724, p = .01) and for males ($\underline{M}$ = 3.76) and females ($\underline{M}$ = 2.43) at the tutor ($\underline{M}$ difference = 1.327, p = .023) Level of CFI Use; thus, suggesting that gender could have an effect on CFI use at the tool and at the tutor level. While gender may have had an effect on the Level of CFI Use as tools and as tutors, its contribution to explaining this difference was minimal (8.2%). Thus, when data from sample 1 was examined as part of the overall analysis, the effect of gender on the Level of CFI Use was no longer significant.

Further, no significance was found for the effect of the level of social work educational program in which respondents taught and respondents' primary curriculum teaching areas on Level of CFI Use. It would seem that, overall, educators do not differ for Level of CFI Use by level of social work educational program in which respondents taught nor in their primary curriculum content teaching areas. However, for sample 2, significance was found for the main effect of the level of social work educational program in which the respondents taught ($F = 2.878$, Eta squared $= .798$, $p = .028$) and it accounted for 79.8% of the variation found in the dependent variables (levels of CFI use). Significance was found at the tool level ($\underline{M}$ difference $= 2.850$, $p = .049$) for CFI Use suggesting that the differences between undergraduate ($\underline{M} = 8$) and undergraduate and graduate (combined) programs ($\underline{M} = 10.85$) was significant enough to effect CFI use as a tool. However, sample 2 is a very small, convenience sample ($\underline{n} = 51$) and when analyzed as a part of all CFI Users, statistical significance is no longer found.

The reliability estimates for the TSI fell within an acceptable range ($a = .54$ to $a = .69$). The reliability estimates for the TGI also fell within an acceptable range ($a = .78$ to $a = .97$) (See Table 4). Mean scores for teaching styles of the total sample suggested that educators were more likely to employ 'Expert', 'Facilitator', and 'Delegator' teaching styles. Both CFI Users and Non Users reported higher mean scores for 'Expert', 'Facilitator', and 'Delegator' teaching styles (See Table 5). For the TSI, characteristics of the 'Expert' teaching style are more closely associated with teacher-centered teaching styles while 'Facilitator' and 'Delegator' teaching styles are more closely associated with student-centered teaching style. On the TGI, .in general, Non Users reported higher means for all six goals than did CFI-Users. While all educators reported perceiving higher-order thinking skills as the most essential teaching goal, Non Users perceived this teaching goal as more essential than CFI Users.

Table 4

Estimates of Internal Consistency for Teaching Styles and Teaching Goals

Teaching Styles					
Subscales	N	M	SD	Total Sample	*National Sample[a]
Expert	254	5.18	.89	.58	.78
Formal Authority	261	5.22	.78	.69	.82
Personal Model	261	5.27	.61	.64	.74
Facilitator	261	5.60	.45	.66	.80
Delegator	261	4.90	1.59	.54	.72
Teaching Goals					
Subscales	N	M	SD	Total Sample	National Sample[b]
Higher Order Thinking Skills	252	3.92	.01	.97	.77
Basic Skills	241	3.05	.12	.83	.79
Knowledge	237	3.47	.16	.83	.71
Values	250	3.34	.22	.78	.84
Professional Development	248	3.10	.05	.87	.85
Personal Development	247	3.35	.11	.90	.86

a--A. Grasha, personal communication, February 22 and 28, 1998; b--Angelo, Thomas A. and Cross, Patricia K. (1993). Classroom assessment techniques: A handbook for college teachers. San Francisco: Jossey-Bass Publishers.

Logistic regression analyses, using backwards-stepwise procedures, were computed to determine if teaching styles or teaching goals could predict CFI Use. After removing the teaching styles subscales, Expert' ($R = -.1299$, $p = .0053$) and 'Personal Model' ($R = .1357$, $p = .0039$) teaching styles appeared to be best predictors of CFI use, even though their contributions were minute (1.6%, 1.84%, respectively). However, there was evidence of an inverse relationship for the use of 'Expert' teaching styles and CFI Use; the more likely the educator was to report 'Expert' teaching style, the less likely s/he was to be a CFI User. In the final analysis, the results of the logistic regression indicated that teaching styles could classify CFI Users (62.14%) more accurately than Non Users; however, this classification was not substantially better than random chance.

For teaching goals, 'Higher order thinking skills' was the only significant subscale of the six teaching goals ($R = .-1735$, $p = .0013$) and accounted for 3.02% of the variance. This relationship was also found to be inverse; that is, the higher a respondent scored on this subscale for teaching goals, the less likely that person was to use CFI. The results indicated that teaching goals could classify CFI Users (79.73%) more accurately than Non Users (49.40%). In particular, higher order thinking skills as a teaching goal was most likely to contribute to this classification, except that it was more likely to predict Non Users; but this classification was not substantially better than random chance either.

Discussion

The results of this research while certainly not definitive due to its exploratory nature, found trends in the data that offers potential areas for discussion and future research. Of particular interest are the data related to (a.) gender and CFI Use, (b.) levels of program in which respondents taught, and (c.) the results from the teaching styles and teaching goals and CFI Use. Not only were females well represented in the overall sample, but also more females reported CFI use in their teaching activities than did their male counterparts. However, even though fewer males were CFI Users, they were using more technology per user than females. These results suggest that future research efforts should examine gender equity in relationship to teaching and technology use in higher education. First, it is possible that female social work educators find themselves with less time to learn and integrate technology into their teaching practices, as do many of their peers who report increased stress in managing multiple roles related to career and family (Magner, D., September 13, 96). In addition, there is much history in higher education in the United States for institutional patterns of gender biases as well as programmatic biases in technology support and equipment towards the less scientific programs in higher education may further complicate this situation. A final factor to consider related to gender equity and technology use may be related to curriculum assignments. For example, the assumption in the field is that educators who teach in the practice related courses are least likely to be CFI users. Females often comprise the majority of faculties in social work education who teach in the direct practice course content. Male faculty are more likely to teach in the research and policy curriculum content areas of helping professions. Finally, gender-equity research related questions should address similarities and differences for female educators and their patterns of CFI Use across multiple programs in higher education. Do the patterns found in this research hold true for female educators in other disciplines? There is a perception that females experience higher levels of anxiety and attitudes that are more negative towards the use of technology. Thus, if the numbers of female faculty are increasing in higher education and, if it is true that females are more likely to experience technology anxiety and perhaps even technology phobia, then it is conceivable that women would be slower to adopt technology in their teaching activities. Furthermore, female educators who do adopt technology are perhaps more likely to use technology simply as a tool, rather than proceed to higher levels of CFI use.

Another result that merits discussion is that more faculty in combined (undergraduate and graduate) social work programs reported CFI use than any other level of social work program while graduate program faculty were the least likely to use technology. However, this same graduate faculty also reported the highest number of instances of CFI use per faculty member. First, research-based institutions, which are more likely to house combined social work programs, are more likely to have increased access to technology-related resources, thus increasing the likelihood of CFI use at all levels (Green, 99). Stand-alone undergraduate and graduate programs are often less likely to be housed in colleges and universities with these types of institutional resources. In addition, faculty in graduate programs tend to have decreased teaching loads with increased emphasis on research productivity rather than classroom instruction. This frees graduate faculty to develop and use more technology than their peers teaching exclusively in undergraduate programs.

Finally, it should not be surprising that social work educators reported higher mean scores for 'Expert', 'Facilitator' and 'Delegator' teaching styles than for 'Formal Authority' and 'Personal Model' teaching styles. The 'Expert' teaching style characteristics are consistent with teacher-centered teaching philosophy while the 'Facilitator' and 'Delegator' teaching styles characteristics reflect a more student-centered teaching philosophy. One would expect that social work educators, as well as educators in other helping professions, are more likely to use student-centered teaching styles, thereby empowering students to experience learning at a personal level in the classroom. These educators have to train their graduates to work collaboratively, while balancing the need to think for themselves and use critical thinking and problem-solving skills in their professional practice activities. In many of these helping professions, their graduates need the skills to make decisions that affect the safety and well being of their future clients.

The data from this research are also similar to the research data for teaching styles in the general population of educators. The trend in higher education has been for educators, most often male tenured faculty, to report the use of teacher-centered teaching styles and for female educators to report the use of student-centered teaching styles (Grasha, 94, 96; Magner, D., September 13, 96). In this research, male educators tended to report higher mean scores for teacher-centered teaching styles while females were more likely to report higher mean scores for student-centered teaching styles. Grasha (96) also found that faculty at the rank of professor tended to employ 'Expert' and 'Formal Authority' teaching styles more often than did faculty at other ranks. This finding should not be surprising and is, potentially, a reflection of the historically larger number of males in the higher education at the rank of professor in the United States and the age of this faculty.

Further, the findings from this research suggest that teaching styles do not significantly influence CFI Use or Non Use and, overall, the decision to use CFI or not to use CFI is unrelated to teaching styles with one exception. Social work educators who scored high on 'Expert' were less likely to be CFI Users. This finding is consistent with the information available for educators who do not use CFI. Educators who report or use the 'Expert' teaching style (teacher-centered) are interested in 'depositing knowledge' into students' minds; are more likely to use lectures as their primary instructional strategy; and may often teach to the lower order thinking skills required for learning in introductory courses. Thus, it is possible that they will not use CFI except as a tool to present information (e.g., using PowerPoint to deliver lectures for large classes) (Grasha, 96; Magner, D., September 13, 96).

For teaching goals, Non Users perceived all six teaching goals as more essential than did their counterparts. However, more importantly, Non Users perceived 'higher-order thinking skill's to be the most important teaching goal regardless of gender, rank, social work program, or curriculum emphasis. In fact, 'higher-order thinking skills' made the most significant contribution to the prediction Non Use. Again, the finding that all educators, regardless of CFI Use or Non Use, perceived higher-order thinking skills to be the most essential teaching goal should not surprise the reader given the need to provide our graduates in helping professions, such as social work, with the problem-solving and thinking skills to make life and death decisions. However, what does it suggest when CFI Users perceive all teaching goals, including 'higher-order thinking skills', to be less important than Non Users? This finding gives credence to the public belief and professional concern that educators often add technology to their curriculum for reasons unrelated to sound pedagogical purposes If, as this research suggests, CFI Users perceive higher order thinking skills and other teaching goals to be less important than do Non Users, what does this reflect: Institutional issues related to resource allocation and support?, The educator's difficulty in balancing the learning outcomes and integration requirements for CFI use?, The inability of technology to be a conduit for effective teaching and learning?

Implications for faculty curriculum activities, faculty development, faculty training, and research are apparent. First, information about teaching styles of educators can be an important consideration in assigning primary curriculum content areas for faculty and in understanding issues related to student evaluations of teacher effectiveness. For example, if an educator who uses primarily a 'Facilitator' or 'Delegator' (student-centered) teaching style is assigned to teach introductory classes, large classes or research classes, a mismatch of teaching styles may occur which could negatively impact student learning and student perceptions of teacher effectiveness. Further, alternative structures for curriculum development for should be explored. For example, educators who primarily use CFI in conjunction with an 'Expert' teaching style and who's goals are to develop lower order thinking skills may expect primarily computer literacy as a basic technology skill for students. However, educators who use student-centered teaching styles and integrate CFI as tutors or authoring agents in their courses may require more of their students in terms of computer competency. Thus, programs may need to rethink their current practices to course assignments and credits. For example, while educators who use CFI as a tool with an 'Expert' teaching style may be able to adapt to a traditional three credit hour approach, but educators, employing CFI as a tutor or authoring agent and a student-centered teaching style, may benefit by offering courses for four credit hours, thereby providing the additional time needed by students to develop skill and competency in technology use. What is important to note is that one teaching style does not necessarily fit all teachers, nor all curriculums, nor all students.

Certainly, faculty development activities should offer opportunities to strengthen and reward the use of pedagogically sound teaching practices with and without use of CFI. Doctoral programs, which train the next generation of educators, should ensure that their graduates have a foundation in teaching pedagogy and in CFI best practices. In addition, training programs should provide opportunities and resources to move beyond the use of technology as a tool to more advanced and pedagogically based integration of technology in teaching and learning activities. One of the largest barriers to technology use for faculty is the lack of institutional rewards and recognitions. Institutions can ease this burden by examining their tenure and promotion policies and by enlarging their vision to include the development, integration, and research of CFI use.

Summary

The primary outcome of this research project is the preliminary identification of the pedagogical activities currently employed by educators who use and who do not use technology in their teaching activities. Certainly, the results of this research should provide an impetus for further discussion, use, and research on pedagogical issues and educational technology. It seems while educators in general have been slow to engage in dialogue (written or verbal) about teaching from a pedagogical perspective, educators do have consistent ideas about which teaching practices are most essential. Framing CFI use as an instructional strategy in the curriculum provides educators with a reference point for knowing when and what types of technology to use to achieve course-specific learning outcomes. Purposefully matching CFI strategies with teaching styles and teaching goals can improve the practice of teaching with technology. In addition to the benefits for educators, students will benefit as technology literacy and competency skills are addressed through a 'planned infusion' for CFI use; thus decreasing the frustration and confusion often associated with an 'add and stir' approach. The responsible integration of technology into today's teaching activities can provide tomorrow's graduates with the skills to shape the future of technology use in practice.

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Webering a Brazilian University: A successul case of change

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At the Pontifical Universidade Catolica do Parana information technology and distributed learning were considered strategic goals since 1998. This did not mean at all that human resources and technology were made available to reach these goals. The ongoing mentality in many institutions in developing countries is that physical buildings (rather than skilled people combined with proper information technology) is the still the best kind of investment. The paradox to solve, then, is the following: Even though distributed and virtual learning are perceived as strategic and inevitable, higher administration decision-makers insist on traditional ways of investing. How then the transition or CHANGE will ever occur?

EUREKA, a Virtual Collaborative Environment isn't any better or worse than most existing similar. Two factors, however, made a great difference on its adoption by the University : the software was free for faculty and departments and any needed changes and improvements could be implemented quickly, since the development team are faculty and students of the university.

More than 500 virtual classrooms were opened and 15,000 people did take the chance and tried this new idea. The process was made simple: Any faculty could try the concept: all that was necessary was a phone call, a visit or an email! A virtual learning space would be instantly made available to the professor. Preliminary data shows that areas such as Civil Engineering, Economy and Administration were the fastest to try and truly adopt these new ideas. It also shows that some areas such as Teacher Education and Architecture did open quite a few virtual rooms but did not fully understand the potential that IT could offer.

http://www.lami.pucpr.br/eureka

GADEA: A General Framework for the Development of User Interfaces Adapted to Human Diversity

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Abstract: The design of user interfaces adapted to the cognitive, perceptive or motor features of certain kind of users implies the development of different versions of the system, which is frequently too much expensive to appeal the software industry. In this paper we describe GADEA, a general framework for the development of applications whose interface is able to adapt itself to the specific features of its users, observing them by mean of intelligent agents. This framework is not only easy to use by programmers but flexible enough to guarantee a universal access to users with different kind of physical disabilities.

Introduction

Traditional design of user centered interfaces is based on the identification and definition of the target audience of an application. Some design guidelines include the identification and understanding of the target audience as the most important first steps to start designing a product (Apple Computer Inc. 1992; Microsoft Inc. 1998]. The idea is that once the target audience –also known as typical user– is understood, then an interface that effectively satisfies their needs can be designed.

However, the search for the typical user of an application is opposite to the individuality and diversity that makes up some much of our identity. If the design of interaction mechanisms aims to make interfaces accessible and appealing to all users, it cannot rely on abstract generalization (Reynolds 1997). For applications, targeted to an extremely wide range of users for example, there is no way to determine a typical user without falling in dangerous misconceptions. Is it possible to describe the typical user of Microsoft Office? Is it possible to identify the typical user of a generic web portal such as Lycos, Terra or Netscape visited by thousands of users everyday? For some authors such as Schneiderman, (1997) the answer is definitively *no* as *there is no average user, either compromises must be made or multiple versions of a system must be created.*

Following this approach, we have developed GADEA, a general framework for the development of low level adaptive applications. This system is able to create multiple versions of an application dynamically, depending on the individual features of the user's cognitive, perceptive and motor system. GADEA provides a universal access to the interface by mean of automatic adaptation mechanisms, specially designed for different degrees of physical, visual or hearing disability.

GADEA as an Expert System

GADEA is based on the classic expert system paradigm, simulating the behavior of a human agent who establishes an interactive discourse with other human through a multimodal communication channel Wahlster (1991). The agent will be able to select the most suitable interaction style, depending on the unique cognitive and perceptive features of its counterpart, adapting the appearance, contents, locations etc. of the interaction mechanism employed along the interactive discourse.

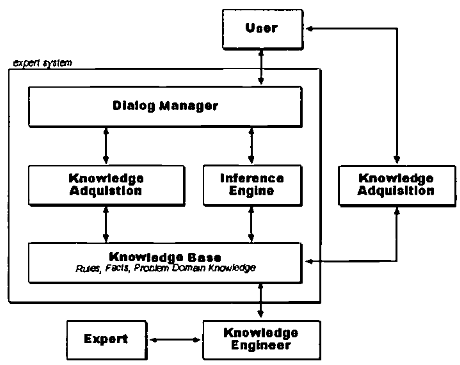

Figure 1: Modified design pattern for the GADEA's expert system module.

An slight modification of the classic pattern for the design of an expert system has been used by GADEA to include an external Knowledge Acquisition module (Fig. 1). This module is able to obtain new facts and rules from the user, including them in the knowledge base, which was previously fulfilled with the facts and rules provided by an expert in HCI. The facts provided by the user include knowledge about the specific low-level features of its cognitive, perceptive and motor system. For example, the age and sex of the user, the user's perception system accuracy (tactile, visual, auditory, etc.), the user's motor system preciseness (for tasks such as key pressing, mouse dragging, mouse pointing, etc.), the reaction and decision time of the user's cognitive system, etc.

GADEA's Modules

GADEA is based on three modules: CodeX, ANTS and DEVA (Fig, 2). CodeX represents the interface between GADEA and the application, converting the user interaction requests in calls to specific methods inside of the application domain's object space. At execution time, the application binary code (Java class files) is automatically inspected by CodeX, who looks for any kind of user processes and data requests, who are then sent to DEVA.

DEVA is the GADEA's proper expert system. It converts the application and user data request into an adaptive interactive discourse. Based on the general knowledge provided by the HCI expert and by the specific knowledge stored in the user model, it uses its fuzzy inference engine to evaluate and to select the best interactive discourse available.

Finally, the ANTS module, employs different kinds of automatic remote agents to obtain information about the state of the specific user's features, which are stored in the appropriate user model entry.

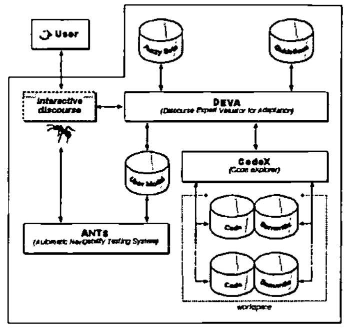

Figure 2. GADEA's basic design.

Conclusions

The automatic code exploring system provided by GADEA allows an easy adaptation of the low-level aspects of a user interface with little or almost no programming effort. The information captured by ANTS along every interactive discourse allows DEVA to adapt the user interface of any application to the current state of the user's cognitive, perceptive and motor system, which tends to fluctuate over time.

Currently, we are working on the design of a low-level adaptive Internet browser based entirely on GADEA's technology, able to be used with the same utility by sighted and blind users, as well as users with physical disabilities.

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An Interactive System for Teaching Electronics

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Abstract: We have developed, tested and assessed a novel educational system for teaching electronics. To implement this system we have developed an "Interactive Lab" application program based on Visual Basic and PSpice. The system was first used to teach the Electronics 2 course at SUNY New Paltz in the spring 1997 semester with much success. It has since been in continual use to teach both Electronics 1 and 2.

INTRODUCTION

The challenges in teaching electronics are to educate the students in the following aspects.

- **Theoretical.** Grasp the fundamental concepts and learn how to apply them to the analysis and design of electronic circuits.
- **Simulation.** Learn how to write simulation code using a powerful circuit simulator such as PSpice.
- **Experimentation.** Verify experimentally theoretical knowledge by assembling and troubleshooting the circuit under study.

The task described above is a formidable one, considering the limited time duration of the theoretical and laboratory classes. Many years ago, educators did not have to include simulation, but by today's standards, a student who does not know circuit simulation will not be able to become a competent engineer. On the other hand, some modern educational systems (Mosterman 1996) exclude the experimentation step and utilize virtual laboratories purely based on software. However, in our opinion, this approach defeats the main purpose of designing and analyzing a circuit, which is to construct the circuit and be able to make it perform close to theoretical expectations.

Therefore, in our view, laboratory experimentation is too valuable to be eliminated. Since the total laboratory time is fixed and reducing the time allocated to experimentation is not desirable, efficient use of the time spent on theory and simulation is essential. Despite the time constraints imposed for theory and simulation, their emphasis needs to be retained. We believe that a computer-assisted application will enhance a student's theoretical understanding and allow for rapidly producing simulation results within the time constraints. For many years, we have worked on developing and improving such a computer-assisted interactive educational system (González & Mandado 1998) (González 1997).

The remainder of the paper is organized as follows: Section 2 establishes our educational objectives and strategy, Section 3 presents a functional description of the Interactive Lab application program, Section 4 discusses the system's educational performance, and Section 5 summarizes the paper's conclusions.

EDUCATIONAL OBJECTIVES AND STRATEGY

Our primary objective is to replace the student's traditional passive role in class with an active one. Our strategy to fulfill this objective is illustrated in Figure 1.

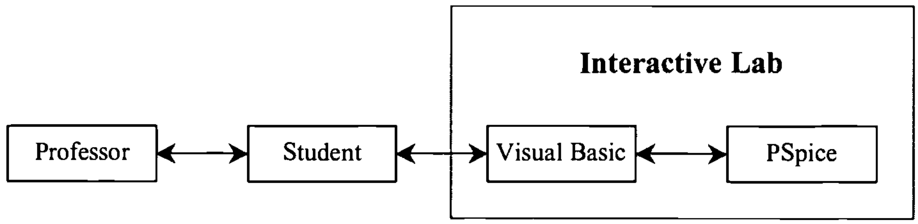

Figure 1: Diagram of developed educational system.

In this system, the professor provides the theoretical explanation of the circuit under consideration in the usual manner. Then the student proceeds to perform calculations on paper to analyze the circuit or to meet the required design specifications. After that, the student *interacts* with the Interactive Lab application.

The following list of goals was considered in designing Interactive Lab.
- Provide students with an insight into the operation of a circuit through simulation.
- Provide an interface that is intuitive and easy to use and that does not require any programming.
- Provide a method that allows students to perform circuit simulation without requiring any previous knowledge of a simulation program such as PSpice.

After several years in development, Interactive Lab was created as a computer-assisted interactive application program to meet the objectives above. The application, which was written in Microsoft Visual Basic for the Microsoft Windows environment, provides an easy-to-use graphical interface to the simulation program PSpice. This idea of interfacing with PSpice has been extended to other environments such as HTML (Valdés, et al. 2000) (Salaverría, et al. 2000), extending a *multimedia* application into a *hypermedia* one. Interactive Lab is written in a modular fashion that presents several choices of circuit simulations that operate in a similar manner. This modularity also allows the program to be easily extended to include additional circuit simulations.

Other than a basic familiarity with the Microsoft Windows environment, no other special computer knowledge is needed. The student can then focus on analysis and design. The application only requires the student to input appropriate values for the analysis or design of a circuit. Time need not be spent learning PSpice commands and syntax.

While at the same time not requiring a student to know how to use PSpice, the student becomes familiar with it because the application reveals the underlying PSpice code used for simulation. This gradual introduction to PSpice should make its formal introduction to PSpice less challenging, as the student is already familiar with some of its commands and capabilities.

FUNCTIONAL DESCRIPTION OF INTERACTIVE LAB

Interactive Lab presents two types of laboratories: theoretical and practical. For the theoretical laboratories, the student is expected to analyze a given circuit and determine some theoretical characteristics, such as gain, cut-off frequency, input resistance, etc. For the practical laboratories, a student is required to calculate component values of a given particular to meet given design specifications. To illustrate the system's functionality, let us consider the practical laboratory "Saw-tooth" which deals with the design of a saw-tooth waveform generator. This laboratory is selected from the Interactive Lab menu as shown in Figure 2.

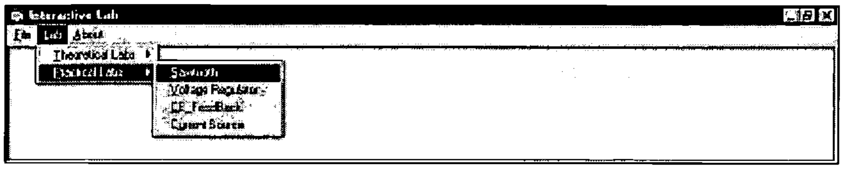

Figure 2: Selecting a particular laboratory simulation.

After selecting the saw-tooth practical laboratory, the student is presented with a window as shown in Figure 3. This window contains a circuit schematic, circuit data and design specification. In addition, there are text boxes for the student to input the values resulting from his/her design.

The student transfers the calculated values to the text boxes one at a time. If a value entered is correct, the student will be allowed to access the next text box. However, entering an incorrect value, that is a value outside a specified range, produces a message box "value out of range." The student will not be allowed to access subsequent text boxes until a suitable value has been entered. We call this feature "Knowledge as a Password." This feature forces the student to review the calculations and thereby prevents a clueless student from obtaining simulation outputs that would be completely meaningless to him/her.

Another useful feature is *hints*, which assists the student in reviewing their calculations. When the student places the cursor over the corresponding component in the circuit diagram, a hint is given. This hint provides useful information that the student can use to calculate the component value.

Once all the correct values have been entered, the student will be able to select the button **Start Lab**. Upon selecting this button, the application generates PSpice code (a .cir file) created from a template that is completed with the values that the student has entered. The application next invokes PSpice to execute that code to perform the simulation. The student is then given access to the PSpice environment to examine the simulation results. Utilizing the PSpice "Probe" window the student can view a graphical presentation of the simulation output as shown in Figure 4. This allows the student to see whether the simulation has performed according to theoretical expectations.

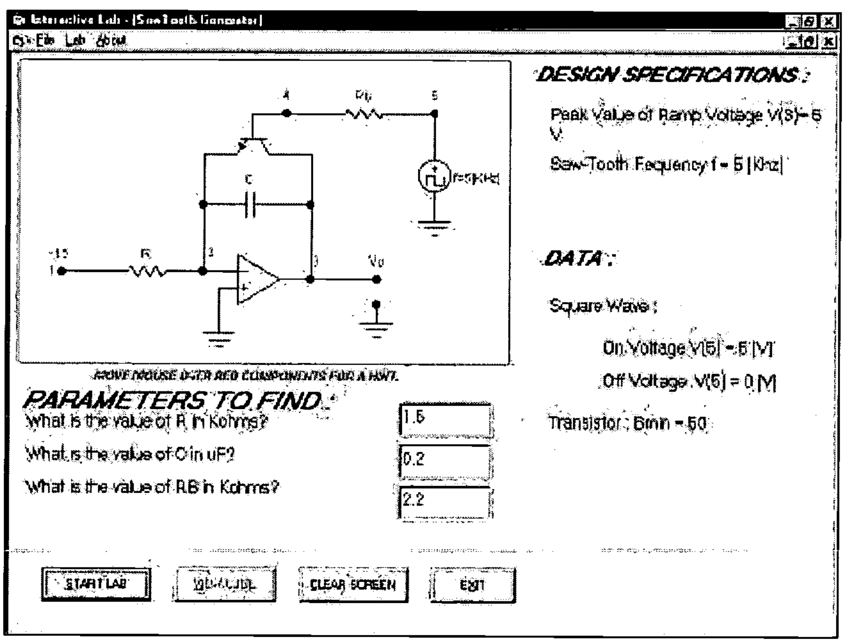

Figure 3: A screen shot of the saw-tooth laboratory simulation.

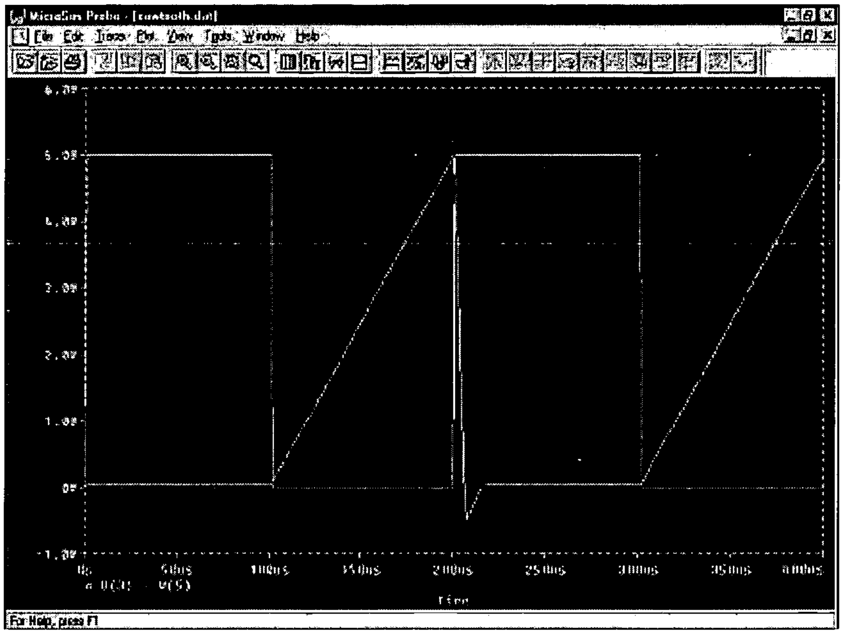

Figure 4: A screen shot of the PSpice Probe window showing the simulation results.

The student can also select the **View Code** button. This opens a window that shows the PSpice code used to perform the simulations as shown in Figure 5. By relating this code to the circuit schematic and the simulation output, the student is able to progressively become familiar with PSpice commands and syntax.

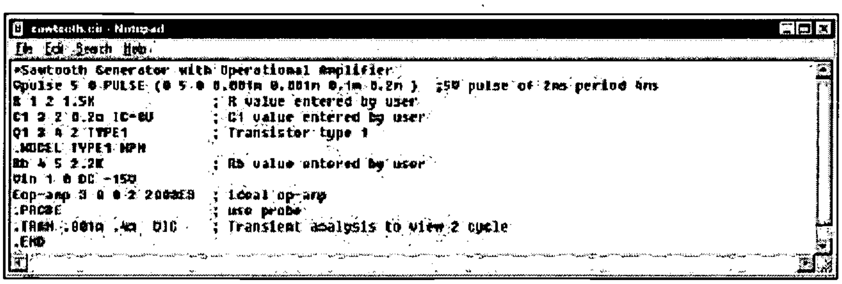

Figure 5: A view of the PSpice code.

RESULTS

Evaluating educational technology is a difficult task that constitutes a research topic by itself (Belfer 2000). Our evaluation approach although primitive is sufficient to point out the advantages of our system. Table 1 shows the average grade obtained by students taking the courses Electronics 1 (E1) and Electronics 2 (E2) at the Department of Electrical and Computer Engineering at SUNY New Paltz. The first author of this paper was the professor in all of these courses. This helps to ensure that the level of difficulty and grading criteria was consistent. To see if implementing the system had a positive effect on the students understanding of electronics we examined the overall grade of the students. We looked at 10 students who had taken both E1 in the fall of 1994 and E2 in the spring of 1995. These students showed an average grade decrease from E1 to E2 of less than 1 point. ($\bar{x} = -0.73, s = 4.96$). The system was first implemented in the spring 1997 semester in E2. Therefore, in order to study the effects of the system, we looked at the 8 students who had taken both E1 in the fall of 1996 and E2 in the spring of 1997. These students showed an average grade increase from E1 to E2 of about 5 points. ($\bar{x} = +4.96, s = 8.47$). We concluded that these improved student grades (one-tailed $t(16) = 1.82,\ p < 0.05$) were due to the use of the system.

While the method used to assess the systems impact is somewhat rudimentary, it substantiates the opinion of the authors that this system provides an incremental benefit to the teaching of electronics. It was also felt that the students who benefited the most were the ones who made a stronger effort to grasp the fundamental concepts.

Semester		Course	Avg. Grade	Number Students
Fall	1994	E1	64.2	14
Spring	1995	E2	64.9	11
Fall	1996	E1	63.7	12
Spring	1997	E2	72.7	11
Spring	1998	E1	69.6	12
Fall	1998	E2	69.4	14
Fall	1999	E1	67.0	10
Spring	2000	E2	68.1	15

Table 1: Average course grades for students of the first author in Electronics 1 (E1) and Electronics 2 (E2). The system was first implemented in the spring 1997 semester.

CONCLUSIONS

We have developed an educational interactive system that increases a student's active participation in class. This system has been satisfactorily tested and shown to improve understanding as reflected in student grades.

Interactive Lab has many beneficial features. The "View Code" feature enables the student to learn PSpice progressively and efficiently. The incorporation of the "Knowledge as a Password" feature requires the student to develop an expectation for the result of the simulation. This reinforces the concept that simulation by itself cannot replace mental effort.

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The Implementation of E-learning in UK Higher Education

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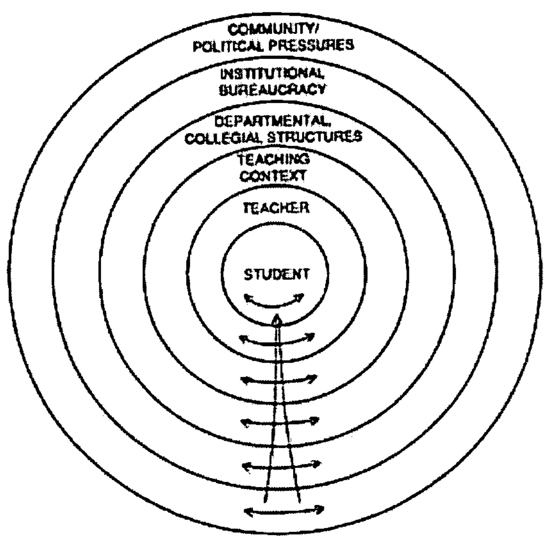
Abstract Higher education in the UK, as in many other countries, is experiencing a period of rapid change, not only because of advances in technology but also because the constructivist paradigm (understood in its broadest sense) has begun to have an impact upon the teaching context in virtually every department of every institution. Change on this sort of scale brings with it many opportunities for renewal and improvement, but also provokes stresses, strains and conflicts that could hinder or even derail the process, so negating potential benefits. By providing a synoptic view of the current state of play in H.E. at the national level, this paper will highlight some of the key issues that need to be addressed if UK institutions are to be successful in integrating information and communication technologies (ICT) into their mainstream provision.

In order to make sense of what is happening in the UK at the moment it might be useful to consider the model of tertiary education proposed by John Biggs (Biggs 1993) just before the technological and educational changes referred to above really began to gather momentum. Drawing upon the work of Ludwig von Bertalanffy (von Bertalanffy 1971) in general system theory, Biggs sees tertiary education as an open system with its own ecology:

> "In the ecology of a system, a change to any one component will, depending on the state of equilibrium already achieved, either effect change throughout and thereby create a new equilibrium and hence a new system, or the changed component will be absorbed, the system reverting to the status quo."

The model he proposes consists of several nested micro-systems wherein "each subsystem attempts a steady state of equilibrium not only internally between its own components, but also with other systems, the immediately superordinate one in particular". Visually, the model is represented like this: (Fig.1)



[The horizontal double-headed arrows represent forces towards equilibrium within micro systems and the single vertical arrow represents forces towards equilibrium across systems.]

At the time when Biggs' article was written, the key relationship, in macro terms, was still the one between the teaching context and the surrounding departmental structures, even though Biggs readily admitted that the balance of forces tends to favour the larger sub-systems:

> "It is true that classrooms can affect departments, departments faculties, and faculties institutions, but it is more likely that the lines of force will go from the larger to affect the smaller system."

But what we have seen since 1994 has changed the situation quite radically.

Despite the abundance of published material on the implementation of ICT, little mention has been made, within the UK context, of the significance of the impact of the Quality Assurance Agency for Higher Education (QAA) but this body has played a major role in defining the educational context in which ICT implementation is being debated. Over the last seven years, first the Higher Education Funding Council for England (HEFCE) and then QAA have been conducting a national review of the quality of teaching, learning and assessment across all academic subjects throughout England and Northern Ireland (alongside a very similar process in Scotland and Wales). Its methods are based on teaching observation, an evaluation of the quality of student work and scrutiny of the systems in place to monitor standards in teaching and learning (e.g. student evaluations, external examiner reports, etc). The significance of these subject reviews for Higher Education should not be underestimated. Firstly, the review process itself is very demanding and resource intensive, particularly for the subject staff under review, and it has come under fire from the Committee of Vice-Chancellors and Principals (CVCP) for this very reason. Secondly, as is made clear in HEFCE's consultation document "Learning and teaching: strategy and funding proposals" (see HEFCE consultation document 98/40 at http://www.hefce.ac.uk/Pub/default.asp) HEFCE's strategy will be to "encourage and reward high quality teaching and learning" and institutions are advised that the results of QAA subject review should be a central element in their bids to the Council for additional funding from the Teaching Quality Enhancement Fund set up by HEFCE. In other words, success at QAA review will impact upon further improvements in funding for Teaching Learning and Assessment (TLA) and universities are very conscious of this.

From the rather narrow perspective of ICT implementation, the impact of QAA subject review has had important consequences, mostly positive. On the positive side, it has succeeded in focusing attention on the quality of students' learning experience and the structures that support it and has thus strengthened the position of those arguing that the role of ICT is to support and enhance student learning. Whereas previously the champions of technology based learning were perhaps seen as peripheral to the main work of departments, their enthusiasm and commitment have become positive assets in the climate engendered by the advent of QAA subject review. Making the change to a more constructivist, student-centred approach, if only in order to meet the standards set by QAA, has greatly helped the case for ICT based learning. On the negative side, however, subject review absorbs large amounts of staff time and, by focusing attention on the effectiveness of routine administrative matters, it might be seen as a distraction, taking away time and resources from other developments.

What then are the criteria applied with respect to TLA at subject review? Its key features are that the review teams, made up of subject experts with a non-specialist review chair, investigate the strengths and weaknesses of provision within the following framework:

- Providers are expected to have a TLA strategy.
- The programme of work should develop and assess appropriately (in relation to the subject's aims and objectives): knowledge and understanding, key (transferable) skills, analytical skills, subject-specific skills, including practical / professional skills.
- Strengths and weaknesses in teaching are to be identified with regard to clarity of learning objectives, quality of materials, student engagement and participation.
- Clear and appropriate learning outcomes are expected and learning should be effectively facilitated in terms of workloads, guidance, supervision and resources.
- Assessment should match learning outcomes, be clear and transparent and promote student

learning.

In terms of what goes on in classrooms, this is a rather coarse-grained approach and there are some significant gaps (there is no specific mention of student-student collaboration for example) but at least it has the merit of concentrating attention on aspects of the learning experience that are central to the constructivist approach: student engagement, the relationship between learning and assessment and the cultivation of understanding as well as the acquisition of skills and knowledge. Clearly, the approach to teaching and learning implicit in this framework is far removed from the "transmission" model which is among the favourite targets of some educational technologists seeking to promote computer-based alternatives to "traditional" or "formal" classroom teaching. But what is perhaps more significant in these developments is that classroom teaching is now embedded in a much wider system of which the QAA is a key component.

To return for a moment to the Biggs model of the educational ecosystem. "When any aspect of the learning/teaching context is the focus of attention," he writes, "the micro-system of which that is a part, and the adjacent systems with which it may interact, need to be taken into account". This is precisely the perspective adopted by the QAA when it expressly links the TLA aspect to the other five aspects, namely:

Curriculum Design, Content and Organization
Student Progression and Achievement
Student Support and Guidance
Learning Resources
Quality Management and Enhancement

For example, a subject's overall TLA strategy is linked to curriculum design, content and organization and learning resources. The teaching component of that strategy is linked to resources and staff development, and student learning is linked to student support and guidance and resources. So, largely as a result of the QAA methodology, what has changed in the UK, in terms of Biggs' model, is that the departmental structures that are relevant to TLA are now strongly conditioned by institutional bureaucracy (in the form of Universities' quality procedures) and these in turn are strongly conditioned by political pressures in the form not only of QAA subject review but also of QAA institutional audit which scrutinizes quality management and enhancement at institutional level. In Biggs' terms, what we are currently witnessing is the re-balancing of the entire system to create, in effect, a new system. It is no longer primarily the components in the **next** micro-system in the hierarchy (departmental structures) which are having the greatest effect on the teaching context. The most important pressures are coming from the periphery, from HEFCE and QAA, and are being transmitted directly to departmental level by the institutions.

The QAA's overview reports (at http://www.qaa.ac.uk/revreps/subjrev/overviews.htm) indicate that a process of change is certainly underway. Reviewers' conclusions do much to dispel the myth that the bulk of TLA in UK universities can still be characterized as "traditional" or "formal" in nature. It was perhaps only to be expected that Communication and Media Studies should be praised for "a wide range of well-considered teaching and learning approaches" which include "lectures, seminars, workshops, demonstrations, tutorials, peer group learning, production projects, small group and team work, film screenings, case studies and critical reviews." What may be a little more surprising to some is that engineering subjects, which in the past have been perceived to be failing to develop deep approaches to student learning (see Ramsden 1992), now appear, in the case of the better providers at least, to be embracing change:

> "Providers achieving the highest grade generally deploy a wide range of teaching and learning methods, including CAL and use of the Internet. In the best examples, the use of directed and independent learning is well integrated with taught elements."
> (Electrical and Electronic Engineering)

The reports also show that specialist reviewers are aware of the importance of IT and the Internet for TLA and that implementation varies greatly both within and between subjects. Comments made in the Sociology overview will strike a chord with a great many university teachers in the UK:

> "Where there are close links with the central services and staff are committed to IT, the

associated software, databases and support are usually available. In such institutions, students were keen and competent in the use of E-mail and the Internet and made full use of the existing resources. However, considerable improvement could be made in the development and application of IT skills."

As this comment implies, the use of IT and, latterly, ICT, in teaching and learning, has in the past largely been a function of the enthusiasm and commitment of small groups of staff within particular subjects, but there is now evidence, in the form of universities' strategies for teaching and learning, that more coherent policies are being formulated with regard to ICT based learning. An analysis of these strategies reveals that most institutions:

- are still in the planning and target setting phase,
- have adopted a gradualist approach,
- are committed to a model where the centre (through teaching and learning units/centres and IT services) supports departmental initiatives,
- are not planning to use ICT to integrate teaching and learning with other student support systems,
- are using a centrally controlled competitive bidding strategy as a way of promoting ICT materials development,
- do not regard materials-based learning (whether ICT based or not) as a viable replacement for classroom contact.

So there are hopeful signs that UK universities may succeed in adapting their teaching and learning to the new technological realities. On the one hand, the technologies themselves are becoming more robust and can provide the performance and functionality that are required. On the other, it seems likely that the continuing influence of QAA in shaping institutions' policies in terms of quality control will have a positive impact on the institutionalization of ICT based learning. QAA has already published a Code of Practice which covers the main elements of "a comprehensive quality assurance process for higher education" (see http://www.qaa.ac.uk/public/COP/codesofpractice.htm). One element of this Code of Practice, published in January 1999 in draft form, consists of guidelines for distance learning (see http://www.qaa.ac.uk/public/dlg/contents.htm) which is seen as having four dimensions, two of them directly relevant to ICT based learning used to support students whether on, or off, campus:

- "*Materials-based learning* ... refers to all the learning resource materials made available by the programme provider".
- "*Learning supported from the providing institution remotely from the student.* This dimension of a system of distance learning refers to defined support and specified components of teaching provided remotely for individual distant students by a tutor from the providing institution."

The purpose of the guidelines is "the assurance of quality of provision and the security of academic standards of programmes of study and awards" and they take the form of a set of precepts defined as "those key matters which an institution might reasonably be expected to be able to demonstrate that it is addressing effectively through its own relevant quality assurance mechanisms".

As far as the implementation and development of ICT based learning is concerned, it would appear that institutions will be expected to conform to a set of standards whose scope is the whole institution, not just the subject or department. The standards cover six main areas:

1. System design
2. Programme design, approval and review
3. The management of programme delivery
4. Student development and support
5. Student communication and representation
6. Student assessment

and the approach is rightly systemic:

"The strength of the chain of system and programme design, implementation, delivery, support, student communication and assessment ... lies in its weakest link."

Of the 23 precepts, spread across the six aspects listed above, four in particular are worth emphasizing in this context (the full list is at http://www.qaa.ac.uk/public/dlg/append2.htm).

Precept 3 (System design)
"Prior to offering programmes of study by distance learning, an institution should explicitly design and test its system for administering and teaching students at a distance..."
The guidelines supporting this precept make specific reference to designing and preparing learning materials, identifying appropriate media, testing lines of communication and field testing materials.

Precept 5 (System design)
"A providing institution's plans for offering programmes of study by distance learning should be financially underwritten for the full period during which students will be studying on them and at a level that safeguards the quality and standards to which the institution is committed."
The guidelines ask for "realistic projections" and "financial policies" with regard to the expenditure and income associated with the distance learning system.

Precept 6 (Programme design, approval and review)
The academic standard of the awards "will be demonstrably comparable with those of awards delivered by the institution in other ways and consistent with any benchmark information recognized within the UK."

Precept 13 (The management of programme delivery)
"The providing institution is also responsible for ensuring that each distance learning programme of study is delivered in a manner that provides, in practice, a learning opportunity which gives students a fair and reasonable chance of achieving the academic standards required for successful completion."
The guidelines stress the need for training and staff development for administrative as well as academic staff and also the need for effective communication between all involved in the provision.

Satisfying the quality requirements in regard to system design in a purely technological sense implies the use of a single, institution-wide system, professionally supported. Administratively speaking, the system will have to embrace a range of functions much wider than the programme of study, and this means the integration of administrative functions within the same technological framework (e.g. student registration, student records, support and guidance and so on). The purchase and maintenance of an integrated system is only a small part of what needs to be costed. As far as materials production is concerned, staff development in instructional design will become essential, even if certain elements of the production process are devolved to a specialist centre, and the training needs of administrative staff cannot be ignored. All of this will be expensive and will need careful central planning even if ICT based learning for on-campus students is the institution's main objective, rather than the full-scale distance learning option.

The precept on academic standards embodies an important principle as far as ICT based learning is concerned. Provided that the quality of the learning experience is demonstrably equivalent to face-to-face delivery, the switch to ICT based learning can be justified simply in terms of efficiency gains for students (more flexible study times and reductions in travel and accommodation costs, for example) and for the institution (provision of classrooms and levels of classroom usage).

In terms of the management of the programme, the relevant precepts and guidelines stress the issue of students' prior skills, knowledge and experience, the need for interactive materials and the importance of effective communications. There are a number of issues here. First of all, a full introduction for all new students to the on-line learning and support system is a necessity and also, incidentally, a natural target for a materials based approach, perhaps in the form of a CD-ROM which simulates the on-line system. Secondly, students should be involved in the progressive development of the whole system, not just the learning materials and the design of the interface, and they have to be listened to. Finally, it is not enough simply to set up administrative structures; what matters is the flow of information between administrators, teachers and students. Course management issues need to be addressed rapidly and effectively and, as the guidelines point out, administrative inefficiencies could easily undermine the whole structure:

"... poor general management or an inadequate administrative infrastructure can negate otherwise good practice in the provision of distance learning."

If a home-based student is able to save significant amounts of time by engaging with ICT, (s)he will not want to have to spend time in a bureaucratic paper-chase around the University's offices trying to get administrative issues resolved.

The growth of ICT in recent times has opened up channels of communication and access to information which have changed higher education irrevocably. What ICT cannot do, however, is to change the way in which students come to understand the process of learning itself. The work that William Perry conducted at Harvard some thirty years ago (Ramsden 1988), is still relevant to teachers in higher education today. Perry, like others in the phenomenographic tradition, is interested in the stages of learning which students go through rather than their individual differences, "academic ability, special talents or disabilities" and he describes a process whereby students progress from thinking that "authorities know, and if we work hard, read every word, and learn Right Answers, all will be well", to the point where they realize that:

"This is how life will be. I must be wholehearted while tentative, fight for my values yet respect others, believe my deepest values right yet be ready to learn. I see that I shall be retracing this whole journey over and over – but, I hope, more wisely." (page 146-7)

and finally accept the full relativity of knowledge. We have all of us watched this type of process unfold over the duration of our students' careers at University, and helping them to make these changes is perhaps one of the best ways of capturing what it is that teachers in higher education really do. By working together with colleagues, as well as with outside agencies such as those described above, and by exploiting the power of ICT, we can make the process by which students gain their intellectual autonomy less arduous and less frustrating, but, in the final analysis, it is the depth and quality of the communication between teacher and student within the learning context which counts.

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How to implement WBT into higher education

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Two examples of WBT courses for university students are presented. The first one is TeleCAD (Teleworkers Training for CAD Systems' Users) and is oriented to teaching basic drawing skills in AutoCAD program and current technology and methodology of teleworking. The second one is MDEC (Multimedia Distance English Courses for Polish Users in Legal, Banking and Finance, Science and Technology, and Safety Training Sectors with Elements of European Union Regulations and Standards). Both projects are based on advanced ICT technology (multimedia, WWW). TeleCAD and MDEC projects were developed under Leonardo Da Vinci programme (1998-2001). Pilot courses for international groups were delivered. Monitoring systems and evaluation procedures online were developed. DE project management support system and online dissemination activities were implemented. Details of Leonardo da Vinci projects are presented at the URL: http://www.dec.pg.gda.pl/dec/index.phtml?id=projekty_leo_en

DISTRIBUTED LEARNING
INTRANET AND INTERNET APPLICATIONS

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ABSTRACT: At a time when learning is finally recognized as a critical component to an organization's success, manufacturing industries are facing an overwhelming challenge to increase efficiency, effectiveness, and competitiveness. Organizations are becoming more centralized, more global, and more competitive, and the traditional classroom model is rapidly losing its value and appeal. Educators and performance improvement practitioners are looking to technology as a tool for effectively growing and maintaining a skilled workforce. Increasingly, companies are using distributed learning technologies to provide timely, economical, and effective learning solutions.

Introduction

Learning has become the most important part of everyone's job. The continuously changing skill and knowledge requirements of workers create a continuous need for learning. Today's organizations require learning to be delivered faster, cheaper, and more effectively. Organizations are reexamining the entire learning process - when, how, and where learning occurs.

The Cost of Training

Most training initiatives in the manufacturing world are classroom driven, led by trainers who were not educated as educators. They deliver content that is often irrelevant, to passive and disinterested learners, on an overtime basis requiring 12 hour shifts, with little or no effective measurements [1]. The costs associated with traditional methods of training are impeding our ability to compete. In 1998, the largest U.S. companies spent over $70 billion on employee training [2]. Half of this was on travel costs, wages, and benefits for employees while in training. A substantial portion was spent on inefficient or outmoded approaches to delivering workforce education.

Perhaps the greatest single issue that impacts classroom learning is time. Most training delivered by instructors is delivered at the pace of the slowest learner in the class. At the same time, companies are applying pressure to limit the amount of time employees spend in the classroom. This dilemma, coupled with an increased demand for training, creates a need for new and innovative methods to develop and deliver more effective training.

The Challenge

Today's technology is reshaping our workplace. As job skills are becoming obsolete, tomorrow's jobs will require a whole new set of worker skills. Not only will the skills of low-skill level employees need to be strengthened, but also employees in jobs requiring high skill levels will require continuous retraining. It is only through company-wide learning systems that organizations can survive. Companies today have little choice but to become learning organizations.

The Learning Organization

The learning organization empowers people to learn as they work. It uses technology to collect, store, organize, customize, and transfer vast amounts of knowledge. The learning organization provides training that is just in time - when it's needed, where it's needed, and how it's needed. The learning organization has four distinct characteristics:

1. It is performance-based; tied to business objectives.
2. It emphasizes skills, and how people process information.
3. It assumes learning is part of work and not separate from work.
4. It incorporates distributed learning applications.

The challenge of learning faster than one's competitors is being met through distributed learning technologies, which include the intranet, internet, computer-based training, and electronic performance support systems (EPSS).

What is Distributed Learning?

Distributed learning is a system and process that optimizes learning and productivity. It considers both presentation (how information is presented to learners) and distribution (how information is delivered to learners) using a combination of technology; learning methodologies, on-line collaboration, and instructor facilitation to achieve applied learning results. Results that are not possible from traditional education are achieved in a flexible, anytime/anywhere fashion.

Whether the training is provided by CD-ROM, the Internet, or the company's intranet, distributed learning provides the power to speed up learning and make knowledge more accessible and economical. Today's corporations are using distributed learning applications to train and retrain both their centrally located and globally dispersed workforces.

In a survey of 700 training professionals conducted in February by the Masie Center, 80% of respondents said that they expect the demand for web-based training to increase in their organizations this year. By contrast, 75% said they expect more demand for web-based training, and more that 60% said they expect the same for classroom-based training [3]. Corporations are using distributed learning applications to address the following needs:

- Job skills technical training and retraining
- Management development and leadership
- Employee orientation
- Customer education
- Government compliance training
- New product and policy information
- Product sales training
- Sales force automation training

Synchronous and Asynchronous Learning

Distributed learning applications can be either synchronous or asynchronous, and generally include a combination of both. The power and flexibility of distributed learning technologies make them suitable for meeting a wide range of education and training needs.

Synchronous learning occurs in real time. It creates a virtual classroom environment with no time delay. For example, an instructor located in Atlanta may conduct a class on Programmable Logic Controllers with students in 20 or more different locations and countries. The instructor can share applications with the students, ask and answer questions, and let a student take control of the screen or simulation software. All that is required of the students is a browser and an audio hook-up, accomplished by a telephone line. Responses to learner interactions and tests are uploaded to a central location for scoring.

Researchers have reported that there is no significant difference in the achievement of students in systematically designed virtual learning environments and the achievement of those in systematically designed face-to-face environments, based on standard performance measures [4]. And with shorter contact times, supplemented with asynchronous technologies, synchronous learning yields superior results.

Synchronous classroom learning has been widely recognized as an effective means of teaching and learning with benefits to the learners and the organization. For example, in 1989 AT&T obtained cost figures for courses delivered via distance learning technologies such as satellite up-link and down-link technologies. The courses were systematically designed using criterion-referenced methods [note 1] (the author was involved in both designing and evaluating the impact of these courses). During that year, 3,650 students attended distance delivered sessions of the courses. Savings in airfare, lodging, and daily expenses resulted in a total cost savings for the 3,650 students of $1,825,000. These figures do not include downtime while traveling.

Asynchronous learning allows participants to learn anytime, anywhere. For instance, students may download and print articles, flowcharts, P&ID drawings, electrical diagrams, or policies and procedures from the company's intranet. Or they may download a computer-based course on Lotus notes from the company intranet. They may take the course later from their seat on a plane. Or a student may elect to take a course on Hazard Communication directly on the Internet from home, at a time that is convenient. When the student takes the test or completes an assignment or exercise, the responses are uploaded to a central location for scoring.

Development and Assessment of a Graduate Level Statistics Course Online

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Abstract: This paper is a report on the development and assessment of a graduate level statistics course taught in an online setting. Students taking the newly developed statistics course online were compared to students taking the course in a traditional classroom. Achievement along with three mediating variables was investigated. The three mediating variables included: prior computer experience, prior math knowledge and experience, and attitude toward the subject of statistics. The participants were forty-two graduate students in their first year of the MBA program. Students' attitudes toward learning in an online environment were favorable. Differences were found in their attitude toward the subject of statistics and prior computer experience; however, no causal relationship in achievement was detected. Students who learned in an online environment achieved comparably to students learning in a traditional classroom.

Introduction

Web based instruction is becoming a convenient and popular means to higher education. Course offerings utilizing web-based instruction are multiplying at unprecedented rates. Although there are many examples of web-based courses, it is now clear that much more is involved than just presenting the components of a conventional course via the Internet (Kahn, 1997). Lectures are not improved by posting them on a web site and discussions do not automatically happen when students are connected to a mailing list or computer bulletin board.

As with any new technology, often the draw is to the technology itself instead of the technology as a tool to enhance learning. When a course is delivered in an online environment, old roles between student and teacher and student and subject become redefined and new roles emerge. Issues involving equity of access, the needs of the learner, and the role of teacher as tour guide and site facilitator emerge. With any college course, the mode of delivery and the design of the course content can make the difference between a learning experience that is truly excellent to an experience that is considered fair or even poor. This holds true for online learning as well. As online educators, it is not enough to utilize new technology, the technology must be accessible to all students and it must enhance learning.

The Statistics Course

Instructivist and constructivist models were utilized to design a Managerial Statistics course for graduate students pursuing their Masters of Business Administration Degree. The course covered principles and applications of descriptive and inferential statistics and was designed to familiarize students with basic techniques for understanding, organizing, describing and computing research data. The course was taught using two different instructional settings. One section of the course was taught once a week in a traditional classroom. The other section was taught in an online environment where a virtual classroom was established utilizing the LearningSpace option of the computer package, Lotus Notes.

Each week using LearningSpace, the online students viewed a slideshow, submitted weekly homework assignments for a grade and participated in online discussions. Students were also responsible for three collaborative learning assignments. The traditional class met once a week for 2.5 hours. The same PowerPoint slideshow viewed by the online class was shown in the traditional classroom setting. Class discussion and problem solving took place during scheduled class time. Traditional classroom students sat for the same three examinations did the same individual homework problems and were given the same three collaborative learning projects as their online cohorts. Furthermore, both courses had the same instructor.

The Study

A holistic approach incorporating both qualitative and quantitative procedures was utilized in this study. Students' attitudes toward learning statistics in an online environment were analyzed using a qualitative approach whereby, questionnaires were distributed and individual interviews were conducted at the end of the course. All data retrieved from the questionnaires were stored, categorized and coded. Individual interviews were built into analytic files, which were sorted using a simple coding scheme. The purpose of this analysis was to assess attitude and the amount of relevant interaction, not just content.

To examine achievement, a quantitative approach was taken. First, an exploratory analysis was conducted whereby, classroom setting (online versus traditional) was analyzed on a number of key variables, which included: prior computer experience, prior math knowledge and/or experience and attitude toward the subject of statistics. To measure attitude, Schau, Dauphinee, & Del Vecchio's (1993) Attitude Toward Statistics test was utilized. Having substantive knowledge in the field of statistics, prior math knowledge and/or experience and attitude toward the subject of statistics are known predictors of success. Second, these key variables were used as predictor variables along with classroom setting in a multiple regression analysis in an attempt to uncover any relationships that may have existed among the predictor variables and achievement.

Findings

Although these groups were self-selected, when the online class was compared to the traditional class, there were no apparent differences in demographics, prior math knowledge/experience and the feeling of value toward the subject of statistics. However, there were significant differences on two variables. These two variables were students' affect toward statistics and their prior computer experience. The online class had a higher average positive affect toward statistics and had more computer experience than the traditional class. The affect score was statistically significant at the .05 level and computer experience was significant at the .10 level.

The significance of affect is consistent with the literature that discusses variables that attribute to success in statistics. This result is to be expected. Student's who are feeling the least bit anxious or who have lower affect toward the subject matter would be dubious to trying an online environment. Furthermore, students with less computer experience could find the online environment threatening. Given the differences in affect and prior computer experience, there is no statistically significant causal relationship between class setting and achievement.

When examining the online students' attitudes toward learning managerial statistics in an online environment, overall students' attitudes appeared to be favorable. However, although traditional barriers to a statistics class online did not appear operational, i.e., lack of computer experience and math anxiety, there was a small subset of the students that did not enjoy learning in an online environment and clearly felt cheated from the experience.

Conclusions

It appears from the quantitative analysis that students who learned in an online environment achieved comparably to students learning in a traditional classroom. From the qualitative analysis, for the majority of the students, online learning is convenient and effective. However, there is a small group of students who need face-to-face interaction with their instructor and their peers to feel that learning is taking place. For these students there is no substitute to the traditional classroom setting. Therefore, as online educators, we need to be mindful of a technologically driven pedagogy that could have the potential for leaving students feeling disenfranchised in a virtual learning environment.

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Use of videoconferencing with computer-supported co-operative work

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Abstract: An evaluation of distributed computer supported co-operative work (CSCW) in a project workshop for students utilising Internet-based videoconference technology, is presented. The workshop has been evaluated in light of relevant theoretical communication factors and according to feedback from the students based on questionnaire data. Conclusions are presented as guidelines for instructors.

Introduction

Computer-supported co-operative work (CSCW) is concerned with how both large and small groups of people can co-operate using computer technology. This paper describes our experience with students participating in a "*Project workshop*" in a distributed CSCW setting. The aim of the *project workshop* was to create distributed project groups that enable students from Switzerland and Germany to co-operate as naturally as possible in order to complete assignments related to different aspects of human-computer interaction. Further, the students should be given the possibility to learn, use and explore the actual state-of-the-art in web-based communication. The choice of Internet-based CSCW tools was motivated by the intention to increase participation through the employment of easily accessible technology. Because of the high technology diffusion in Germany and Switzerland, the participants could run their activities for the project workshop both at the university and at home. The distance between the two institutions ensured that the students had to use the infrastructure to communicate and to co-operate.

The project workshop

The project workshop (URL in References) started in 1998 as a co-operation between the University of Karlsruhe (TH), Germany, Institute of Applied Informatics and Formal Methods (AIFB) and the Swiss Federal Institute of Technology (ETHZ), Institute of Hygiene and Applied Physiology (IHA). Students form project groups for co-operation during one semester. Each project group consists of between 2 and 5 students and involves students from both sites. The students' motivation for participation is either to follow a self-chosen course to gain study credit (AIFB), or as a means to perform an obligatory assignment (IHA).

The workshop enhanced the acquisition of experience with the technology in four ways. First, the students used web-based technology to communicate. Second, Web-based technology is employed to present the end results. Third, the assignments are related to problems using the technology; and fourth, the assignments could be designed as Web pages.

At the beginning of the semester the project workshop starts with an introductory course in the use of the technology (at each site). Then, the students "meet" in a videoconference and discuss the assignments in detail. The group formation is performed online in the first videoconference. The teams exchange names and addresses, and leave the videoconference with the task to contact the other members of their group and to stay regularly in contact to work on the assignment with the available tools. The students at each site are supervised independently, the general schedule is to meet the administrator once per week during the semester.

Infrastructure

We optimised the technology to fit our needs, taking into account that we still have to accept inferior communication quality. To support and augment co-operative group work, special software, so-called GroupWare, is needed. We combined several standard systems to form our GroupWare. The communication- and workspace offered the following functions:

- Audio and video communication between the team members.
- Sharing of workspaces (information and application sharing, co-ordination of shared objects and tools)
- Organisation of the work process, e.g. project management, workflow management and administration of project data, e.g. document management.

To communicate, to share applications and to present results, we used Microsoft Netmeeting© (point to point) with its video conferencing capabilities, white board, chat board, screen capture, file transfer function and application sharing. For co-ordination of our work and for administration of documents, we used BSCW© (Basic Support for Co-operative Work). The BSCW software is cross platform compatible, and supports synchronous (planning and organisation of virtual meetings) and asynchronous (e.g. shared workspace for document transfer) for interactive co-operation. The students have access to BSCW from the project-server via a web-Browser. Presentations and project reviews were presented with Microsoft PowerPoint or as for Web-presentations. In addition the project homepage, e-mail and telephone extended the information and communication possibilities.

The hardware configuration was optimised for our purposes, a powerful computer is essential in order to gain good audio and video transmission quality. At home the students could run videoconferences with lower quality with a minimal equipment, basically with a web-cam and a video-capture-board + microphone. The videoconference equipment at the university is shown in Figure 1 and consisted of:

- 1 PC-workstation (300 MHz, 5 GB Hard Disc, 128 MB RAM, 2 video capture boards, 1 duplex soundboard);
- 1 high resolution colour screen;
- 1 high resolution colour beamer;
- 1 cordless mouse and 1 cordless keyboard;
- 2 VHS-video cameras (for the face of the current speaker and one for the audience);
- 2 microphones (one fixed and one cordless).
- A telephone is available in the conference room, which has been very useful, whenever we had difficulties due to PC-breakdowns or Internet overload.

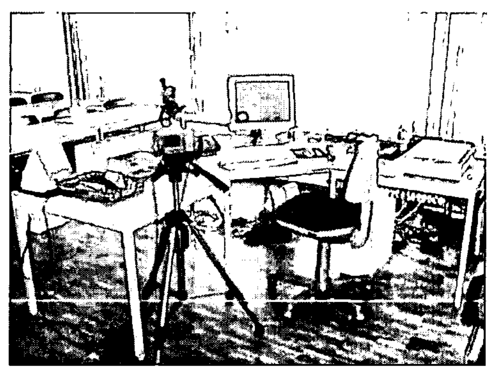

Figure 1: The video-conferencing room

Theory

In a CSCW setting many questions about how to support real communication and co-operation are still open. One of the most present questions of the *Ed-Media'2000* conference was how to enhance co-operation in a distributed context (Ed-Media, 2000). In order to approach an answer it is important to understand the basic elements of communication and co-operation. When working at distance with technical tools to enhance the communication, the tools take on an important function in supporting communication, task management and co-operation.

Communication in the CSCW context

Computer mediated human communication is less "rich" than direct human communication. The challenge not yet achieved with current videoconference technology is to support the different modes of communication we know from real face to face meetings. Communication aspects relevant for CSCW are those directly affecting human task related information exchange. With videoconferencing the communication mode, e.g. verbal and visual information becomes important (Guttormsen & Voorhorst, 1999). The content of the communication can be expressed differently as verbal and visual information. Table 1 shows different *modes* and *contents* of communication. In the following we will look at different aspects of communication. The problem for distributed communication is how to enable optimal communication under conditions in which the natural float of information is impaired.

Content \ Modes	Verbal	Visual
Person oriented	• Transmission of text with relational information. • Spoken relational information	• Voice intonation • Gaze direction • Facial expression • Gestures / movements • Relational visual information
Non-person oriented	• Text with task oriented / formal information. • Spoken task oriented / formal information	• Voice intonation • Gaze direction • Facial expression • Gestures / movements • Task oriented visual information

Table 1: Different content and modes of communication

The Communication Studies Group (CSG) considers person-orientation to be the core-category in understanding communication mediated by teleconferencing. Short et. al. (1976) from the CSG distinguish between *person oriented* and *non-person oriented* communication categories. These categories are based on Bales analysis of communication, which took place in simulated meetings (Bales 1955). From these experiments Bales elaborated four main categories: positive reactions and negative reactions (person-oriented), problem-solving attempts and questions (non-person oriented). Later Bales offered a more differentiated, three dimentional, view on the *person-oriented* factor: (1) *Dominance* vs. *Submissiveness, (2) Friendliness* vs. *Unfriendliness*, (3) *Acceptance* vs. *Non-acceptance of Authority* (Bales 1999).

Also the *non-person*-oriented category has been analysed. Thorngren distinguishes between three kinds of communication in business (Thorngren, 1972). *Programmed* communication activities are routine, repetitive and standardised, e.g. giving or receiving orders, or making sales or purchases. The involved people usually are well acquainted with one another. In contrast, *orientation* communication activities are novel, unstructured and complex, e.g. developing ideas for new products. Between these two extremes are *planning* activities. They result in the development and realisation of alternatives suggested by the *orientation* activities. Other theorists use similar categories: Ansoff (1965) distinguishes between strategic, administrative and operating activities, or Simon's (1960) concepts of intelligence, design and choice.

Co-operation

Successful co-operation pre-imposes that the involved people can establish satisfying communication on the different levels mentioned above. Besides communication between people, CSCW also involve sharing of information and of task-space, co-ordination, organisation and decision-making (Ohlson et.al, 1993, Macaulay, 1995). In a co-operation context an important distinction can be drawn between the person space and the task space. The shared task space (Buxton 1992), or action space (Harrison et al. 1996) can be distinguished from the space where people are physically or virtually present, i.e. a place (Harrison et al. 1996), or a person space (Buxton 1992). When people share the same person space and the same task space communication and the exchange of information are facilitated naturally. The flow and quality of several modes of communication (e.g. speech, gestures, expressions, text and graphics) arrange itself almost automatically. Co-operation pre-imposes that people share the task space. Distributed CSCW implies that the task space is being shared, but only a part of the information concerning the person space. Reducing the information from the person space has impact on the content of the communication. Hence, a rich CSCW context should offer communication tools that also support person-orientated information.

Evaluation

We evaluated the project workshop according to tool use and satisfaction by the termination of the spring workshop 2000. The intention was not to perform a quantitative statistical analysis, but rather to get an impression of the most successful communication channels. Data was collected by means of a questionnaire addressing the frequency and related satisfaction of tool-use. The return rate of the questionnaires was 85 % (n=7) from Zurich and 75 % from Karlsruhe (n=9). Table 2 shows an overview over tool use and satisfaction.

	Videoconference tools			Other tools				
Mean	**Video-conf.**	**Program-sharing**	**White-Board**	**Text**	**E-mail**	**E-mail + data**	**Tele-phone**	**BSCW**
Freq. use	10.1	5.4	3.9	8.3	27.7	15.9	3.9	17.0
Satisfaction	4.6	3.7	3.7	2.6	1.9	1.9	1.9	3.3

Table 2: Overview over tool use and satisfaction

The table shows the mean number of times a tool was used over the semester. Satisfaction is the mean of ratings on a scale from 1 to 7, where 1 was *excellent*, 4 *neutral* and 7 *too bad*. Prior experience in distributed CSCW: mean = 5.2 on a seven-point scale where 1 was much and 7 was none. 25 % of the students performed the videoconferences at home. General satisfaction: 76.9% of the students would recommend a study colleague to participate in the project workshop, 23.1 % did not know. The students were also asked to express their experience with the workshop. The feedback could be sorted in three categories: positive and negative and reactions related to co-operation. On the *positive* side the experience with the new technology is prevalent. The reactions show that videoconferencing was given high importance:

- "This is THE chance to work with new media and communication possibilities as well as applications. The world talks about videoconferencing, the project workshop is the best way to learn about the technology in a playful way, about what is possible already, and how it functions."
- "It is a great experience to work with videoconferencing although it didn't always work."

The *negative* feedback was mostly related to technological factors:

- "The quality of the videoconferences was often bad."
- "Good experience but hard to communicate. Technology is still a steep threshold."

Much of the feedback was related to the new *co-operation context*:

- "There are lot of possibilities in videoconferencing and Internet, but I think it will take some time before communication in co-operative teams is as effective as a face-to-face meeting. It needs a lot of learning on both sides."
- "The co-operation across such a long distance as well as locally repeatedly, presented new challenges. It was very interesting because it was different from traditional student assignments. The co-operation between the universities should be continued and even extended."

Discussion

The most used tools were e-mails, BSCW, e-mails with attachment and videoconferencing, in this order. The use of telephone was low in comparison to e-mails. Some students reported that telephone calls were used to spontaneously address the need for a group session. E-mails accomplished asynchronous communication needs. Distribution of information with e-mail is more time independent than telephone calls. The frequent use of e-mails with attachment shows that the BSCW tool did not reach full acceptance among the students. Some students also spontaneously reported during the semester that they preferred e-mails for the transmission of smaller files. However, the co-operation often implicated the generation of large files and applications, which only could be shared and distributed effectively with the BSCW tool.

In spite of the unstable video-quality, the students still preferred to run videoconferences at an average rate of almost once per week during the semester. In light of our observations and their comments the reason is most likely to be first, that they were inclined to want to experience this technology and second, that it did offer the only way of demonstrating their on-going developments: the feature program sharing enabled on-line and synchronous co-operation sessions. Further, the accessibility of the videoconference equipment must account for the relatively low usage. Due to the fact that the videoconference-room was used for many activities in the institutes, the students could not access it spontaneously. This certainly resulted in less use of videoconferences as a means to communicate for some, while other compensated for this by installing the necessary equipment at home. Videoconferencing from at home impairs the video/audio quality more than at the university because of slower transfer via modem. The reported complaints may also reflect this.

Person-orientation seemed not to be the major reason for the use of the videoconferencing tool. The videoconferences did not offer enough information about all the modes of communication to satisfactorily support person orientation. In line with recent research we found that the video image was less important for the perceived communication quality than the voice. Good video-quality, without satisfying voice-quality can not enhance communication. Some students even reported that they closed the video-window in order to focus on the shared application. The voice quality during videoconferencing reached telephone quality, consequently the verbal information mode was feasible.

In general, our CSCW setting made co-operation possible. All of the groups produced accepted assignments, some of the assignments were outstanding with a quality and volume not to be expected from single person effort. The reported dissatisfaction concerning co-operation may reflect poor person-oriented interaction. Obviously, the students noticed that distributed co-operation did influence their collaboration style. Most clearly this was expressed as loss of personal contact.

General discussion

We recognise a general positive effect of the creation of distributed co-operation teams. The combination of two universities/countries results in an extended information transfer and larger information space. The students take advantage of the extended pool of knowledge resources and experience.

We found the assignments to have a key function in stimulating the distributed co-operation. Earlier experience taught us that the assignment is an important key to real co-operation. When we first started, the assignments comprised theoretical work and literature reviews. These tasks did not really require the students to work in a close co-operation. The result was rather that they adopted a kind of parallel work style. Co-operation was only initiated by the end of the semester in order to co-ordinate the presentation. We predicted that more direct interaction throughout the semester could be achieved by giving assignments with more components of design, also integrating work with a graphical representation and the development of interactive demonstrations related to the topics. To reinforce this development we required the students to present their work as Web pages, which also were accepted as a replacement of a printed report. As results of these actions, we have noticed a remarkable improvement in use of the tools and active co-operation during the entire semester.

The intention to keep up with new technological development was a major motivation for this workshop, both for the students as well as for the organisers. Our distributed co-operation concept invoked a pioneer spirit, which positively influenced the groups and also implied more tolerance towards the technological deficits. The project workshop enables the students to practice and experience new communication and co-operation methods. This serves as preparation for the increasingly computerised environment they may be expected to meet when leaving the university to work.

Some problems were, however, obvious. First, high motivation can not completely make up for the immature videoconference technology. The video frame-rate for Internet based videoconferences does not guarantee fluent movement, and the audio quality when the load on the net is high, makes long conferences too exhausting. Other practical consequences were related to the fact that two different institutions co-operated. The semester schedules between the two universities were not always identical. Consequently, the project workshop could not always start at the beginning of the semester for both sites, and also not end according to the semester brake for both sites. Last but not least, the student's motivation for participation differed between the two universities because of different credit systems. This resulted in an unequal pool of students at the two sites. Some students expressed that a more equal distribution of students from each site would have been better.

Practical implications

Our experience is formulated as a set of guidelines for communication, co-operation and technology use. Further guidelines for how to optimise communication, co-operation and tool use CSCW in a student setting are offered by (Bordeau et. al., 2000; Mcculay, 1995).

Utilise assignments that support co-operation. The assignments have an important role in initiating real co-operation. Theoretical work does not encourage co-operation to the same extent as assignments that incorporate practical design (e.g. interface design, web publishing).

Ensure that the assignment is interesting for the team. Fascination for the use of new technology is not enough for a close co-operation. A good team is motivated by the possible outcome of the teamwork.

Let the team members modify the assignment to fit their qualifications and interests. Present the initial assignments as a concept idea with a rough strategy for how to proceed. This is a means to increase the motivation in the team and to support autonomous team organisation. Students often interpret the assignments differently to the organisers, hence use this as an opportunity to start a discussion about the content of the assignment. Setting the final aim of the assignment is a part of the learning process in the team.

Reinforce the technology employment in the assignments. Reinforce multiple ways to employ the technology, if possible. (In our case the students developed solutions to various software ergonomics problems presenting both the theoretical work and eventual applications in web pages.)
Make the technology accessible. If at all possible, offer the teams portable videoconference equipment, to be used at computers available within the university or at home.
Employ user friendly software. Students have an educated preference for good software. When alternatives exist, they will automatically use the tools that are easily available and easy to use. (The BSCW-tool in our context, in spite of its powerful potential, may not have come to its full employment for the co-operation management, because of the easier alternative with e-mails.)
Offer multiple communication and co-operation channels. People have different preferred means of communication and different means for co-operation. If a variety of tools are available everybody should be able to find their preferred method.
Practice correct videoconference behaviour and presentation techniques. Videoconferencing is for most students a new experience, and even under good conditions it demands a new behaviour. A small communication guide for an Internet-based-setting, is given at the Project Workshop Web page (URL in ref. list). We have repeatedly observed that it requires some hours of practice until the students adopt these rules, and before they do, the videoconference sessions are often dominated by communication relating to misunderstandings.

Further research

In spite of the existence of different conferencing system satisfaction and usability with such systems still have to be improved. The remaining problems are caused by low usabilit and low platform compatibility, related both to technology and applications. Due to such problems the use of videoconferencing in a CSCW setting is still not widespread. Important questions to be addressed in this context are:

- How do communication and co-operation tools influence communication *content* and *modes*?
- How can different *contents* of communication be achieved in a distributed CSCW context, and to which extent?
- How can we optimise the employment of existing tools to enable a rich communication?

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Teaching University-Level Computer Science to High School Students over the Web

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Abstract: The need for novel approaches to attract high school students to information technology related careers is huge. At the same time, very few high school teachers have been trained to teach these topics. In collaboration with high school teachers in the rarely populated district of North Karelia, Finland, the department of Computer Science of the local university created a program to teach university-level Computer Science studies for high school students. The goal was to provide a flexible and reliable learning environment for the students to ensure a meaningful way of learning. The educational design is based on a Candle model: the students get help to their authentic learning needs from the web-based environment, in terms of exercises, learning tools, and feedback. However, the learning material consists of real textbooks. Preliminary results indicate that the scheme chosen has motivated the students to carry on their learning efforts.

1 Introduction

In Finland, the Ministry of Education is funding a three-year project to establish the Virtual University of Finland, during years 2001-2003. One of the particular goals in the project is to develop new methods for science education. The three universities in eastern Finland, University of Joensuu, University of Kuopio, and Lappeenranta University of Technology, work jointly in the virtual university project. One of the concrete objectives is to create a web-based learning environment in introductory Computer Science, intended for high school students. From the research perspective of educational technology and Computer Science education, this task is a particularly challenging one. We have aimed at designing a solid model for building the environment.

The project is called *Virtual Certificate*, indicating that high school students can take 15 credits of Computer Science studies in one and a half year via the Internet. In the Finnish system, each credit equals 40 hours of studying; 160 credits are required for the Master's degree. Thus, after passing all the 15 credits of the program a student has the first year Computer Science studies completed. Moreover, if the student passes the program with grade 2/3, she is free to enter the university as a Computer Science major.

Why are we offering Computer Science studies for high school students? There are three major viewpoints to support our decision.

1. There are very *few qualified Computer Science teachers* in most of the schools. Moreover, most of the students live far from universities and each other; therefore, it is not possible to solve the problem by sending temporary teachers to these schools or invite the students to the university.
2. There is a great *need for professionals* in the computing industry. As a partial solution, Computer Science departments have to be able to attract more students. By entering the university with the first courses completed already at high school, the students will have better chances to finish their studies.
3. From the research point of view, it is important to *assess the Internet as an educational tool*. Like the extensive popularity of mobile technology in Finland indicates, high school students are enthusiastic about new opportunities in web-based education. Moreover, they are open to give very frank and well-grounded feedback on the systems they use.

The main educational dilemma to solve in the project consists of several interrelated factors:

- High school students are used to an instructional setting different from that at a university.
- The opportunities of the Web are limited in compensating for a missing, face-to-face teacher.
- Complete web material covering 15 credits of Computer Science courses was too much to compose within the given time constraints.
- Synchronous communication or even delivery of asynchronous video lectures was out of question because of the low bandwidths available at students' homes.

Therefore, we had to create a model to support designing web-based instruction. We ended up to a scheme that we call a *Candle* model. The main principle was to create a package that helps the student at authentic learning problems or critical situations, in a simple and meaningful way. We wanted to provide him with electronic candles to show the learning path, step by step. However, we assumed that he has got the required facilities by himself, like a textbook and an encouraging tutor.

Basically, the Candle model of web-based learning requires an intelligent technique for accessing the needed support for authentic learning needs. For the time being, the system is not yet adaptive. However, approaches based on prerequisites for learning a given topic and outcomes of learned material, like used in AHA (De Bra & Calvi 1998) and InterBook (Brusilovsky et al. 1998), may be utilized in our model. However, contrary to the common uses of these systems, we will not compile the basic learning material to the web. Even in the future, we will make full use of textbooks, and the Candle-based environment will consist of various targeted tools. These tools support the user in the authentic learning needs while studying the textbook-based material.

Theoretically, the problem of locating information relevant to a given user is a challenging one. However, in the area of computer-supported learning, different schemes have presented. For example, the Ahmed environment for special needs education models the learning process as a path in space; the learner moves from one learning seed another (Kurhila & Sutinen 1999). These seeds can be learning tasks, and the system suggests the learner to proceed to the next seed based on the system's assessment of his or her performance at the previous seed.

Most of the discussion around web-based education, like virtual universities, stresses the importance of users' needs. After all, distance learning by technology, with little human touch compared to regular education, requires a highly motivated student. Whereas in the traditional setting face-to-face instruction or hand-to-hand-guidance compensated for obscure *learning goals*, the very same obscurity often shadows a web-learners path, or *learning process*. Therefore, at least the final goal must be clear enough to encourage a lonely learner's walk. The Candle model is designed to enlighten the path as well.

2. Overview of the Offered Courses

In the program, the 15 credits include nine different courses. Courses will give students basic knowledge of three main domains: introduction to Computer Science, basics of programming, and preliminaries of computers. The emphasis in this project is to give students good programming skills. We chose to use Java as programming language. This gives students a chance to present their work via Internet after completing the courses. The timetable and structure for the courses is illustrated in Table 1. We use the abbreviation cu to denote a credit.

General knowledge about computers, 3 cu		
	Computers, operating systems and networks, 1 cu	Fall 2000
	Practical use of computers, essential applications and network Services, 1 cu	Fall 2000
	Computers and society, 1 cu	Fall 2001
Introduction to Computer Science, 5 cu		
	Design of algorithms, 1 cu	Fall 2001
	Hardware structure of computers and operating system, 2 cu	Spring 2001
	Research fields of Computer Science, 2 cu	Fall 2001

Programming, 5 cu		
	Basics of programming, 2 cu	Fall 2000
	Programming part 2, 3 cu	Spring 2001
	Laboratory project, 2 cu	Summer 2001

Table 1: Timetable for the courses

Most of the courses have a similar structure: students have material to work with, they do weekly assignments, and their learning outcomes are evaluated by an exam. However, we have tried to add flavors to studies by employing a few other teaching methods. *Group activities*: A few courses will be implemented so that students work in small groups. We hope that this encourages students to work collaboratively and brings about interaction into the learning process. *Learning by writing*: Students compose an essay on a certain subject. This is hopefully done in cooperation with local newspapers: the students will be reporting on what they learn. *Netbus consulting*: An Internet-connected bus will visit each school for a few hours. A Question & Answer session will be organized, as well as individual consulting. *Days at campus*: To make the students experience themselves as members of the academic community, they are invited to the campus on four days during their studies. *Camp at campus*. The theoretical course on algorithm will be arranged at campus, as a one-week intensive period.

3. Design Principles

The educational and instructional design of the package is based on a close collaboration between high school and university teachers. In fact, the expertise of the high school teachers was invaluable since it helped us to coordinate the courses to the schedules of the schools – which differ quite a lot from school to school! Moreover, the teachers made the designers to understand the limitations of the students. Furthermore, they emphasized that the students want to be a part of the university: therefore, it was essential to give at least a few real lectures, and examinations. A group of teachers is monitoring the course during the whole period of 1.5 years. In fact, the contribution from the teachers was crucial for the development of the Candle model.

3.1 Educational Design: the Candle Model

The Candle model is designed to support a student loCally in her Authentic learning NeeDs, by Electronic tools served in a Light way. Thus, cANDle emphasizes **real human contacts** for the learners. The web site helps the students to communicate with the *instructors* and each other in multiple ways. Instructors are Master's level Computer Science teachers working at university. Furthermore, each school has a *tutor-teacher* who supports students in different situations. Tutor-teachers do not need to be experts in Computer Science but their pedagogical knowledge is crucial. They are experienced teachers who can support the students' learning process sufficiently. The students also help each other, both locally and over the Web.

Another major design principle in candlE is to **link the printed learning material with an activating learning environment on the web**. The printed material gives a main structure and knowledge of the domain while the web materials guide the learners step by step. Activating *visual tools* like Jeliot, Excel, and BlueJ serve as students' virtual laboratory. *Exercises* play an important role in the learning process. Especially in programming the learning-by-doing principle is effective. Each student must complete at least 1/3 of all the course exercises; those who exceed the minimum requirement get bonus points for the grade. The bonus point system has been a motivating factor to the rate of answers. Although we have restrictions about the amount of exercises, we have been as flexible as possible to the students concerning practical matters like timetables, to meet the needs of most students.

In Candle, almost all **teaching is carried out via Internet** because the students come from all around the district of North Karelia. Students do not have to waste their time and money by travelling from their home to the university.

In our experience, sophisticated user interfaces in many web-based educational settings might be confusing for a novice. The features tend to be superficial or shallow, and often of no pedagogical importance. Therefore, candLe keeps the **user interface simple**. To make the interface of the learning environment more student-friendly, we hired a fresh high school graduate to design the pages.

3.2 Learning Environment and Course Materials

We have built a specific learning environment for the students by WebCT. The students can connect to the environment with commonly used browser (Internet Explorer, Netscape) and the use of the environment does not require any special equipment. WebCT works with a low bandwidth. This is essential because the students connect to the environment often at home by modem. The environment includes learning materials, discussion forums, chat, personal homepages, etc. Every student has a personal username and password for the courses so the environment is closed for outsiders.

Course materials on the web are composed mainly by HTML and they mainly support the printed materials. The course textbooks give a complete information of the subject, and web material is designed to help students in critical situations. The web material brings the most essential parts of the course to the learners and it quickly shows the structure of the domain to the student. Furthermore, web materials provide examples, visualizations, and interactive experimentation to the students. We hope that the web material will provide active learning experiences and helps the students in their learning process.

In addition we are planning to use video clips as mini-lectures. These lectures will give extra information and improve comprehension in specific more complicated areas. The clips will be approximately 5 minutes long because we think that the longer clips would be boring for the high school students. With short clips we can focus on one or two narrow pieces of information or skill.

3.3 Tools

Visualization has long been an important pedagogical tool in Computer Science education. The use of the web and interactive animations provide opportunities to expand the availability of visualization-based teaching and learning tools. We have been experimenting with BlueJ, Jeliot and Excel that provide activating learning tools. BlueJ is an integrated visual teaching environment and language, developed at Sydney University and Monash University. BlueJ helps students to understand object-oriented concepts such as objects and classes, message passing, method invocation, and parameter passing (Kölling 2000). The aim is to concentrate on solving programming problems without becoming distracted by the mechanics of compiling, executing, and testing Java programs.

The Jeliot environment allows a web user to animate algorithms of his own over the Internet (Haajanen et al. 1997). The user writes a Java program in a text field of a Web page, submits it and gets back its animation. The animation is generated automatically from the source code, and it is displayed on the user's screen. Built on an extensible architecture, Jeliot can be modified to animate most common data structures. Jeliot 2000 is a program animation system intended for teaching Computer Science especially to high school students (Ben-Ari et al. 2000). The emphasis is on program animation that demonstrates the execution of input-output, assignment, selection, and loop statements. The original Jeliot was structured as a server application together with a client applet so that it could be run from a web browser. It was decided to change the implementation of the Jeliot to a single application for the following reasons: simplicity, reliability problems with browsers in newer versions of Java and the availability in the school laboratory of PCs powerful enough to install the Java runtime environment on them.

We have also been studying how to prepare animations of simple algorithms with Microsoft Excel spreadsheet program. Excel offers a light, adaptive and inspiring platform for creating visualizations of various needs in Computer Science (Dybdahl et al. 1998, Rautama et al. 1997). A teacher can prepare visualizations for teaching or visualizations can be student assignments. Two standard features of Excel, i.e. data visualization and macro programming with VBA provide together an environment to animate algorithms. Jeliot and Excel have been successfully experimented in Computer Science courses in the University of Helsinki.

4. Evaluation

The first 93 students of the program started in August 2000. After the first two months, there were approximately 80 active students, coming from eleven different schools in the district of North Karelia, as far as 100 km from the university.

4.1 Case: Basics of Programming

We evaluated the second completed course, Basics of programming, which covers the introduction to the concepts of programming in Java. The general feedback from the students and the teachers has been mainly positive and we got enthusiastic answers for our exercises. There were 50 exercises in the course so if the student wanted to take part in the exam he had to complete 17 of them. Out of the enrolled 84 students, 76 returned at least one exercise and 62 of them answered compulsory amount of exercises. Hence, 62 students were allowed to participate in the exam. Figure 1 (n=76) illustrates the distribution of the returned exercises.

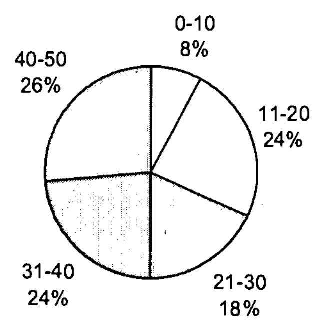

Figure 1: Distribution of the completed exercises.

Out of 62 students allowed to participate 56 took part in the exam. Figure 2 shows the results of the examination (3=highest mark,..,1-= lowest mark). The average mark of the exam was 2- which is a little bit higher than marks received in normal courses in our department.

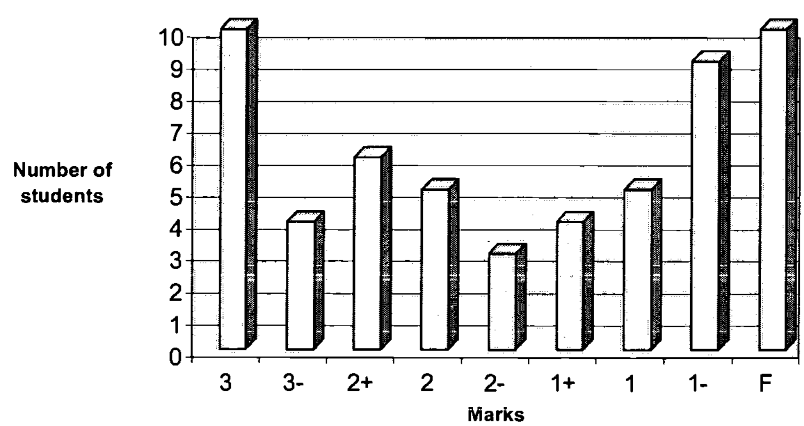

Figure 2: Results of the exam

Although the amount of low and failed marks was quite high we think that the results were satisfying. One can clearly figure out three categories from the results of the exam. The first group is managing rather well (above 2-) and they have got pretty good chances to reach the average mark of 2/3,. which allows them directly to continue their studies in our department in future. The second group consists of students who had trouble both in exercises and in the exam (marks 1+,1). Next courses have revealed that they have got good chances to pass the virtual certificate but they probably won't get the average mark of 2/3. The third group is comprised of students having major difficulties even in passing the first courses. These students have in many cases ended their studies either after this course or in following courses.

5. Future Work

From the tutoring point of view, the Candle model needs to be developed further. By default, the model assumes that the learner is motivated. Thus, the teaching intervention can be focused on the authentic difficulties, not his or her long-term goal itself. However, it would probably be useful for even a highly motivated learner to understand the relationship of a local learning step in the framework of the overall learning process. To manifest this relationship, one can make use of several visualization schemes where the life-long learner can explicate his or her learning status with respect to the larger educational context. Therefore, the model will be developed further in collaboration with the experts in student counseling.

Many Computer Science professionals think of their field as a truly universal one. However, learning difficulties identified at early stages, like when doing the first programming assignments at high school, might help us to recognize different ways of comprehending even abstract structures. Therefore, we are localizing our environment to other cultural contexts, in order to analyze this problem.

Traditionally, elementary school teachers, especially those working at small village schools in rural areas, have been called folk candles, bringing the light of the civilization even into most remote places. Hopefully, our Candle model can work in the same direction, at the time when most of the people in the industrialized countries are moving into cities, like the misled children in the famous folklore story on the pied piper of Hamelin. The Candles remain as long as these areas belong to the rest of the networked civilization.

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Fostering Mental-Model Thinking During Design

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Abstract: To investigate the use of mental-model reasoning about mechanisms in design, we had 12-13 year old students design a Mars Colony including physical, biological and social systems. Unlike previous research, we did not find significant gender differences in the designs. We found more reasoning about mechanisms from the beginning with physical systems than with biological and social systems. However, this mechanism reasoning did not increase across three design sessions for any of these systems. We did get increases in the initial relations that the students included in their designs. However, this was countered by a decrease in component and relational thinking during the final trouble-shooting task. We suggest that a more guided design environment starting with physical systems and then moving on to biological and social systems will be needed to foster mental-model reasoning about mechanisms with students this age during design.

INRODUCTION

We investigated to what extent 12-13 year old students would use mental model thinking when designing an artifact, and how we might increase that kind of thinking during design. We examined whether a constructivist design task would facilitate sophisticated mental-model thinking (Hmelo, Holton and Kolodner, 2000; Jacobson & Archodidou, 2000) and whether there were gender differences in mental-model development (Honey, Moeller, Brunner and Bennet, 1991). From this study, we drew implications for the creation of a computer-mediated learning space that would foster mental-model thinking during design. Our specific questions were: 1. What types of think do these students do when designing and how do these types of thinking change with experience and instructional support? 2. Are there gender differences in types of thinking during design and are thinking differences when designing in different domains?

MENTAL MODELS

Most cognitive theories about mental models concur that they consist of objects and their relationships (Johnson-Laird, 1983; Kearney and Kaplan, 1997; Jonassen, 1999). However, this definition is limited in that it does not address the greatest power of mental models: the ability to mentally simulate mechanisms to infer rules or make predictions about the operation of a system (Schwartz and Black, 1996; Koffijberg, 1996). From this mental-simulation perspective, a mental model is a dynamic mental structure whose behavior can be used to show how the systems modeled will function under different circumstances (Gentner and Stevens, 1983; Aronson, 1997). Thus, in the fullest sense, mental models consist of the structural components of the system, knowledge of the inter-relatedness of those components and a causal mechanism describing and predicting the performance of the system (Jonassen, 1999).

Therefore, an adequate mental representation (components and relationships) of a system is not sufficient for understanding. There must be the capacity to reformulate or restructure the model and incorporate the consequences of this manipulation (Newton, 1996). This transformation or running of a mental model pertains to adjustments made through the application of the causal reciprocity found in the system. Our definition of mental models involve images of interacting parts that are animated (Schwartz and Black, 1996b). Thus, transformations involve the delineation of kinesmatic information into mental spatial representations (Newton, 1996; Aronson, 1997; Koffijberg, 1996). It is this act that allows the thinker to visually infer how or why a complex system works. A prevalent way of expressing this transformation is as mechanistic.

Understanding is more than the regurgitation of superficial facts and procedures. It is a product of mental processes that infer dependence between elements of information (Newton, 1996). Koffijberg (1996) avers that understanding may even equate with acquiring an accurate mental model. Therefore, research that focuses on mental-model development is essential to facilitate software instructional design aimed at developing student understanding of complex systems.

CONSTRUCTIVIST DESIGN TASKS

Design tasks, as instructional tools, have been proposed as facilitating the development of mechanism thinking, and thus, understanding (Honey et al., 1991; Jonassen, Peck and Wilson, 1999; Hmelo et al., 2000). The act of design concentrates student efforts on the elements needed to build robust and sophisticated mental models: that is, student designers focus on acquiring the necessary information, its underlying structure, generating model examples and using the foundation entailed by the subject matter to justify the design (Jonassen et al., 1999). Therefore, the purpose of a design task is to allow the student to determine the relevant components and the ways they influence each other, and allows for the exploration of how systems work (Koffijberg, 1996; Hmelo et al., 2000). However, the context of the constructuvist design environment itself influences the kind of knowledge acquisition and the potential for the formation of a mental model. (Wood, E, Woloshyn, V. and Willoughby, T. (ed), 1995; Koffijberg, 1996, Jonassen et al., 1999). Therefore, analysis of the levels of mental-model development that occur during design tasks is necessary to provide guidance in devising the kinds of scaffolding, modeling and effective modes of transmitting information that need to be present in technology to support understanding.

GENDER ISSUES

Psychological and sociological research suggests that females approach, interpret and understand various aspects of life differently than males (Honey et al., 1991; Gilligan, 1982). Two studies (Hawkins, Brunner, Clements, Honey and Moeller, 1990; and Brunner,1990) pointed to gender differences in domain content concentration during design tasks performed by adults and children. The researchers found that females focused on the Social domain (communication and affective aspects) while male designs tended to focus on the Physical domain (transportation). Further, females were less concerned with describing the internal mechanisms of their designs than males. These findings recommend an examination of gender differences in types of mental-model thinking across differing domains of content and their consideration in a computer-based design environment.

THE DESIGN STUDY

We investigated student thinking during design by having them design a Mars Colony. In using this particular task, we were able to utilize the Mars Millennium Project (see www.mars2030.org), which a number of organizations (e.g., NASA, NEH, etc.) were conducting in order to inspire students to be more interested in science at a time when several space probes would be reaching Mars. Thus, were able to use the information on Mars that this project put on the WWW and exploit the excitement that had been generated. Also, designing a Mars Colony had the advantage of being multidimensional (unlike previous design studies) involving physical, biological and social systems. In the study, we had students design the colony twice on different days, then take part in a trouble-shooting task with the Mars colony.

METHOD

PARTICIPANTS

Twenty-seven eighth grade students, nineteen females and eight males, participated in this study. The students attended a model middle school in the South Bronx section of New York City. Entrance to the school was selective and students were conscripted from surrounding neighborhoods, consisting of African-American and Hispanic populations. This middle school was lodged within a high school and was characterized by reduced class size (between 20-28 students). All students were involved in a daily science curriculum.

PROCEDURE

This study took place during the regularly scheduled, eighth grade, science hour. Two researchers, along with the science teacher, were in the classroom for three days (Monday, Wednesday and Friday), henceforth referred to as Time 1, Time 2 and Time 3. Each time involved a general introduction, content share and presentation of a variation of the Mars Community design task, and an individual, student problem-solving period. Content for the Mars 2030 design task was obtained through the Mars Millennium Project at www.nasa.gov.

Based on Newton's (1996) outline of Model Processing Failure, we investigated three, slightly modified design tasks. The first task (Time 1) involved the least amount of instructional direction. Students were instructed on minimal base knowledge regarding the intent of the task. Further, there was a purposeful withholding of a conceptual model, which allowed students to formulate their design from only their mental resources. The second task (Time 2) entailed more instructional direction than the first design task. In addition to the previous base knowledge, 10 essential concepts in the complex system were highlighted and students were instructed to focus on the "how and why" of their design (Newton, 1996). Finally, the third task (time 3) contained explicit instructional direction. While still maintaining a strong design element, focused questioning on the mechanistic aspect of the student's mental model and forced prediction were employed.

Following the introduction and content sections of Time 1, the students engaged in approximately 30 minutes of individual work. Each student was supplied with an 8 ½ by 11 piece of white paper and a pencil. (More paper was provided based on individual requests.) The class was then told: "Based on everything that we've just talked about, we now want you to design a community for 100 humans on Mars, for 1 Martian year, in the year 2030. We want your design to be as clear and understandable as possible, so if you need to explain things, please do." The researchers stressed the need for the designs to be comprehendible to outside viewers and gave the analogy of the designs as being comparable to a blueprint. Further, the students were encouraged to complete their work on their own, in an attempt to cut down on collaboration.

A reiteration of the introduction and content sections from Time 1 initiated Time 2. In addition to Time 1 content, the researchers highlighted 10, pre-established categories as important to community design: culture, food, communication, shelter, government, water, transportation, air, health & safety and sanitation. This was followed by 30 minutes of individual work creating another paper and pencil design. The class was instructed: "We want you to design a community for 100 people on Mars again. However, this time, please consider the 10 categories we just talked about as you design your community. You can incorporate any of your first design into your new design." The students did not receive the design they had created during Time 1.

For Time 3, after the introduction and content sections, the researchers posed the following situation to the students: "An emergency situation has arisen within the context of your second community. A third of your community members have become seriously ill." This was followed with the following lowing questions: (1) What do you think happened in your community that affected the members? (2) Why do you think it happened like this? Justify and explain your answer. Then complete the following tasks: (3) Show us how you think this happened. (4) Make a prediction of how this will effect the future of your community. (5) Design a research plan to investigate whether or not your theories/ideas about what caused a change in the community are true." Each student received a pencil and a stapled packet of five pages (8 ½ by 11). Each page had a question or task at the top, with the rest of the page blank. All of the packets were ordered as shown above and the researchers read through the packet with the class before they began the task. Further, each student also received a copy of his/her Time 2 design to be used as a reference. The students were given approximately 30 minutes to design their answers.

DATA ANALYSIS

The raw data for this study are the pencil and paper designs created by the students each day. The student's mental models (what we ultimately want to investigate) are just that mental. One method of externalizing these models is to have subjects draw or write them out (Wood et al., 1995). Thus, we view the student's designs as cognitive maps (Kearney & Kaplan, 1997) or concrete models (Getner & Stevens, 1983), which characterizes each student's general knowledge regarding his/her Mars community. Specifically, we use the students' designs to assess the level of component (i.e., objects), relational and mechanistic thinking found in their renderings, with the intent that this reflects the level of processing happening in the students' heads.

The coding of each of the three levels of thinking were couched in 10 researcher, pre-determined categories, which we later classified in four domains. These 10 categories where chosen by the researchers to promote coding consistency, because we believe they are all necessary for community survival, and also because they cover physical, biological and social aspects of community development. Further, the 10 categories remained constant for the coding of Time 1, 2 & 3 designs. For Time 1, students during the design task were completely unaware of the pre-established categories. For time 2, the 10 categories were outlined and stressed at the beginning of the design task. During Time 3, students were aware of the categories because of their Time 2 experience, however, the 10 categories were not reiterated or highlighted before the design task began.

Within each of the 10 categories, three scores were tabulated for each student. First, the components within each category, whether pictorial or written, were counted. Second, scores were gathered for relationships among components. Relationships were identified by explicit pictorial or written connections between components. To promote coding consistency, spatial distance was not taken into consideration as indication of a relationship. Thus, components bunched close together were not counted as connected unless specifically indicated in some way by the student. Finally, scores were collected, within each of the 10 categories, for the depictions of mechanisms. Mechanistic representations were coded as being present when objects were pictorially or written with explicit, directional relations that conveyed movement. That is, the relationship between objects where depicted as causal and directional. Based on the coding method explained above, each of the 27 students received 90 scores (3 levels of thinking X 10 categories X 3 sessions).

During the analysis process, the 10 category scores in each level were reduced, through summation, into four domains. The Physical domain consists of the categories of Transportation and Shelter. The Biological domain consists of the categories of Food, Air and Water. The sum of Communication, Culture and Government make up the Social domain. Health & Safety and Sanitation, key elements of communities, did not fall into any one of the three previous categories, so their scores were summed into a Multi-dimensional domain.

RESULTS AND IMPLICATIONS

For brevity, we are only including information on results with specific implications for the instructional design of a Mars 2030 computer environment. We conducted three (one for Time 1, Time 2 and Time 3) GML mulivariate tests in the four domains, for each type of thinking, with Gender as a fixed factor. For Time 1 and Time 2, there were no significant differences, at any type of thinking, in any domain, between females and males. Time 3 results indicate non-significant differences between females and males, with the four domains, for relational and mechanistic thinking. There was a significant difference between females (5.556E-02) and males(1.5556) in component thinking in the social domain ($p<.000$) [all other component-domains were non-significant]. Evaluation of the direction revealed that males had more components, which counters what Honey et al. (1991) might have expected. Thus, our research indicated no instructional implications for domain design with gender as a factor.

Next, we conducted individual 2-Tailed T-test for each type of thinking (components, relational and mechanistic) on each day (Time 1, Time2 and Time 3). All levels on each day were significant (null hypothesis = 0) at the .05 level, thus in general, these types of thinking did occur during the design process. This was followed by Time 1 T-tests for each domain. In Time 1 mechanistic-type thinking, all domains were non-significant except physical-mechanistic (2.126, $p<.043$). This may imply that a computer environment that initially focused on the physical domain and gradually moves to more abstract domains would foster learning. Further, Time 2 T-tests for Social-mechanistic (3.704E-02, $p<.327$), Time 3 Social-relational (3.704E-02$p<.327$) and Social-mechanistic (.0000) thinking yielded non-significant results. These results may indicate that more structured or supported instruction than what we provided over the three-day experience should be included for this domain in a computer design environment.

Finally, we summed domains and conducted 2-Tailed Paired-Sample T-test comparing Times within types of thinking. (Note: we did not conduct a repeated measure because although all the measures are designs, Time 3's measure was altered compared to Time 1 and Time 2). Results indicated significant differences between Time 2-component (23.0741) and Time 3-component (5.5926) thinking ($p<.000$), Time 1-relational (1.6667) and Time 2-relational (6.3704, $p<.000$) and Time 2-relational (6.3704) and Time 3-relational thinking (2.3704, $p<.001$). These results suggest practice in addition to instruction on key concepts fostered relational thinking, however, forced prediction actually had a negative effect on the number of components and relations in the students' thinking. This seems counter to Newton's (1996) proposal for decreasing mental processing failure and may imply that the trouble-shooting task shifted students' attention from the components and relations in their mental models. One would have hoped that the shift would have been to mechanistic-type thinking. However, no significant differences were indicated for mechanistic-type thinking from Time 1 to time 2 or Time 2 to Time 3. Several reasons could be responsible for these results. First, the trouble shooting task was in the Multi-dimentional domain (specifically, Health & Safety) and earlier results indicated initial focus should concentrate on the Physical domain. Further, students only had 2 experiences designing and this may not have been enough practice to foster mechanistic thinking. Finally, the static nature of the medium of instruction and student design (paper and pencil) may have inhibited both the mechanistic thinking of the students and our assessment of their work. This indicates that repeated exposure to a dynamic design environment (one where students could run simulations on their creations), rather than a computerized version of the paper and pencil task (such as a drawing tool) and one that initially focuses on Physical domain trouble-shooting might be the best format for a computerized instructional and assessment tool of complex systems.

CONCLUSIONS

In the study reported here, we had students design a Mars Colony including physical, biological and social systems. Unlike previous research, we did not find significant gender differences in the designs. We found more reasoning about mechanisms from the beginning with physical systems than with biological and social systems. However, this mechanism reasoning did not increase across three design sessions for any of these systems. In contrast, we did get initial increases across the sessions in the number of relations that the students included in their designs. However, this was countered by a drop in component and relational thinking during the final trouble-shooting task. We suggest that a more guided computer-based design environment starting with physical systems and then moving on to biological and social systems will be needed to foster mental-model reasoning about mechanisms with students this age during design.

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From Course Management To Open Learning

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Abstract In the past years, different course management systems for the World Wide Web have been developed. Usually they assist in providing courses for distant or distributed learner communities (tele-learning). Most course management systems are quite restrictive concerning the way to be taken through a course material and the tests and assessments to be done to complete the course [Hornung and Wang, 1997,WBTSystems00, 2000]. This paper suggests a different approach to tele-learning: a less restrictive environment for the learner to work with and modify the course material provided and to communicate with other learners and experts of the field. The system design is deducted from experiences with the course management system CMS-W3 which has been developed and used at Fraunhofer IGD Rostock since 1996.

The Course management system CMS-W3

CMS-W3 supports composition, administration and study of course material via the World Wide Web. Integration of all document types common in the WWW is possible. User interaction is provided by a highly functional but still easy-to-handle interface. [Hambach et al., 1999,Voskamp, 1997] describe CMS-W3. The most important concepts will be explained in the following.

Basic Concepts

Introduction of modern communication structures into traditional education scenarios like distance education substantially improves the information processing and interaction between course attendants. Course material is no longer restricted to written paperwork or video tapes. It is now possible to integrate new media like online lectures, interactive tutorials and simulations.

CMS-W3 supports composition, administration and study of distance learning course material via the WWW, which means that it supports the students in studying a course, and the course manager in managing and administrating a course.

The system is based on a distance learning scenario, having

- experts, who are responsible for course integration and management,
- students, studying courses and
- tutors, being responsible for technical support for the students.

Starting from the distance education scenario described above, four user roles are supported by CMS-W3: experts, tutors, students and administrators (see Figure 1).

User Roles

An expert is the central course manager. He composes and maintains courses and modules, integrates new material, defines the course structure with a sequence of modules, provides online lectures, and gives marks.

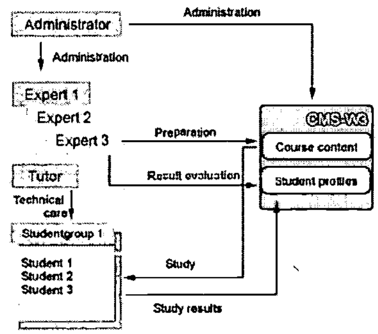

Figure1. Different user roles

A tutor gives regional support to students. He forms the link between students and experts or administrators by controlling the work of a student group or giving technical support to participating students.

The student studies one or more courses using CMS-W3. While attending a course, he is member of a student group, has access to his own results, to his user profile and to the course specific or group specific Newsgroup. An administrator is responsible for creating and maintaining courses and user accounts (experts, students, tutors) in his area. CMS-W3 supports a hierarchical user administration structure.

Courses and Modules

Courses in CMS-W3 have a hierarchical structure and consist of sections and a discussion forum. A section is defined by a module. Modules may be HTML structures, printable documents, exercises or test files (see Figure 2).

- At study time, the student can study the HTML structure online. It may contain HTML files as well as other document types like VRML models, Java Applets, video, audio etc.
- Files can be downloaded and printed for offline study. They also can be changed by the students and again uploaded for download by other students of the student group.
- Exercises and Tests for knowledge assessment are written in the CMS-W3 test description language. CMS-W3 interprets them using Java Applets.

Every expert has his pool of modules. He prepares them with other tools than CMS-W3 and integrates them remotely via a WWW browser. He also structures these modules in courses, thereby defining dependencies between different sections.

Practical use of CMS-W3

In the past, CMS-W3 was practically used several times in an institutional framework. At the University of Rostock, materials for the lecture "Multimedia Communication" of the Institute of Computer Graphics were made available in CMS-W3. The system was also used for the tele-course "Webdesign" for computer assisted instruction and education (see Figure 3). Other educational institutions offered their own courses using CMS-W3. In addition, the system is used to publish instruction manuals for different software systems.

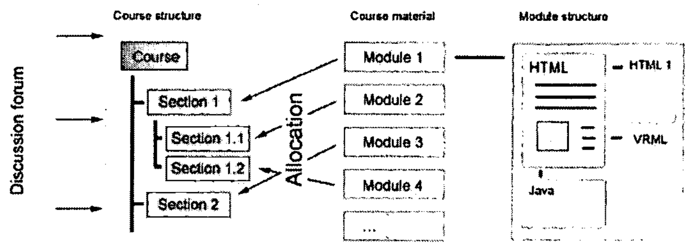

Figure2. Courses and modules

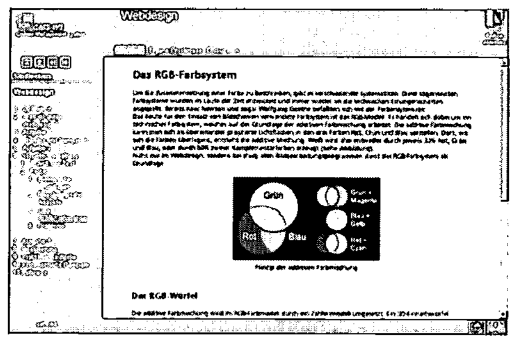

Figure3. The tele-course "Webdesign"

Different curricula were selected depending on the respective basic conditions. The spectrum reaches from meetings with supplementary self study to self study only. Thereby, the provision of further written materials was handled very differently. In the case of self study only the whole communication took place via Email and Newsgroup. Different observations have been made based on courses already held. A generally safe and directed handling of CMS-W3 was observed. However, some problems led to further conclusions.

Concept of learning

The fundamental concept of CMS-W3 results from learning independently of place and time. This was very welcomed by the learners. However, the missing guidance proved as obstacle in some cases. Learning successes depended on the non-standard self learning authority, meaning the ability to perform a study conscientiously without any special direction. If the appropriate authority lacked, the own motivation to experience learning successes was missing. Therefore it was necessary to promote the motivation of students by additional didactical interventions. Constant care and guidance were guaranteed by Email, Newsgroup or telephone.

Communication

CMS-W3 provides different means of communication (Newsgroup, Email, etc.). However, these were not widely used so far. They are not a central part of CMS-W3 and they are not dynamically linked to important sections of a course. Additionally, two more factors for not communicating could be observed:

Till now, only a few students took part in a single course; Second, the learners simply did not know about the tools and how to use them. For this reason, extra promotion for communication had to be done in the past.

System operability

The work with CMS-W3 was designed for different user groups. Each user fulfills a function according to a given user role. They all require basic knowledge in handling IT systems and a minimum of technical openness. The graphic interface covers the extensive functional spectrum of CMS-W3. It is arranged consistent and promotes intuitive navigation. The requirements of the complex interface in expert mode are rather dedicated to IT specialists. Therefore, it is fewer suitable for other experts outside of this area. Insufficient screen resolution leads to a disturbance of the balance between window contents and window navigation.

Learning material

The quality of courses and the supplied material influence equally the acceptance of CMS-W3. Therefore, materials badly edited can easily be understood as a weakness of the entire system. Exactly the same, a course structure without a definite line can lastingly disturb the navigation concept of CMS-W3 and mislead the user.

The observations during practical work led to the following conclusions: CMS-W3 strongly depends on internal and external factors. The internal factors result from system properties, particularly from system operability. The external factors are quality of teaching aids and the characteristics of individual users. On one hand those factors are influenced by the attractiveness of the provided material, on the other hand by the amount of self learning authority and appropriate user knowledge. Beyond that, the acceptance of communication tools available in CMS-W3 is strongly bounded to purpose and motivation. Therefore, the interaction of individual factors should also sufficiently be considered in the future.

Developing an Open Learning Space

The course management system CMS-W3 was developed to provide knowledge. However, following the constructivists approach to learning, knowledge can not be supplied. It can only be achieved by actively working with material and applying content in different contexts. A learning environment should support active learning: material addressing different senses, complex practical work, communications and collaboration with other learners, modifying the material according to the own understanding. Like similar systems ([WebCT00, 2000,BSCW00, 2000] beside others), CMS-W3 supports communication and collaboration in different ways. However, experience showed, that the tools are not easy enough to find and to handle.

Grune [Grune, 2000] describes an open learning environment (according to learning psychology) transferring the approach of constructivism into practice. The only obstacle: His approach is based on the ideal learner: a competent user of new technologies, highly motivated for continuos learning, able to adapt to material of different qualities, self-organized and always able to coordinate his aim and the way to reach it.

Learners in real settings are not usually like that. Our observation of tele-courses in different scenarios show: material has to be of good quality, the learner asks for continuos support in using the technology and in working with the material, and, most important, he needs gentle pressure to finish the course. Based on our observations we suggest to include the following tools into a course management system in order to support orientation, communication and cooperation.

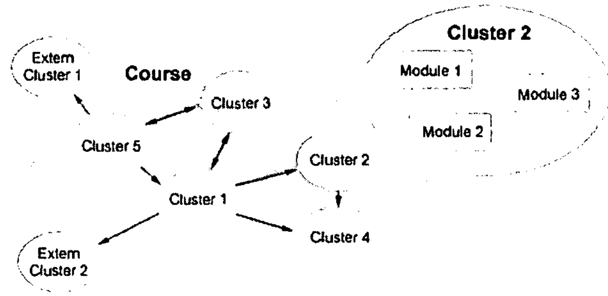

Figure4. Structure of courses and clusters

Structure of content

Our intention is to provide as much material online as possible. The material is organized in courses. In the moment, each course consists of different sections containing single modules. The granularity of this structure is too coarse, so we decided to change it in the following way: each course will consist of different clusters which themselves consist of different sections containing modules (HTML-structures, downloadable documents or tests) as shown in Figure 4. A module may be used in different clusters as well as a cluster may be used in different courses.

Due to high modularization the material is highly reusable. However, it is more important that the thematic organization of clusters results in non-sequential studying for advanced learners: Different clusters of a course are organized in thematic plans and may be accessed via a visualization of the plan (described later).

Orientation

In CMS-W3 the learner has the table of contents as the only means of orientation. It is used for navigation purposes at the same time. He has to follow the given sequence and is not able to re-arrange the different units according to his own plan of how to work with the material. A few learners were not able to execute all steps to be taken in order to reach the course aim because they could not grasp the complete program or did not fulfill the prerequisites. Other learners studied just the parts of the material providing new information. To support orientation in a course material we now use three tools, the learning plan, course descriptions and subject cards. All three of them support the learner orienting within a course.

The learning plan is derived from the sequential course structure given by the expert who planned and prepared the course. For the unconscious learner it possibly is the order in which to work with the material. However, the conscious learner is able to adapt the learning plan to his own needs. He may rearrange the sequence or even exclude single units to get his individual learning plan. Working progress will be measured according to the given or individual learning plan. At each time the learner is able to compare his learning plan and a survey of the work he completed. This tool is an important addition because the learner will be able to structure and study "his own" course. He may include or exclude different clusters and define their sequence.

Each course is described by a set of data including title, description, scope (hours online and hours present), form of learning (tele-learning, seminar, presentation, etc.), pre-requisites, agenda, material (online, written, CD-ROM, etc.), certification. These data are for the learner to be informed about the setting and development of a course.

Thematic plans visualize the contents of a course as a hyper-medial network. They are an ideal way to show semantic connections between different clusters and may even be used to access them. Advanced learners will appreciate the possibility to randomly access all clusters and to study non-sequential (see Figure 4).

Cooperation and communication

Based on our experiences in using CMS-W3 we decided do provide the tools to support cooperation and communication as well as to force learners to communicate and cooperate with each other and with the tutor of their course as the centerpiece of the system.

An important means of supporting communication are personal cards. They are an instrument for each learner to introduce himself to other learners of his group. The account name and a dummy picture are given by the system before logging in the first time. The learner is obliged to complete his card by adding his personal picture, his name and Email address and a short comment. That way, the system as a whole as well as the single course are less anonymous. Communication is easier because the partner to communicate with is "known" through his personal card. In differentiating between pre-set data and data to be added by the learner, anonymity is guaranteed if the learner wishes to stay anonymous.

A forum is an essential tool for communication and cooperation. In CMS-W3 we had classical Newsgroups. Experiences with different target groups showed, that Newsgroups are difficult to handle by non-computer experts. For this reason, a forum is provided for each course for learners to interchange with each other and the tutor of a course. It is much easier to handle than a Newsgroup and will surely enforce communication.

Annotation will be provided for each cluster to add comments about the content close to the information itself. They are not specific to a group of learners. All comments are listed together with the user name of the learner providing the comment. Annotations may be accessed by clicking a small icon near the cluster name either in the sequential course structure or in the thematic plan. Using this means of collaboration the learner will be able to actually change the material.

In adding the tools described we provide a learning environment much opener for self-directed learning, much more motivation for the learners to study materials and to communicate with other learners. According to our observations with CMS-W3 this learning environment will better be able to support the learner in learning self-directed and on demand.

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Magellan, the Paderborn Approach to Distributed Knowledge Organization

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Abstract: The primary goal of the Magellan concept is the development of individual and cooperative semantic structures on side of the students by using tools that both support and accompany the cooperative learning process. With regard to this the Magellan system functions as a communication media for fellow students and lecturers and as a collection- and structuring system for all materials that accompany the learning process. The conceptual approaches of the Magellan system concentrate on the aspect of the establishment of cooperative and individual link- and navigation structures which might be described as paths or trails over learning materials. One of the key ideas for the integration of external web resources into such trails is the concept of annotations. First implementations of Magellan concentrate on the integration of an universal annotation mechanism inside virtual learning rooms. The following paper will discuss various approaches of semantic representations of web structures and annotation mechanisms for web documents. It will introduce our architecture based on the sTeam (structuring information in teams) system and will shortly describe our first prototypes.

A new concept of learning: cooperative knowledge organization

Both, individual and cooperative forms of learning need documents, graphics or other graphical representation for the purpose of structuring the learning process. Developing tools and methods for the computer supported cooperative learning (CSCL) has a long tradition and has been developed parallel to the growing World Wide Web. Our research group "Computers and Society" now aims since more than 5 years at the integration of net-based graphical representations—so called semantic maps and semantic rooms—into learning supportive infrastructures at our university (Hampel & Selke 1999).

In the following section we will shortly introduce the main approaches and concepts for the development of navigational structures. Based on our experiences we will motivate our Magellan approach which is in large parts based on the development of an cooperative system called sTeam (structuring information in teams).

During the last years various tools and environments for representing navigational structures of the WWW have been developed. These representations are based on the idea of offering guidance and general maps of a field of knowledge. Resultant from an inherent navigational problem (lost in hyperspace syndrome), (see Theng 1996) within large hypertext structures and especially within the WWW, the necessity of these structures has been rapidly recognized.

The basic approach to the support of a cooperative knowledge management fits primarily in the area of cooperative creation and use of knowledge, which generally means the structure might be changed. With this in mind the form of generation of maps, structuring the informational room by the users or students respectively is an important criteria in regard to the following differentiation of existing basic approaches.

Here we have to differentiate automatically generated maps from cooperatively created maps or also maps created by authors for users. On the side of the generated maps and graphical representations we have to differentiate completely automatically generated maps from semi automatically generated ones, which means from maps created by the influence of an author or of a user.

Beneath automatically generated site maps there belong a variety of 2D or 3D representations to this class of generated maps, in order to represent large quantities of data, which also may be used for navigational aims. Early examples show the „self-organizing semantic maps for information retrieval" created by Lin, Soergel and Marchionini (Lin et al. 1991). Here semantic connections among documents are represented as a self-organizing map that is used as a guidance instrument in a library research system. A typical example of a topological map is the representation of semantic relations by spatial proximity. This gives the viewer an overview of a field of knowledge to be worked on.—However, the demand of navigational support is not in the centre of attention among the authors within this context.

On the other hand there is a variety of semi automatically generated maps. Even the trail-concept of Memex (Vannevar Bush), which might be the father of many approaches, is an example for this: „*The owner of the memex...runs through an encyclopedia, finds an interesting but sketchy article, leaves it projected. Next, in a history, he finds another pertinent item, and ties the two together. Thus he goes, building a trail of many items. [H]is trails do not fade.*" (cf. Bush 1945). Here the learner takes his/her path through hypertexts by following existing references. This trail is recorded and after it has been revised and recreated by the author, the trail is given to other learners as a basis for navigation through the learning materials. This idea of trails was transferred on hypertexts by the Brown University within the inter-media project (1985-1990) (Utting & Yankelovich 1989). Here paths of users are visualized by references in form of a map beneath a survey of connections between documents. A really new quality in the research approach results in the possibility for users, to annotate references and maps and to keep these annotations without regard to later modifications of the document. During the last years different research teams have worked upon parts of the question of this idea, to offer a widely automatically generated path through a field of knowledge by recording and later edition and reorganization as a guidance for other users.

In this context, Wexelblat provides important preparations in his „Footprints"-approach. The paths of users through the WWW may be traced and may be used for a later navigation—but may not be exchanged and communicated between learners. As a second component, the traces of other users in the net are offered as a navigational assistance in form of graphical maps. This means a navigational assistance is created by the cooperation of the users on basis of their actions. The amount of the visited knot is shown by different colours (Wexelblat 1999). This idea of considering social components—the amount of informational visits by other users, which means a form of information sharing in creating navigational structures and representations—is characterized as „social navigation". It has been decisively researched by Dieberger (Dieberger 1998) as a combination of a virtual environment (Juggler) with a web-client. Especially the creation and management of own references, lists of so called „bookmarks" and their transmission to other users is interpreted of him as a phenomena of „social navigation". This is similar to navigation in virtual environments (special MOOs); Dieberger gets information about the behaviour of user-navigation by tracking paths in the MOO (Dieberger 1994).

In addition to the generated maps and graphical representations there is a big group of spatial structures created by authors. In this context the author means the intervention of a man in the process of creation of a mostly graphical navigation assistance. But there exists a high number of mixtures between an automatic generation and a guidance that is completely created by man.

Important impulses are delivered by the works of Furuta and Shipman (Furuta & Shipman 1999). In their „Walden's Path"-project they researched in particular the generation of linear paths by means of the materials of teachers for students. An important aspect in this context is the generation of paths through the WWW by active composition of addresses, which means that the generated map resp. the generated path is not restricted to a limited quantity of documents. (Furuta and Shipman developed an architecture consisting of a path-server, which communicates between a web browser and a web server. On the site of the author they provide a Java-tool, the „Path Authoring Tool", to create and modify paths connected to a simple Java-database for registration of the paths). Therefore Furuta and Shipman focus on the creation of paths by materials of authors for students and not on their cooperative work upon the materials or a specifically graphical representation.

The main difference in regard to the researches in the field of the Magellan project is to consider the degree of cooperation within the creation of these navigational structures. The most primitive group of structuring assistance, the given overviews, directories, site maps (or graphical „click able maps") by the authors of a website resp. the authors of learning materials, give few possibilities of cooperative creation, modification or annotation. Although Pilgrim and Leung (Pilgrim & Leung 1999) differ four different basic types of site maps (differentiation in the degree of presentation knots and links of a site—representation of all or selected knots and links of a website, as well as maps, which are based on a temporal dimension, a „history") these author-based navigational structures offer nearly no possibilities for the cooperation of learners in the development of such navigational structures. These are unfortunately moderated, a strictly given navigation assistance representing the present standard of the WWW.

Only a few advanced approaches exist; for example the one of Heuer and Meinel (Heuer & Meinel 1999) within the area of temporal dimension based concepts uses a database to store the paths through hypertexts (the WWW) and represent them as graphical paths and maps. In combination with the implementation of a proxy-server (Luotonen & Altis 1994), the annotation and the referencing of hypertexts which are not restricted to one WWW-server is also possible.

Our current prototypes

After studying existing concepts and approaches it seems clear that a learner centred approach which allows the creation, structuring, and communication of navigational structures by the learners themselves needs a well designed infrastructure. We have chosen a web based client-server approach to allow learners to arrange media in a room based virtual world. The Magellan project especially focuses on all mechanisms for the integration of various web materials into such learning supportive infrastructures.

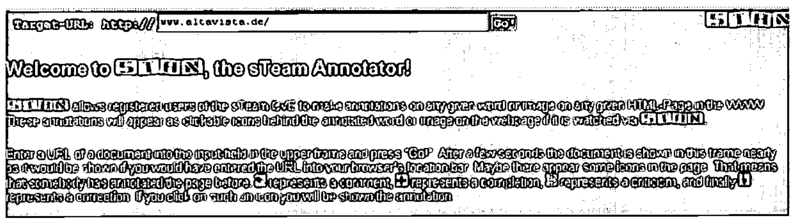

figure 1: The STAN annotation applet

The basis for all the tools is our open-source sTeam server that brings together all activities and serves as a persistent platform for any client. For a more detailed description of the sTeam server confer (Hampel & Keil-Slawik 2001). Different components of the client-side include a whiteboard, an annotation tool, a trail mapping tool and of course a chat. Each of these can work both independently or as part of a more extensive client framework that allows the individual composition of the client. Different windows can be docked at each other and can be positioned freely on the screen, which means that each tool is basically a module—and a sTeam client is a composition of such modules. Unfortunately most modules are currently only prototypes and the work on a usable client is still in progress. On the other hand the server design is more settled, although there are minor details changing every week. In order to get a stable system we are currently developing test scripts to guarantee the functionality and backwards compatibility in each version.

One of the most important clients for the integration of the Web into the sTeam system is the sTeam annotator (STAN) (Tappe 2000), a tool for annotating external web pages. To better understand it's design we shortly introduce some existing approaches. Technically there are two main approaches: They can be differentiated into browser based or proxy based architectures. The proxy based version merges the content and the annotations in a proxy server while the browser based approach modifies the content right before displaying it.

An example for a browser based implementation is DreamView, which is part of the CSCW platform DreamTeam (Roth 1997), using an own cooperative browser. web pages are displayed on the left side of the browser, it's annotations are displayed in an separated window on the right side. Connections between the annotated part of the web page are illustrated by links from the annotation text on the right side to the annotated position on the left.

Another implementation is CoNote (Davis & Huttenlocher 1995) which works with a standard web browser. Annotations are composed in ASCII- or HTML-format and are directly integrated into the web page. Again the annotation is related to a specific position inside the document. Access permissions play a role here—the visibility of certain annotations depend on the membership in groups. Unfortunately CoNote only allows the annotation of web pages, that have been modified to enable annotation.

The latest annotator is CritLink Mediator (Jones 2000), a part of the discussion environment CritSuite. Like CoNote it works in a normal web browser, but allows annotations on any web page. Therefore the content of each page is modified dynamically when it is loaded by the web browser. To accomplish this, it uses some kind of proxy mechanism—each HTML page passes through the so called mediator and the current annotations of the page are added. Apart from this a toolbar at the top of the page is added featuring the target URL edit-box, a GO-Button and some help functionality. The annotations are identified by a context-phrase and a target-phrase—the target phrase is the annotated area of the document and is part of the context phrase.

The sTeam STAN annotator can be described as mixture of the tools mentioned above. It uses the browser based approach and allows the annotation of specific parts of the document. Annotations are stored within thc sTcam scrvcr. Thc contcnt of cach wcb pagc is dynamically modificd whilc loading and aftcrwards is displayed in the browser. STAN is started by going to an initial URL displaying the top navigation frame and loading the mediator (an applet). The navigation frame includes an edit box for the target URL and a "GO"-labelled button. The content of a page will be shown at the bottom frame—at first there appears a short introduction page for STAN. As soon as someone enters an URL and presses return or the "GO"-button, the applet will fetch the document and patch it according to the present annotations on the sTeam server (see figure 2).

To annotate an element of the document one has to click at the corresponding word and an additional window will pop up to enter the annotation text. Apart from the text, the type of annotation can be appointed—the different types are visualized as icons positioned right behind the annotated text. Clicking the icon will reveal the annotation text in a small window below the icon—clicking the icon a second time, will close that window. If the annotation text is short enough it will be displayed as a tool tip text when moving over the icon. Each new annotation will be sent to the sTeam server as an HTTP-request. The context of the annotation is at present only identified as the position of the annotated word inside the document. Of course this leads to problems when used with dynamic or constantly changing content (especially if a database generated site such as http://www.altavista.de would be used).

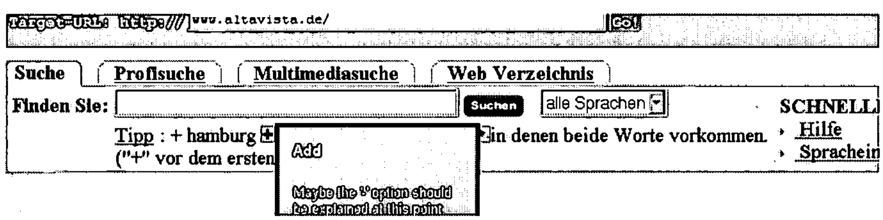

figure 2: STAN annotations integrated into a web page

The Magellan/sTeam architecture – technically viewed

Form the technically point of view the Magellan system basically consists of a client which is connected to the sTeam server. This client allows one to cooperatively create, modify and maintain personal views on the structure inside the server. To understand the relation between Magellan and the sTeam server we must take a closer look at the server:

The sTeam server architecture is based on MUD/MOO technology (cf. Hampel & Keil-Slawik 2001) Incoming commands are processed and the results are subsequently sent back to the clients. Furthermore the execution of any command triggers events that are distributed among the users. For example the current user might move a document into another user's inventory. In this case, the target user would of course desire to be notified about this, thus the move action itself would run the event „enter-inventory" which the user is able to observe.

In order to keep the communication at a minimum, each user/client is able to decide which events he wants to subscribe to, obviously there might be lots of things going on outside the users' focus of attention—for example in another room. This event–orientated architecture is very important when it comes to synchronous working—an object is moved on a whiteboard and the event is distributed to all clients currently running the same whiteboard. The communication between client and server takes place through COAL, the client object access layer, a simple binary protocol allowing the calling of functions inside objects—quite similar to RMI (Remote Method Invocation)[1]. While the client sends a command to the server, in the other direction the server

[1] cf. http://java.sun.com/products/jdk/1.2/docs/guide/rmi/index.html.

returns the results and events that are originated by commands of this and other users. This means even if the user is not doing anything, the client may receive events about objects entering or leaving the users current environment, conversation, changing attributes of objects, etc.

There are two separate implementations of COAL. One is in Java on the side of the client, the other one is in LPC (Lars Pensjoe C), an object oriented interpreter language, as the server is written in this language (cf. http://www.lysator.liu.se/mud/lpc.html). Due to this design the protocol must be able to handle all data types of LPC and the Java implementation and must especially be aware of thosc typcs such as LPC types which differ from Java types.

The reason why sTeam is implemented in LPC is, that—as a language designed for MUDs—, it is well suited for a multi user application in the sense that client/server communication can easily be established and it allows the extension of the system at runtime. To further improve the easy extensibility of a MUD, the sTeam system features a so-called proxy-object. This may be described as a special object type that is actually only a pointer to the real object, but every single reference to the object keeps the proxy instead of the object itself. When it comes to changing the code of an object/class at runtime it is possible to drop all instances of a class and recreate them (the data is kept inside a database). Even though a pointer to the object would be invalid after destruction of the object, the proxy object updates its pointers automatically and the relation is maintained. Note that this is the default behaviour of the DGD (Dworkins Generic Driver, another LPC implementation) that implements it on the driver level. Due to copyright issues we have been forced to use another implementation called Pike[2]. Fortunately the Roxen IS Company backs up Pike and so a future development is certain.

As mentioned before on side of the system architecture the Magellan system is subdivided in the Client and the sTeam-Server. In this relation the sTeam server is the central part that controls all the activities and synchronizes communication between several clients. Inside the server exist different types of objects that are kept persistently inside a database (for example MySQL).

The object structure of sTeam is quite similar to that of a classical MUD—key elements are objects, containers, rooms, exits and users. The most important objects regarding Magellan are the rooms and their connections. The users create objects and documents and place them somewhere inside the room. Exits between rooms represent the semantic connections between different topics.

Each room (like any other object of the sTeam system) features an access control list that keeps track of the privileged users. (e.g. A room administrator gets some additional permission on the objects inside the room – this behaviour is required as someone must be able to maintain the room) Each client or client module may create a different view on the server's objects. So the present structure inside the server is represented by different clients/modules. For example the room display module shows the current state of a room. Another module is the room-map visualizing the connections between several rooms and allowing the creation of new rooms and exits between them. Objects inside a room can be positioned in the room display and users may create links (references) to other objects. Furthermore any document can be annotated and previously added annotations are directly shown by the client. The server automatically synchronizes any action taken.

The STAN annotator belongs to the asynchronous parts of the sTeam system and is implemented as a special client module. Technically the sTeam annotator is implemented as a Java applet, which uses the sTeam server to allow the annotation of external documents (HTML pages/documents not present on the sTeam server). To accomplish this a lookup-table is integrated into the sTeam database keeping both track of the URL and the related annotation container. This container contains all annotations to the document – each an object of its own – including relevant data like type, annotated area of the source document and the annotation data. Due to the fact that an annotation document is handled like any other object in sTeam, it also features an access control list. Thus, individual permission can be associated with each annotation (nevertheless by default they are public). Right now there are only two options supported by STAN, public and private annotations. In this sense private means the annotation belongs to it's creator (the annotating-user) and cannot be read by anyone else. In the nearer future it should be possible to assign the annotation to a specific group.

The only way to display a document including its annotations is apparently through the annotator – in this relation the sTeam server functions as the annotation repository. The annotations of a given URL are transferred to STAN by an XML wrapper.

[2] cf. http://pike.idonex.se.

Conclusions

Our Magellan approach aims at the integration of semantic representations into a room-based virtual world. Annotations play an important role for the integration external documents into any learning environment. To set up cooperative learning processes a computer supported cooperative learning environment has to integrate documents, graphics and links to external web resources, which can be easily created, arranged and communicated by the students themselves. This cooperative process, which we call self-administration, can be characterized as the key idea of successful cooperative learning.

The majority of currently existing solutions need learning materials to be integrated into the learning environment. The most important idea of Magellan is to allow the integration of external materials freely available on web servers into the learning process. Therefore powerful annotation mechanisms are necessary, which work both on internal and external resources. For the nearer future we plan to intensify this connection between internal and external learning materials. All clients should leave the prototype status and will be used in real learning situations at our university.

On the technically site we will further develop the usage of standard interfaces, for example the RDF[3] (Resource Description Framework) format for annotations should be considered. This would bring together various annotation solutions and make them work with the sTeam system.

Acknowledgements

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[3] cf. http://www.w3.org/RDF

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A student model for web-based intelligent educational system

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Abstract: This paper describes the structure, functionality, and implementation of a student model used for web-based domain independent educational system. It is designed to take advantage of Internet based group inferencing while providing adaptivity in offline, online and mobile scenarios.

1. Introduction

The intelligence of an ITS is largely attributed to its ability to adapt to a specific student during the teaching process. The adaptation involves choosing and presenting each successive teaching activity as a function of entire scope of student's knowledge of the subject being taught and other relevant features of the student, which are in turn maintained in a student model. A prototype student model is under development as a part of the Technology Integrated Learning Environment (TILE) project. It is able to provide adaptive features in various scenarios including offline, online and roaming profile environment.

2. Initialization and update

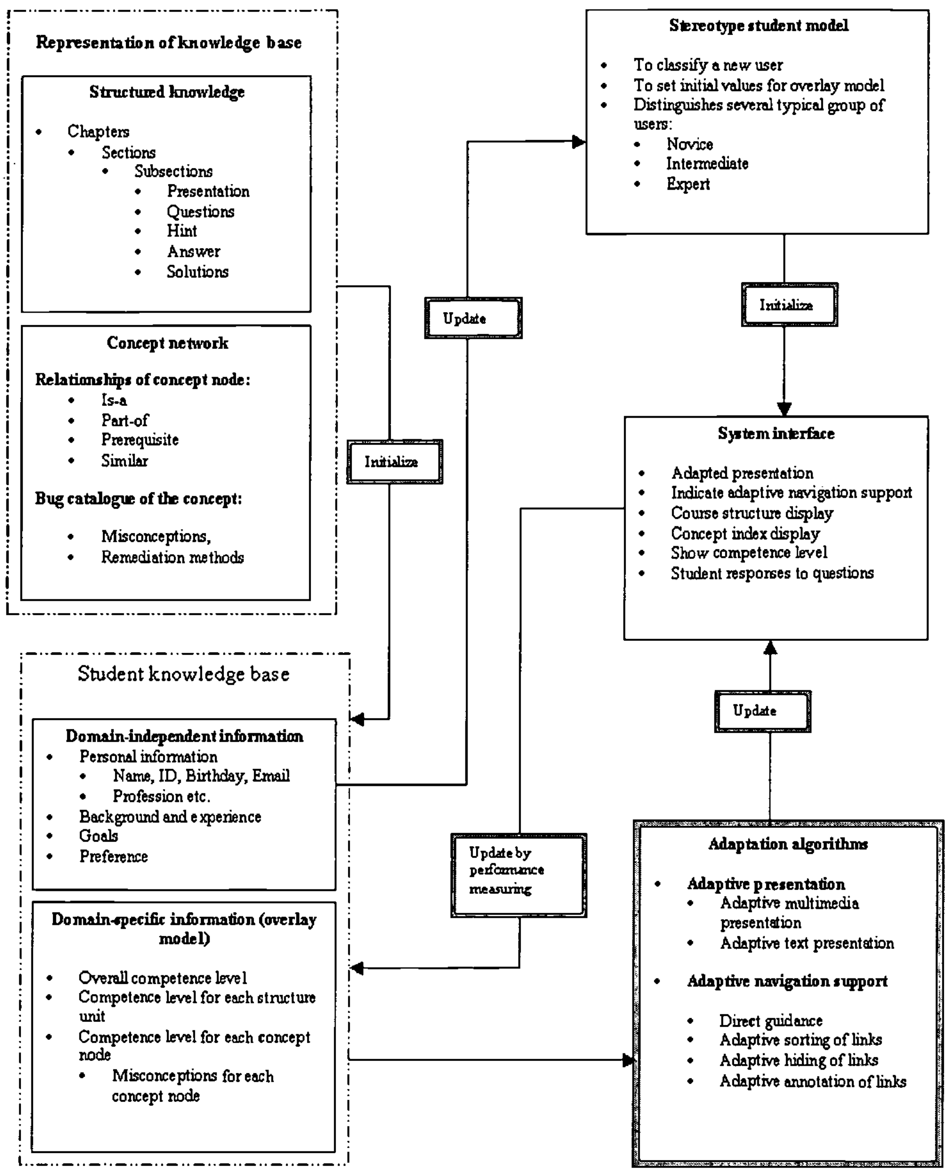
The student knowledge base is represented by an overlay model in which the current state of a student's knowledge level is described as a subset of the domain model. The domain-independent part of individual student model includes student's personal information, background, experience, goals, and preferences of learning style. The domain-specific part contains student competence levels for each concept node and each unit in the content tree, and an overall subject competence level. A group student model is constructed by averaging corresponding values in the models for all individual students within a group. The data in previous group student model may be used to initialize current individual models if no reliable information is available.

The student model is initialized by a simple but carefully designed questionnaire which is presented to the student in first session. The initial overall competence level is decided by checking the student grades of prerequisite courses and previous experience data, if available. The student learning styles are assessed by tracking student learning behavior. The students are allowed to set and modify their learning preferences and goals. The competence level of each concept is dynamically updated at each interaction, which are then used to update the competence levels of the related leaf units in the content tree. The competence levels of non-leaf units are determined by their child units. Finally, the overall competence level is calculated from all concept competence levels.

3. Usage

Two types of adaptation features are implemented in the student model: navigation adaptation that mainly decides the sequence of the presentation, and content adaptation that involves selectively presenting learning materials in various hypermedia forms. The domain independent information supports content adaptation. The system is able to create an individualized content presentation based on the student learning preferences and goals. The domain-dependent information supports both content and navigation adaptation. For example, the contents dealing with difficult details may be hidden from students with 'unsuccessful' competence levels, and additional explanations may be provided. The competence levels of content tree units are used to decide the recommended learning paths.

Structure of Student Model Prototype



4. Current state

This student model is implemented in a client-server architecture in accordance with the framework of TILE system (Jesshope, Heinrich & Kinshuk, 2000). The presentation interfaces run in a Java applet. The model adaptation and update application resides in the middle layer. This architecture is flexible and easier to maintain.

5. References

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SCAFFOLDING PERFORMANCE IN EPSSs: BRIDGING THEORY AND PRACTICE

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Abstract. Two promising developments have emerged: 1) Electronic Performance Support Systems (EPSS); and 2) scaffolding approaches. The link between these developments, however, is relatively new. The purposes of this paper are to introduce EPSS design and implementation issues, to describe the relevance of scaffolding to EPSS design, and to present a case study involving the application of different scaffolding approaches.

An EPSS Primer

Simply stated, performance support systems help users do or accomplish things as they attempt to perform (Dorsey, Goodrum, & Schwen, 1993); EPSSs do so using computational technologies (Hoschka, 1996). An EPSS is a system of task-integrated online job aids, support tools and information systems that assist users with workplace performance (IETI, 1995; Stevens & Stevens, 1996). While some have expressed the need for caution (e.g., Clark, 1992), EPSS technology has gained broad acceptance in the education and training communities (see, for example, Banerji, 1999; Gery, 1991, 1995; Huber, Lippinott, McMahon, & Witt, 1999; Raybould, 1995). Interest in EPSS technology has been evident in professional organizations, corporate training and education environments, and academic R&D settings (Carr, 1992).

According to Gloria Gery (1995), two simple goals define what *any* EPSS should provide: 1) software to integrate knowledge, data, and tools required to help a performer succeed at a task; and, 2) task structuring that guides performers to create deliverables. In a sense, EPSS technology is not so much a unitary design concept, with fixed features and components, as it is a perspective on designing systems that support learning and/or performing. This, however, can prove elusive and deceptively complex. A recent volume describing the development of EPSS and other tools to support instructional design (van den Akker, Branch, Gustafson, Nieveen, & Plomp, 1999) highlights both the advances realized in the 1990's as well as needed research and development.

A Scaffolding Primer

Scaffolding is the process through which efforts are supported while engaging a learning or performance task. Scaffolding can be differentiated by mechanisms and functions. Mechanisms emphasize the methods through which scaffolding is provided, while functions emphasize the purposes served.

Scaffolding complexity varies according to different contextual variables; scaffolding approaches, therefore, vary accordingly. In some instances where the problem or task is very explicit, scaffolding can be closely linked to the specific performance demands; when the task is not well-known or is ill-defined, scaffolding of a generic nature is generally provided. A number of different types of scaffolds are possible, including Conceptual, Metacognitive, Procedural, and Strategic.

Conceptual Scaffolding

Conceptual scaffolding is provided when the task is well defined and guides users regarding what to consider. At times, this is accomplished by identifying key conceptual knowledge related to a task or creating structures that make conceptual organization readily apparent. These structures can be made available through a variety of mechanisms, ranging from the graphical depiction of relationships, to outlines featuring ordinate-subordinate relationships, to information and hints provided by experts.

Conceptual scaffolding can be designed to help users reason through complex or fuzzy problems, as well as for concepts where known misconceptions or misunderstandings are prevalent. Hints can guide users to available resources or tools where understanding is typically problematic.

Metacognitive Scaffolding

Metacognitive scaffolding supports the underlying self-management processes associated with performance, i.e., it provides guidance in how to think. Metacognitive scaffolding can be either domain-specific, such as where performance contexts are externally induced, or more generic where the performance context is not known in advance. Metacognitive scaffolding might also remindusers to reflect on the goal(s) or prompt them to relate a given resource or tool manipulation outcome to the problem or need at hand.

Procedural Scaffolding

Procedural scaffolding emphasizes how to utilize available resources and tools. It orients to system features and functions, and otherwise aids the user while performing. For example, some users become disoriented in complex or fuzzy performance contexts. Procedural scaffolding is frequently provided clarifying how to return to a desired location, how to "flag" or "bookmark" locations or resources for subsequent review, or how to deploy given tools. Users need not develop facility with all procedures until they have established, on an individual basis, the need for a given tool or resource.

Strategic Scaffolding

Strategic scaffolding emphasizes alternative approaches that might prove helpful. It supports analysis, planning, strategy, and tactical decisions. It focuses on approaches for identifying and selecting needed information, evaluating available resources, and relating new to existing knowledge and experience. Another type of strategic scaffolding involves alerting the user to available tools and resources that might prove helpful under given circumstances, and providing guidance in their use. Expert advice regarding approaches that might be helpful can also be embedded. Finally, strategic scaffolding may take the form of response-sensitive guidance at key decision points.

Scaffolding in an EPSS: A Brief Case Study

The Tactical Readiness Instruction, Authoring, and Delivery (TRIAD) project is developing a set of authoring and delivery tools that will enhance the quality of tactical guidance disseminated through the U.S. Navy.

Introduction to TRIAD

Decision-makers are faced with increasingly complicated and stressful tactical environments characterized by situational uncertainty, time compression, and capable adversaries. To cope with such environments, today's decision-makers must have absolute command of a vast and varied knowledge base. Decision-makers must be familiar with situational cues, their ship and fleet capabilities and limitations as well as those of potential adversaries, and tactics at his or her disposal as well as those that potential adversaries might employ.

The bulk of requisite knowledge and skill is developed through experience and personal study of tactical publications (including Tactical Memoranda [TACMEMOs]) and combat system doctrine (Cannon-Bowers *et al.*, 1994). TRIAD is a PC-based system being designed and developed to improve the coherence and usability of TACMEMOs. TRIAD will provide authors with an integrated tool set to enable them to create tactical documentation (*i.e.*, TACMEMOs) using a variety of multimedia presentation techniques, and to create associated interactive multimedia instruction (IMI) to support the documented tactic/doctrine. In turn, readers will receive a multimedia tactical documentation "product set" that supports tactic/doctrine presentation and briefing, instruction, quick reference, and facilitation of electronic feedback regarding tactic/doctrine evaluation. In the following sections, we emphasize TRIAD's on-line author interview scaffolding of efficient and effective TACMEMOs.

Author Interview Overview

The TACMEMO development process consists of three stages: interview, edit and review. During the interview stage, the author creates and/or imports existing resources regarding the tactic in response to TRIAD-supplied interview questions. Using the information gained from the interview, TRIAD generates a draft TACMEMO product set consisting of the following integrated components: Base Document, Tactic Training Component, Quick Reference Guide (QRG), Feedback, and Brief. The Base Document contains the core TACMEMO content and procedures. The Tactic Training component addresses training requirements keyed to specific tactics knowledge and skills identified in a given Base Document. The QRG is an on-line job aid designed to distill the most essential aspects of the tactic for ready reference and to enable the user to link to associated Base Document and Tactic Training sections of the TACMEMO. Feedback, of a formative nature related to the tactic's usefulness, is elicited from users and recorded electronically. Finally, TRIAD generates a PowerPoint® presentation Brief containing the primary information contained in the tactic. The Brief can be edited and otherwise modified to provide greater or lesser breadth and depth, per audience needs.

The process begins through progressive decomposition of the product set's content. That is, the author is first asked to specify broad categories of information that the product set will address (*e.g.*, Threats, Weapon Systems, Tactical Employment) and to specify one of these categories as the main thrust of the product set. For example, a given product set may focus on how to use a certain weapon to defeat a certain threat. In this case, the Tactical Employment, Weapon, and Threat categories would all be uses, but the Tactical Employment category would be marked as being the central theme or frame.

After specifying the broad categories of concern, the author breaks each category into smaller and smaller units. For each category, the author is asked to specify which of a set of possible *anchors* are important to the product set. For example, within the Threat category, the possible anchors include Type, Mission, Design Characteristics, Identifying Characteristics, *etc.* This process continues as the author determines which aspects of the anchors themselves to discuss. For example, within the Identifying Characteristic anchor, the author could choose to discuss Identifying Features and/or Indicators via Equipment.

The interview process continues by further decomposing the material to be presented (*e.g.*, creating sub-sections for the base document or learning objectives for the tactic training component) and by eliciting content associated with a particular element (*e.g.*, creating a description of a piece of equipment or a particular practice exercise). Content is added to the skeleton created through decomposition through tools that allow authors to create novel content or select from a library of existing knowledge objects.

The process continues with a guided elaboration and augmentation of the draft product set. The process consists of three iterative strategies, confirming, elaborating, and fine-tuning, designed to help authors refine and augment content. Confirmation assists authors in validating content accuracy and completeness as well as confirming TRIAD-generated structures and sequences. Confirmation is critical because it safeguards the accuracy of both the content and structure of TRIAD-generated documents. Elaboration helps authors to extend, amplify, and otherwise augment TRIAD documents. Authors elaborate and detail descriptions and supporting examples, especially those considered critical to the user's knowing and implementing the tactic. Fine-tuning enables the author to clarify information, directions, instruction, and presentation. At this step, the author amplifies key information, reducing or eliminating ambiguity and unclear or non-essential information.

Once the interview is completed and the draft product set generated, the edit stage commences. Here, the author is again presented with the draft product set and can choose to edit any or all of the product set components. The author can add new media and edit existing media (text, graphics, animation, simulation, *etc.*). The author can import related media from the local TRIAD database, or from a remote database, into a product template and then edit as desired.

The review stage commences after all TACMEMO product set components have been developed. Reviewers will be able to comment within the document and return these comments to the author. Comments received electronically will be stored in the TRIAD database for use by the TACMEMO author to revise components as required. The capability to merge comments into the document will be provided. As in the edit stage, the author can create/import new media and edit existing media (text, graphics, animation, simulation, *etc.*) in response to review comments.

TRIAD's Scaffolding

TRIAD is essentially an EPSS authoring environment for producing EPSSs. That is, the authoring environment must support authors as they attempt to produce a TACMEMO "product set" that supports the performance of field users (readers). It is useful, therefore, to consider TRIAD as a family of EPSSs, some designed to aid the author's performance and others to support readers' performance. In Table 1, we summarize TRIAD's scaffolding features.

Scaffolding assists individuals as they engage various activities. For example, conceptual scaffolding assists the learner in defining what to consider. Within TRIAD, the searching mechanisms described earlier also function as *conceptual scaffolds* by directing the users' attention to product sets and sections that are likely to contain the most relevant information. At a macroscopic level, the majority of conceptual scaffolding actually takes place during authoring. By enforcing a performance-focus during authoring, TRIAD ensures that the base document, tactic training component, QRG, and brief indicate to the user the key concepts within a given product set.

Metacognitive scaffolding is provided through the practice and assessment area in the tactic training component. These sections provide a definitive indication of what each user knows. Rather than just providing an indication of correctness, these spaces try to capture "teachable moments" and deliver guiding feedback to users. *Procedural scaffolding* is provided through a task-oriented help system and results-oriented tool tips. Rather than defining buttons and functions, TRIAD's help system and pop-up tips describe how to complete tasks and explain the consequence of using a control. The TRIAD navigational construct is another procedural scaffold. Depending on user actions, this construct provides a table of contents, an index, or a list of the active bookmarks.

Conclusions

Scaffolding is a natural "fit" in EPSS design since, by definition, the systems guide or facilitate task completion. Scaffolding provides a more principled approach, however, in that it differentiates among the different types of both performance support needed and the methods/media used to support performance. This paper and presentation focused on defining and differentiating among scaffolding levels and illustrating their applicability in an ongoing R&D initiative. We believe the principles are more broadly applicable across a range of both performance support and knowledge system support. Future efforts should demonstrate scaffolding's viability accordingly.

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TRIAD Scaffold	Description	Example
Guidance	Context-/task-sensitive advice and clarification for performing, completing, or understanding the task at hand.	If a topic discusses a new piece of equipment, an illustration may improve the discussion by showing the new features or changed aspects of the equipment. Likewise, a textual discussion of complex information often benefits from a tabled summary of the presented data and information. Use the following 'Select if table' to help you decide how the information can best be presented. Select 'Table' if it is important to summarize complex data &/or information. Tables organize information &/or data to be summarized into rows & columns labeled in ways that make sense given the information. For example, create a table that lists different types of equipment in rows and the conditions/constraints for employment in each column. Select 'Graph' if it is important to visually present data for two or more critical variables in order to aid the reader's understanding of how variables interact along a particular continuum. For example, create a graph that illustrates trajectories of various projectiles. Select 'Illustration' if it is important to identify the visual aspects, features, or variations of parts, components, or processes for the reader. For example, create an illustration that displays numbered sequences indicating the path water follows when flowing through a particular valve system.
Definitions	Operational definitions of important terms that need to be understood in order to complete, perform, or understand the task at hand. The following are example definitions,	"A good annotation is a concise statement that provides a critical explanation or description." " A performance goal describes the expected performance of the trainee and it helps focus the author's writing on the required performance."
Examples	Completed exemplars or models demonstrating the task at hand , e.g., an example summary statement; an example assessment item.	
Explanation	Additional related information regarding the task at hand. The following is an example of AI provided after receiving Guidance to review a particular performance goal for clarity, accuracy, and completeness.	To determine if a goal should be edited: Read for clarity. Read the goal aloud and if you 'stumble' while reading, the statement is probably too wordy. Edit it by removing any unnecessary words. Read for accuracy. If the verb does not reflect the desired performance, select another verb from the verb table. Read for completeness. Read the goal and make sure it describes the required performance completely (subject, verb, object).

Wizard	Provides two types of information: 1.) a numbered step-by-step listing of the sequential steps to be followed when completing a given task; and,	This task requires you to refine and clarify the text by either adding missing detail or deleting unnecessary detail. Read each section and ask yourself the following questions: Is the text understandable and able to 'stand alone' without further detail or explanation? That is, is the information complete? If not, you'll need to add additional detail or explanation. As you read each topic, ask yourself if the information presented is complex (e.g., involves multiple steps) or is difficult to understand (e.g., easily confused with similar concepts). If so, emphasize each important step in a bulleted or numbered list. If the concepts are difficult, underscore how the concepts are dissimilar/similar by developing a list which compares/contrasts the similarities and/or differences. Additionally, as you read each section ask yourself if too much information or too many examples have been included. If so, edit to be more concise. Delete any descriptions/explanations that are not unnecessary.
	2.) guiding questions or reminders aimed at helping the author think about initiating, completing, or confirming a to-be-completed task. The Wizard is a 'pop-up' feature and can be disabled by the author.	This task requires you to inventory all existing media and documentation. Gather together all supplemental documentation and media that you'd like included in the memo. Read each topic heading and click 'Yes" to indicate you have an existing piece of media or documentation that is relevant to the topic. Type the name of the item so that it can be easily identified later. For example, Graph: Typical trajectory of a ... When you have completed inventorying all existing items, press ENTER to continue. Remember, if you'd like to read your memo in its entirety, select the 'View' button.
SCREEN CAMS	Screen Cams introduce and demonstrate new procedures, e.g., dropping & dragging topics into an outline. Screen Cams combine the 'live' movement of the cursor with a simultaneous voiceover that describes how to complete each required step in the procedure.	SCRIPT: In this section you'll indicate which topics are essential and which are supplemental. This distinction determines where topics are placed within the document's main text or appendices. Review the displayed topic headings. Notice as you roll the mouse over a topic heading the drafted content appears. You are going to click on each topic heading you consider essential to Knowing/Performing the tactic. You will continue this process until all topic headings are reviewed. Remember, your goal is to develop a concise memo and the main text should contain only the information and procedures that are essential to Knowing/Doing the tactic.
HELP	System-wide TRIAD HELP. Includes editing, navigation, etc. rather than task-specific guidance.	

Table 1. TRIAD's scaffolding features.

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Lesson Plans on the Internet: A Critical Appraisal

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This study focused on the abundance of lesson plans available on the Internet and while no judgement was made about the "goodness" of plans, the study attempted to determine if the lesson plans contained generally accepted qualities that increase usefulness to teachers. 271 Plans were examined for Objectives, Activities, Resources, Usability, and Assessment, across the K-12 spectrum in English, History, Mathematics, and Science. 51% of the sites had objectives that were behavioral, specific and complete. 45% of the Activities were complete enough to be easily followed. 55% presented adequate resources. 53% were usable without adaptation, while only 24% presented valid, usable assessments. Clearly, based on this sample of lesson plans, great care should be exercised when using most of the lesson plans on the Internet.

Humanities on the Internet: A Collaborative Model for Faculty Development

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Abstract: This brief presentation includes a summary description of a Web enhanced, team taught course, ***Humanities on the Internet*** (http://library.weber.edu/humanweb). This course demonstrates how faculty and students can enhance their learning through collaboration and active learning in an electronic classroom. Presenters will describe the development and implementation of the course focusing on new technologies and new pedagogies. Collaborative methods and increased learning by faculty will be described.

Introduction

The *Humanities on the Internet* is a General Education course designed for first or second year college students. Although the purpose of the course is to enable student learning of Humanities content and information literacy skills, a major outcome is increased learning for faculty. This use of this course as a model for faculty development and collaboration within the Humanities will be described.

Background

The faculty development team were most interested in implementing a multidisciplinary, multicultural Humanities course providing students with the writing, speaking, and information literacy skills they would need throughout their college careers. Most of the faculty involved have long histories of collaborative activities. They have a strong interest in seeing the connections among different cultures, communities and disciplines. They wanted to learn to incorporate new technologies in their courses. The development of the course was as collaborative as its teaching methods. A strong motivation for course development was the Liberal/General Education reform movement in the US. Over 13 faculty, the Dean of College of Arts and Humanities, University Librarian, five department chairs, academic advising, three campus committees and over 60 students have been involved in the development of the *Humanities on the Internet* course. The course was accepted by the Curriculum and General Education Committee as a three credit hour semester General Education Humanities course in Winter 1998. The course has been taught regularly since Fall 1998. Student interest in the course is high, as sections fill quickly. Student end of course evaluations are very positive. The course is co-funded by the University Library and the College of Arts and Humanities.

Teaching Methods

The course is team taught by four faculty from the College of Arts and Humanities and one librarian. Faculty and students collaboratively developed the course Web site at http://library.weber.edu/humanweb. The Web site contains the complete syllabi, calendar, gradebook, links to faculty homepages and email, links to all of the readings, many online discussions and all the course assignments. Each faculty member teaches a two-week segment of the course. Faculty teaching the course have varied levels of experience with technology. Faculty with strong technology skills and experience work with others that are just beginning their involvement with Web delivered course materials. The entire group teaches the introduction and conclusion to the course. There are four discipline specific segments interspersed with technology and information literacy instruction taught by the librarian. There are always at least two faculty in the room. Faculty see themselves as facilitators and guides. The instruction takes place in an electronic classroom. This enhances the faculty's efforts to enable active learning and to keep the classroom sessions student centered. Every class session involves an active learning component, with hands on use of computers, writing to learn, small group discussions and student presentations.

Learning Outcomes

Faculty see this course as a wonderful way to introduce students to the variety of subjects within the Humanities, within one course. Students have learned multiple ways to access more information on and off campus. Students feel more confident and comfortable expressing themselves via E-mail, Internet discussion and Web publishing after taking this course. Students acquire information literacy and computer skills within the Humanities context. The classroom and the pedagogy are designed to promote independent learning and to enable students to learn much from each other. Students are expected to work cooperatively in, and outside of, the class. Many active learning methods are introduced in this electronic classroom setting, which also contains 6 round tables and chairs for small group work away from the PC's. As students see faculty collaboration they have a practical model of a learning community to work from as they begin to build their own learning community of students. Assignments may include reading responses, Web research, developing Web sites on Humanities topics. Students are expected to engage in the arts virtually and experientially. For example, they visit a local art museum and view Web museums and art works. Faculty are particularly pleased with student performance on their last group assignment. Here, as a group, they attended a performing arts event, researched the event and prepared a summary of their research on the Web. The Web site was presented to the class in an oral presentation with the use of large screen projection. The instructors felt the faculty collaborative model assisted students as they worked together on their assignments.

Impact of Collaboration on Faculty

The course has become an important faculty development tool for the College of Humanities. The faculty have learned a great deal from each other. This course offers an excellent opportunity to teach new technologies to faculty. Faculty are able experiment with developing Web and large screen instructional media for two weeks of course work, then later they may be much more willing and able to use the same technologies within the larger context of a complete course or program. Each faculty member involved has gained insight into:

- New uses of technology to enhance learning
- New ways to plan, execute and deliver Web enhanced assignments
- New ways to present content, particularly using small groups, on the Web and with hands on computer use
- Using electronic information resources including Web syllabi, readings and EReserve
- Techniques for successful collaboration in course development, teaching, assessment and grant writing
- Modeling learning community behaviors for students

Students are encouraged to comment on the content, assignments and pedagogy throughout the semester, and they do! Faculty benefit greatly from the students willingness to collaborate. Students learn something about the process of designing and refining a new highly technologically driven course through this collaboration and ongoing dialogue.

Overall Quality of Collaboration and or Results of Collaboration

Both students and faculty have worked together to develop effective learning communities. Collaborative teaching and learning was enhanced through the use of an electronic classroom and through Web delivered course materials, assignments and assessment tools. Faculty strived for and gained new skills and new levels of teaching excellence by collaborating with their peers. Students benefited from learning from several faculty within one course; they were able to view different perspectives, attitudes and teaching styles. Students witnessed first hand faculty interaction and collaboration. Faculty use the experiences gained in this course to enhance their other courses. They see the student's appreciation of Web enhanced materials and better understand the new role of the Web for instructional delivery, even within a "face to face" course setting. This experimental team-taught course has become an effective and popular learning center for both students and faculty and a significant instructional model.

WWW-based Multimedia Training System Linked with Teaching Materials

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Recently, a WWW-based CAI/CAL system has been needed as the Internet spreads rapidly. We also have been engaged in developing a WWW-based CAI/CAL system that supports to learn and teach foreign language. In this paper, we present a WWW-based training system that supports to learn German. This system, which enables the learner to learn the language at a level, has the following three features: First, this system is closely linked with WWW-based teaching materials (lexical and grammar materials) which we have devised, second, the teacher can edit exercises on WEB browser, third, the form of this exercises is often used in examinations of foreign languages at universities in Japan. This system has just been used by the students at our university, and we receive good evaluation from them. We intend to improve this system in order to make it easier-to-use to satisfy the needs and requests of the learner.

A Review of Virtual Learning Environments From a Learner Centred Approach

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Abstract: This paper is a report on the findings of a study to investigate a range of approaches to Virtual (Managed) Learning Environments which the United Kingdom's National Health Service might take in its implementation of a 'virtual classroom' for health informatics. The paper describes the detailed methodology employed, provides a brief analysis of some of the representative VMLEs identified, and discusses the need for new or integration of existing technologies to support a learner centered (rather than curriculum centered) approach.

Introduction

This paper arose from a study commissioned by the National Health Service (NHS) Information Authority in Spring 2000 which aimed to assess possible approaches towards developing a 'Virtual Classroom' for the NHS in the United Kingdom with reference to current and evolving developments in Internet technologies, learning and teaching, for a disparate, dispersed workforce of over one million employees.

"It is required for the purposes of this study [approximately] 10 Internet based learning environments are explored... It is known that significantly more than 10 environments exist and this work will require an initial top level 'sift' of the many examples found, such that the 10 environments selected provide the broadest view of approaches to Internet based learning." (NHS Information Authority, Invitation to Tender, 2000)

The study produced a high level review of over one hundred virtual (managed) learning environments (VMLEs)[1], components of VMLEs, the results of Higher Education (HE) research projects and example case studies, and mapped these against the requirements of an NHS learner together with an envisaged technology architecture (previously defined in a confidential report Towards a Virtual Classroom – Phase One Scoping and Needs Assessment, 1999). The term VMLE was adopted to reflect the projected implementation of the Virtual Classroom as stated in Working Together with Health Information, 1999, and as concluded in the previous study:

"A [VMLE] linked to a supporting physical network, which dynamically responds to the learner and their individual learning needs, which are continuously assessed, and where relevant information is 'pushed' to the learner, whilst also allowing personal sourcing of resources." (Towards a Virtual Classroom – Phase One Scoping and Needs Assessment, 1999, TVC-P1)

The paper describes the methodology employed, provides a brief analysis of some of the VMLEs identified, and discusses the need for new or integration of existing technologies to support a learner centered (rather than curriculum centered) approach.

The study was undertaken by a partnership experienced in life-long learning, e-learning, health and technology standards, and consisted of Ms S Hardy, Dr G Nestor, Dr M Quentin-Baxter, Dr K Lawrence, Dr EH Smith, Dr A Drury, Dr NJ Fox, and Professor IN Purves, drawn from the Sowerby Center for Health Informatics at Newcastle (lead partner, University of Newcastle), the Faculty of Medicine Computing Center (University of Newcastle), a Salford collaboration between Academic Enterprise (University of Salford) and the Salford Royal Hospitals NHS Trust, and The WISDOM Center for Networked Learning (University of Sheffield).

Major goals of the study

1. Assess current learning and teaching strategies in Internet-based learning via a review of current known VMLE products and projects in relation to the needs of the NHS, as outlined in Information for Health (1998) and Working Together with Health Information (1999).

2. Consider the suitability for transfer of a VMLE to a UK-wide learner centered continuing professional development environment, specifically the NHS, based on an adult learning model, incorporating sophisticated portable reflection and recording tools.
3. Examine the conceptual models of both 'teacher' and 'learner', and how these definitions might affect the assessment/construction of a VMLE based on the required adult learning model and applied to a hugely disparate and distributed workforce.

Background

The TVC-P1 study outlined an envisaged topology and associated learning process, which encompassed access to information, eCommunity technologies, and distributed learning resources (Table 1). It was assumed that issues of hardware, connectivity and access were resolved in the NHS environment, although this is not yet the case (NHS Plan, 2000; p49). The heart of the flexible adult learning model was person-centered, including a learning record and continuous needs analysis (Kaufman, Mann and Jennett, 2000). This model personalized learning, facilitating a lifelong educational process with emphasis on tutoring, mentoring, personal reflection time, quality assurance of the learning experience, personal development planning and certification (Vescoukis and Retalis, 1999). Coding and classification could be used to describe each of the components of the system to facilitate matching relevant information to learners and information exchange. This is fully learner-centered, focused on supporting learning and teaching requirements (Patel and Kaufman, 1998), as opposed to the more traditional curricula centered style adopted by many commercial providers of VMLEs, and has the potential to accommodate new audiences and wider learning and teaching needs (D'Alessandro, et al., 2000).

Architectural Component	**Functions**	**Technology Options**
Database	• Enable certification • Learning record (needs, learning path, outcome, tutor and learners notes) • Mapping descriptions • Personal development plan • Private and secure	• Authentication and encryption services • Central database Content negotiation • Cookies (or set preferences) • Distributed database • Smart card (or floppy disk as pragmatic alternative)
Data Input	• Evaluation of resources/accreditation • Learning outcomes assessments • Needs assessment • Personal development planning and reflection • Other profiling	• Learning record interface • Navigation tracking Web based learning tools • Web forms
ECommunities *(local and distributed)*	• Collaboration • Communication • Co-ordination • eClass • eCommunity archives and FAQ's • eTutoring and eMentoring	• Chat • Diary functions • Email • Listservers, News & BBS • Netmeeting • Regional/national action learning network • Resource scheduling • Other developing technologies

Resource Gateway/Portal *(local and distributed)*	• Courseware Internet • NeLH	• Agents Channelling/tunnelling • Push/pull technology • Streaming • Web (HTML, PDF, any MIME type)

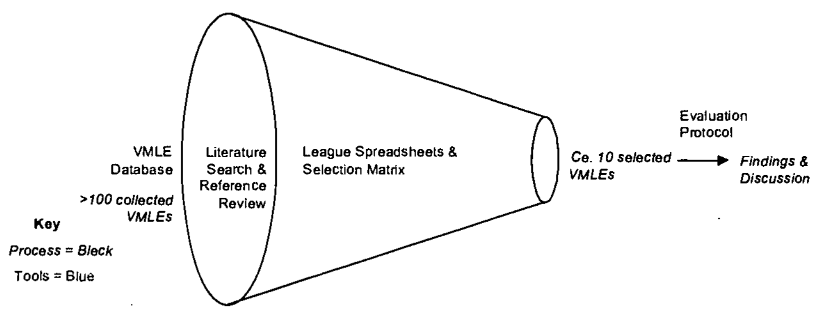
Table 1:. Virtual Classroom architectural component, function & technology options based on the identification of learner needs (based on TVC-P1).

Method

Outline of the basic approach

The methodology for identifying and evaluating the possible approaches attempted to reflect pedagogic and process issues as well as recording product features. It included an initial review of journal literature, electronic databases and the Internet, employing standard literature search techniques and a range of electronic search tools (based on Berry et al, 1998). The filtering process used a complex matrix to yield a representative group of c.10 VMLEs, which subsequently underwent an individual in-depth evaluation according to an agreed In-Depth Evaluation Protocol (IDEP)(Figure 1).

Figure 1:. Illustration of the approach and methodology schema for determining the final VMLEs to be considered for in-depth



evaluation using the IDEP.

High Level Literature & Resource Review

On-line Database of VMLEs: An on-line, web-based database was designed using MySQL, Zope and interactive extended Wikipages. Researchers were asked to contribute as many unique entries as possible. These ranged from descriptions of components of VMLEs (e.g. web based assessment tools) to detailed descriptions of complete VMLEs or enterprise resource packages. There were also case studies of applications of particular VMLEs (e.g. University of Wollongong makes use of WebCT) and details of published comparative analyses of VMLEs. The database contained over 120 entries by May 2000. [Since the cut off date further information has been added, and more than 300 entries were available at the time of writing. http://www.ltsn-01.ac.uk/vle]

High Level Review: An initial rich overview of the structure, functionality and usability of c.100 VMLEs was undertaken. The home web site of each VMLE available in the database in May 2000 was visited by one of the researchers and graded in terms of three parameters which were used to inform the development of the 'League Spreadsheet' and 'Selection Matrix' below:

- Technical sophistication ('Technology')
- Pedagogical model appropriate for adult life-long learning ('Pedagogy')
- Whether already applied in health context ('Health')

Identification of VMLEs for In-depth Evaluation

: A **League Spreadsheet** was designed and linked back to the original requirements identified in the TVC-P1 study, the High Level Review and cross-referenced against the proposed IDEP. This method also corroborated the results of the High Level Review, and limited subjectivity in the choice of representative VMLEs to compare (Table 2). Each feature was scored according to the agreed system ranging from Not Present (0) to Good (3).

Pedagogical Foundation – overall educational philosophy and approach of the VMLE; encompassing pedagogy, user types and facilitation, synchronicity, etc.; examples of effective use in practice
Needs Assessment – profiling of user as point of entry into the learning environment
Learning Record – continual dynamic record of activities facilitated by the VMLE, incorporating support for reflection in addition to the development of a simple transcript
Communication – community, collaboration, and facilitation of communication, architecture, functionality and range of features
Standards – conformity to accepted and emergent Internet and database standards, encompassing technology options and requirements, architecture, potential scalability, and cost implications
Functionality – ease of use, fit for purpose, user requirements, ease of content provision

Table 2: League spreadsheets feature headings with explanations.

League spreadsheet reviews were performed with reference to the VMLE web site, access to full installations or demonstration copies. The mean feature scores, mean total score and standard deviation for each VMLE were calculated by adding the results from the separate assessments performed and adjusting for number of reviewers. Standard deviations were used to indicate the level of agreement between reviewers, and another reviewer investigated VMLEs with high standard deviation in any category. Using a **Selection Matrix** VMLEs were ranked according to their mean total score and examined in detail to ensure that the required representative breadth had been realized. The top two VMLEs for each of the six feature categories were also identified for possible inclusion in the final selection by ranking all VMLEs by feature, in order to identify potentially strong component parts of a VMLE. An **IDEP** was developed and one reviewer for each of the representative VMLEs identified completed a pro-forma. In-depth evaluations documented detailed specifications, scalability, features and functionality, pedagogic focus, usability, strengths and weaknesses, risks and benefits, cost, implementation issues, standards and compatibility of the identified VMLE (available from authors). In-depth evaluations were performed with reference to the VMLE web site, and at least one of the following: access to full installations or demonstration copies, demonstrations by sales team and interviews with key stakeholders. Each evaluation took between one and three days to compile.

Major points of results

The twelve representative VMLEs yielded from the range of research tools employed, mapped against the study requirements, are detailed below alphabetically. These represent the top eight results from the selection matrix, the remainders were chosen as examples of strong components of a VMLE, or representative of an under-represented area.

- Blackboard Course Info – commercial on-line learning delivery environment, with extra functionality and additional management and administration tools provided as higher levels are adopted.
- British Aerospace – large-scale company Intranet focused on training and mapping needs. The BAe systems Virtual University received the 'U.S.A. Corporate University Xchange Excellence Award'.
- Centra Symposium – commercial NT based server product using Java to deliver mostly synchronous tools to web clients. Used a didactic teaching model, although it supports a range of mentoring functions and could probably be adapted to other styles of learning.
- Colloquia – example of a HE research project taking a user-centered pedagogical approach which functions off-line and without a central server.
- Learning Space - commercial online learning tool aimed at providing a learning platform for corporate and HE clients.
- Microsoft Learning Resource Network (LRN) Tools – major software supplier and LRN Tools might meet many of the identified user needs.
- Mindlever - commercial web authoring and course management software aimed at the corporate market.
- Open University – primarily asynchronous curricula centered HE on-line delivery method built on the Centricity First Class software.
- Internet Personal & Academic Records – a HE research project implementing a sophisticated tool for maintaining on-line personal development plans and recording achievement (component of a VMLE).
- Prometheus - A web based course management and design system, built using ColdFusion on a Windows NT platform, iteratively developed as a HE research project, which may become commercially available.

- WebCT - commercial online learning delivery environment, facilitating course delivery and learning community activities developed from HE research project.
- WISDOM - provides an integrated method for accreditation of on-line learning, and facilitates dynamic learning community activities - a good example of a community of practice (component of a VMLE).

In order to map the representative 12 VMLEs to the range of characteristics of an NHS learner, the in-depth evaluations were analyzed for relevant pedagogy; continuous needs assessment and learning record, flexibility and scalability to potentially one million users (Table 3). The price of VMLEs varies widely from nil (HE research projects) to over US$500,000 per annum for a limited user license. In addition, there were costs associated with start-up, support, infrastructure, content provision, training and maintenance.

VMLE	Type	Curriculum/ Flexible	Range of Features	Relevant Pedagogy	NA/LR Reflective Learning	Scalability NHS-wide
Blackboard Course Info	Commercial	Curriculum	Strong	Weak	Moderate	Strong
British Aerospace	Corporate Intranet	Flexible	Moderate	Strong	Strong (p)	Moderate
Centra Symposium	Commercial	Curriculum	Strong	Weak	Weak	Weak
Colloquia	HE Research Project	Flexible	Moderate	Moderate	Moderate	Moderate
Learning Space	Commercial	Curriculum	Moderate	Moderate	Weak	Moderate
Microsoft LRN Tools	Commercial / Component	Flexible	Moderate	Weak	Weak	Moderate
Mindlever	Commercial	Curriculum	Strong	Moderate	Moderate	Moderate
Open University (based on Centricity First Class)	University 'Intranet' / Commercial	Curriculum	Weak	Weak	Weak	Strong
Internet Personal and Academic Records	HE Research Project / Component	Flexible	Weak	Strong	Strong (e)	Strong
Prometheus	University 'Intranet'	Curriculum	Strong	Strong	Moderate	Strong
WebCT	Commercial	Curriculum	Strong	Moderate	Moderate	Moderate
WISDOM	Health Gateway	Flexible	Weak	Strong	Strong (p)	Weak
Key: p = partially paper based e = online/electronic						

Table 3: Summary of the representative VMLEs indicating whether they are curriculum centered or flexible, range of features supported, presence of a pedagogic foundation relevant to the NHS needs, needs analysis and learning record, and evidence of whether the VMLE could scale to support a large number of users.

It should be noted that these results are limited by the rate of change in technological developments, and by reliance on the outcomes of the confidential report TVC-P1, which mapped the NHS learner requirements and the envisaged technology architecture.

Discussion

The very large number of VMLEs identified is indicative of many institutions taking a homegrown approach to implementing VMLEs in order to engender ownership and produce systems which are tailored to their unique situations. The 12 representative VMLEs examined in-depth ranged widely in terms of their pedagogic approach, features, functionality, implementation, and application. None exhibited all of the characteristics identified to deliver a VMLE for the NHS, but there was evidence of the availability of the appropriate components (many of which did not make it into the final 12). Most of the more robust and scalable commercial VMLEs were only weakly relevant to the learner centred ('androgogic') approach required, particularly with respect to a continuous cycle of learning needs analysis and establishing a reflective learning record, while those with a stronger relevant pedagogy lacked a variety of functionality or could not scale as easily.

The pedagogic approach identified is essential to facilitate the establishment of content in the VMLE suitable for adult learning and continuing professional development for the NHS. The development of content is a shared responsibility as part of the two-way conversation of learning, and the process of developing content is the outcome, not the content itself, as identified over a decade ago by Laurillard (1987).

Many of the preferred curriculum centred systems being trialed in the UK to support institutional distributed course delivery present a traditional metaphor of 'teaching'. The implications of this for continuing professional development demands a review of the nature of courses offered to the new wave of mature, part time students who are being encouraged back into education as part of the national agenda to widen participation and promote lifelong learning. To adapt to the need for novel approaches to the delivery of curricula brings the model much closer to the NHS learner model outlined above, and necessitates a more learner centred approach than is currently available via any of the proprietary products or research projects reviewed or evaluated as part of this study. Whilst may be possible for curriculum focused and learner centered solutions to co-exist, this requires institutional organisational and technological convergence, and an understanding of the potentially conflicting functions of the two systems.

The evolution of IMS standards[2] may bring about a change in the functionality of VMLEs, whereby they move away from trying to deliver complete solutions, and adopt a more component-style architecture. Interestingly, as this becomes more sophisticated, a new architecture model based on learner objects emerges, which maps more closely the learner model and architecture envisaged in the initial TVC-P1 study. This has been described as moving towards 'second generation virtual learning environments', where coding and classification are used to richly describe all of the objects in a learning system, and rules dynamically determine 'communities of practice' (Wenger, 1998) through the relationships and associations between these objects (Malet, et al., 1999). This model enables 'server push' whereby relevant information is made available to learners, and the system monitors new opportunities or needs, and provides updates to the individual, according to their characteristics, attributes and preferences. NHS learner information would enable the system to dynamically identify new learning opportunities or needs, based on these changes in the learner profile.

The NHS has yet to determine its preferred way forward, however this study highlighted a number of issues that suggest to the project team that the NHS learner centred model may align closely with current VMLE developments both in commercially available proprietary products or research projects.

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New Designs for Web Based Learning Environments

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Abstract

With the continued advances in information and communication technology comes the interconnectivity of education institutions, businesses and industries. Either by default or association, the traditional education system will need to change and adapt to these new demands and opportunities. With these changes we are in danger of losing the focus of the learning process, and not recognising the importance of maintaining a balance between technology and pedagogy. This paper will review these issues, and examine an investigation of new learning designs which take advantage of the affordances of the Web and the opportunities which arise.

Focus for the web

In today's society, greater demands are being placed on education systems at all levels to produce citizens who can use knowledge in new domains and different situations. Members of society at every level are being asked to demonstrate advanced levels of problem-solving skills to retain their level of employment. Learning to think critically, to find, analyse and synthesise information to solve problems in a variety of contexts and to work effectively in teams are crucial skills for modern employees and thus consistently appear as attributes of the graduate in the prospectus of many universities.

Whilst these demands are being expressed in a variety of contexts, strong claims are being made for the role of information and communication technologies in supporting learners in achieving these goals. Authors such as Joo (1999) are proposing that the possibilities for improving educational practices using the Internet seem to be boundless. Higher education institutions are seeking innovative ways to provide flexible courses through new media (Barnard, 1997) and the possible era of a truly inter-connected global schoolhouse (Knight, 1996) is no longer considered to be extreme in the age of technology -mediated learning and the transmission of information at the touch of a button.

One of the difficulties for higher education institutions is to develop an understanding of the focus of their endeavours, that is, how to we balance the demands of technology against the need for strong pedagogy. The technology is not universally seen as a panacea for our current educational systems woes. As long ago as 1984 Cuban warned "there should be a page in the Guinness Book of Records on failed …….. reforms, for few ever seem to have been incorporated into teachers' repertoires". Alfred Bork (1995) has argued in his critical review of the failure of computers in universities that the effective use of new instructional paradigms, supported by technology, requires a shift in instructor's pedagogical approaches

Additionally, many authors, such as, Hutchison, (1998), fear that institutions are rushing into this technological dimension too quickly. He warns that there is a need to think carefully about the implications of technology on society and specifically on higher education.

> *'All aspects must be deliberated to ensure that we get the idea of virtual universities right in order to envelope the rapid expansion of the university sector and the ever growing dependence and recognition of formal qualifications.'*

Morrison (1999) shares this fear and debates whether something essential to higher education is being sacrificed when college and university courses take place on-line rather than on-campus. Hayes (1996) argues that "a catalogue of courses is not really a university", and it is simply not possible to learn the skills of teamwork and leadership, so vital in today's employment market, at a virtual university (Hayes, 1996).

Whilst the change predicted is transformational, and according to many writers, damage may be inevitable, a focus on the impact of IT on education not being detrimental to the education process must be maintained. Additionally, the focus on the web to support learning does raise a raft of additional issues not previously faced or fully resolved by tertiary institutions. Issues such as teleworking, ownership of intellectual property, transference of student management to the instructor, technology risk management, 24 hour service and access, etc. are being often overlooked or not recognised before implementation.

As Reeves and Reeves (1997) suggest, "despite all the interest, little research evidence exists to support claims for the effectiveness of Web-based instruction" (p. 59). One of the key issues appears to be the pace of change of emerging web technologies which is so rapid that learner-centred pedagogical models are urgently needed

(Bracewell et al., 1998). Gavriel Soloman (1998) has supported this concern and has noted that for the first time in history, technologies could be outpacing pedagogical and psychological rationale.

Learning Design Characteristics

The speed and rapid growth of information and communications technologies (Moores Law, 1965) has enabled many new and exciting developments in the last few years or so, opening up new possibilities in all sorts of different fields, including higher education. On-line delivery is still of an embryonic nature (Morino Institute, 1994). However, evidence suggests that the maturation of on-line delivery is starting to be realised as innovators develop realistic pedagogical models (Britain & Liber, 1999). For example, a body of literature is now starting to report on innovative tools, with strong pedagogical underpinning. Bonk (1998) has reported on interactive tools for on-line portfolio feedback, profile commenting, and Web link rating, while Oliver and McLoughlin (1999) are building tools for on-line debate, reflection, concept mapping and student surveying and discussion. There is a determined effort in the research community to investigate the key issues which we will need to address if we are to match pedagogy with technology affordances. Research agendas will need to address issues such as; design models to support development teams in re-conceptualising traditional modes of instruction for on-line delivery; academic instructional design skills which are not well represented in higher education; information about the learner's experience and their needs in on-line mode; student preparation and supported through the initial stages of using on-line environments; options for specific groups; drop-out rates for distance education; cohesion in on-line delivery; resource implications for infrastructure, personnel, professional development and administration; comprehensive costing and cost-effectiveness studies

A Collaboration in Developing Learning Environments

In this information age of global competition universities, both in the UK and abroad, Universities are moving into on-line delivery. In support of the need for a better understanding of moving quality student learning into this domain, the Digital Media Centre at the University of Wollongong, Edith Cowan University and the DELTA Institute, at the University of Wolverhampton, are working on a series of ideas to develop our understanding of moving academics forward in the design of learning ie attempting to move pedagogy forward to keep pace with the technology. The collaboration will build on an Australian University Teaching Committee project, *Information and Communication Technologies and Their Role in Flexible Learning*, being developed by the University of Wollongong and Edith Cowan University. The AUTC project is seeking to construct an evaluation framework for technology based learning products that can identify and articulate underpinning learning designs which have he potential for redevelopment outside the immediate context in the form of generic learning environments which can be adapted for use in different knowledge domains.

This collaboration will make use of the outcomes from development of the WOLF web environment, at the DELTA Institute, to investigate a series of exemplars which will illustrate the application of a number of the generic designs developed in the Australian project. The exemplars will attempt to address the less traditional learning designs, and illustrate the extended range of learning environments which the affordances of the Web offer. Additionally, the project will seek to incorporate additional media elements, such as broadband signals, into the designs.

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VoiceXML Editor: A Workbench for Investigating Voiced-Based Applications

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Abstract: The most common interaction with the Web is visual and accomplished through the use of the keyboard or mouse. Currently, the user cannot interact with a Web page using speech. This orientation limits the mobility of the user and his interaction with the Web because both hands and eyes must be involved in the task. Speech technology will promote an increased use of the Web in untapped environments in a similar way that cell telephones have promoted the increased use of telephones. One of the limitations to the development of voice systems is the lack of easy-to-use tools for creating spoken dialogue systems. One of the most promising emerging technologies for solving this problem is VoiceXML. VoiceXML brings the Web and content delivery together in voice response applications in an easy-to-use manner. This paper presents an editor for creating VoiceXML documents and narrates the research behind the tool.

Introduction

Currently, the most common interaction with the Web is visual and accomplished through the use of the keyboard or mouse. While sound files can be incorporated as part of the presentation, the user cannot interact with a Web page using speech. This orientation limits the mobility of the user and his interaction with the Web because both hands and eyes must be involved in the task. In fact, most pervasive computing devices today are used in a hands and eyes busy mode. The use of speech recognition and synthesis will remove this limitation and promises to be the next wave in Web interfaces. The use of speech recognition frees the user from the windows, icons, menus and pointers (WIMP) interface. It will enable the user to interact with the Web in a hands-free or mobility required manner (e.g., while traveling in the car) with no manual intervention [1,3,7]. Speech technology will promote an increased use of the Web in, as yet, untapped environments in a similar way that cell telephones have promoted the increased use of telephones.

Currently most of the speech interfaces are similar to telephone response systems in which the user is expected to enter a preset number from a menu of choices. While these systems are commonly used today, these systems have been viewed as limited because the user must remember the mapping to keys, there may not be an appropriate option, and navigation must proceed through a prescribed set of options, even if the user knows exactly what he wishes to do [1].

A review of the recent literature indicates that researchers are working diligently to understand speech interaction and when its use is most successful. Several recent articles have reported on studies of the voice interaction of humans with computers and how to make speech interfaces more conversational and adaptive than voice response systems [1,2,4]. Boyce investigated the use of key word driven and spoken dialogue systems and found that spoken dialogue systems were more flexible, but more complex to design. She also found that users preferred to interact with systems that referred to themselves as "I", but found no significant differences in the preference for casual versus formal speaking style. Other results indicated that the right initial system greeting is essential for establishing user expectations and helping users determine how to proceed [1].

Schneiderman investigated the limitations of current speech interfaces, particularly the interaction of speech and physical activity (e.g., keyboard manipulation), in interfaces. He found that most humans find it easier to type and think concurrently than to speak and think concurrently. Thus, voice command users needed to review their work more often than keyboard users in a word processing environment. He concluded that an understanding of the cognitive processes utilized in speech will aid interface designers in integrating speech in a more effective manner. Schneiderman also indicated that future uses of speech in Web environments will not be as standalone components, but as complements to visual interfaces as part of a multimodal interface [7].

Multimodal interaction, which includes speech, is part of a paradigm shift away from the use of WIMP interfaces. These systems have the potential for functioning more robustly than a single recognition-based technology such as speech. The design of these systems requires a knowledge of the properties of the individual modes, such as speech, and the information content that accompanies them [6].

One of the limitations to the development of voice systems is the lack of easy-to-use tools for creating spoken dialogue systems, particularly by non-experts who have no experience with or desire to learn the low level details of speech technology [2,3,7]. This lack of tools inhibits the development of applications and the portability of existing applications. It also results in a scarcity of skilled application developers and high costs of development and deployment [3].

One of the most promising emerging technologies for solving this problem is VoiceXML (Voice eXtensible Markup Language). VoiceXML is an XML-based markup language that brings the Web, content delivery and voice response applications together in an easy-to-use manner. XML is a specification for designing markup languages that are used in the Web and is an accepted standard for providing structure to Web documents. It specifies a standardized text format for representing structured information on the Web. HTML, which is a markup language, as it is currently designed, is not an XML application, but could be redesigned to be one. XML documents consist of data and markup components (e.g., element tags, processing instructions, data elements, comments, etc.) that are parsed and interpreted by an XML processor (such as a Web browser). Each component of an XML document (e.g., page, image, audio clip) is stored independently from the document. SMIL (Streaming Media Integration Language) and VoiceXML are just two of many XML vocabularies that have been developed. Currently, there are a limited number of browsers that support XML documents, but both Netscape and Internet Explorer have committed to supporting XML 1.0 [5]

VoiceXML was released in March 2000 and accepted in May 2000 by the World Wide Web Consortium (W3C) as a basis for developing a dialogue markup language for voice [8]. Basing VoiceXML on the existing standards of XML (eXtensible Markup Language) has the benefits of allowing the re-use and re-tooling of existing tools for creating, transforming and parsing XML documents. Several vendors including IBM and Motorola have implemented versions of VoiceXML 1.0 [8].

The purpose of this research was to develop a prototype for an easy-to-use editor for creating VoiceXML documents. Such an editor allows novice users, as well as experienced ones, to create or edit Web-based speech systems easily.

Objectives

The objectives of the research project were:

1. To determine the attributes of an effective voice interaction interface.
2. To identify the components that are needed in an editor for developing VoiceXML applications using the attributes identified in objective one.
3. To design the interface and supporting system for a VoiceXML editor that incorporates the components identified in objective two.
4. To develop a prototype of a VoiceXML editor using Java.
5. To determine the effectiveness of the editor in creating new VoiceXML documents and editing existing documents.

Significance of Research

As indicated previously, the lack of tools for creating voice dialogues for the Web is inhibiting the development of voice applications on the Web. This project will help to fill that gap. Additionally, the project is timely since voice systems are the next frontier of Web-based interfaces. Advancing technology has finally reached the point that it can support speech synthesis and recognition systems in voice applications in a reliable and efficient manner. It is expected that many E-commerce applications will soon support voice [4]. Web-based voice applications also have potential in academics. The tool created in this project has the potential for assisting non-technical developers in developing voice applications.

Hardware and Software Environment

The language used for development of the VoiceXML editor was Java since it is portable. The system was developed as a Java applet that enables anyone with a Web browser to create voice applications for the Web. The editor was developed and tested using a personal computer, although the code was developed using JDK1.3 (Java Development Kit) which makes it possible to develop and execute the system on any platform that has JDK1.3 and a Web browser that supports VoiceXML 1.0.

Methodology

The first step in the project was to determine the attributes of an effective voice interaction interface. Current voice response system dialogues represent paths through a decision tree. An investigation of approaches to the representation of a voice dialogue in the development environment was conducted. Because the editor interface is visual, a review of the literature on the development of graphical user interfaces was also conducted in this step. Since the dialogues are not visual, the usual procedure used in developing graphical user interfaces by laying objects out in a window as they would appear in the interface was not be appropriate.

The second step was to identify the components that were needed in an editor for voice applications using VoiceXML. During this phase of the project, the attributes identified in the literature above, along with a review of the VoiceXML syntax and the attributes of existing language editors, were used to decide what support was required in an editor for creating VoiceXML applications. First, the VoiceXML syntax was reviewed to determine which syntactical constructs of VoiceXML needed to be supported by a prototype editor. It was decided that because of the scope of the language syntax, that only a fundamental set of components would initially be supported, with plans to implement support for the entire VoiceXML syntax in a future project. Second, existing language editors with a visual interface (e.g., Visual Basic, Visual C++) were reviewed to identify the basic set of editor functions that were needed in the editor.

The third step was to design the interface and supporting system for an editor that incorporated the components identified in objective two. Standard systems analysis and design methods and tools were used to design the software components of the editor. The design approach was object-oriented so that components could be easily modified and new features easily added to the system at a future date. Java is an object-oriented language so this approach is most suitable for supporting the subsequent implementation.

The next step was to develop a prototype of a VoiceXML editor using Java. The system was developed as an applet so that it can be executed in the Web and distributed to interested users.
The editor is similar to other visual language editors. The editor includes the typical file operations (new, save, open), editing capabilities (cut, paste, search), a tool box representing the objects that compose a VoiceXML application, a development window, formatting capabilities, the ability to switch to and edit the code behind the application, the ability to switch between different components in the application, and a visual layout of the components of the application.

No attempt was made to reverse engineer an application that was created outside the environment into the graphical components that are used by the editor to create a new VoiceXML application.

Several applications were identified for development in VoiceXML and created using the editor. For each, a list of predicted behaviors and outcomes was manually generated. Each application was tested within a browser and the behavior matched to the predicted outcome.

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Successful integration of learning technologies in school classrooms (SILT)

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Abstract: This paper reports on the progress of a research program based in Victoria, Australia, where teachers are strongly encouraged to integrate technology in their classrooms. The teachers in this study are generally positive in their view of the potential benefits for students of learning with technology, and many have their own government-subsidised laptop computer which provides the opportunity for regular access for their own learning. However their classroom behaviours vary widely. Preliminary findings from classroom observation, surveys and a series of reflective conversations with teachers have identified some reasons for these differences and ways in which teacher professional development might be enhanced.

Introduction

Kerr (1996) and Fisher, Dwyer and Yocam (1996) suggest that the increasing use of technology results in greater student involvement in project learning, increased learning in groups, a shift in the teacher's role and attitude from being a source of knowledge to being a coach and mentor, and a greater willingness on the part of students to take responsibility for their own learning. However a recent Australian study (Cuttance et al. forthcoming) found that teachers, overall, appeared to find the acquisition of the skills to lead learning in these environments a major challenge and there was a major gap in the provision of high quality professional development.

The Study

This two-stage ethnographic study was conducted in Victorian state schools during 2000. Teachers participating in the larger Successful Integration of Learning Technologies (SILT) project participated in conversations and classroom observations, through which broad issues affecting teacher's practice and their professional learning have been identified.

Stage One

The context was established through 53 observations of classes in 27 schools. Twenty-seven observations (51%) took place in Year 5/6 primary classrooms, while 25 observations were in secondary settings, mainly Years 7 and 8. Each observation was written up by the observer and coded using QSR N4 Classic™ (Richards 2000). The data were analysed to identify the range of teacher roles currently in use.

It appears that teachers are engaged in a variety of behaviours in relation to the classroom. Jones (1995) describes the teacher as facilitator providing rich learning environments, experiences, and activities; creating opportunities for students to work collaboratively, to solve problems, do authentic tasks, and share knowledge and responsibility. The observations in this study showed numerous behaviours falling into this description. As a result, the term "facilitator" is taken to be a broad term conceptualising an approach to teaching which is more student-centred and constructivist than the teacher-directed approach, rather than a set of specific behaviours. The roles observed were planner, content manager, people manager, technician, instructor, demonstrator, coach, monitor and assessor, guide and reflector. Data from Stage Two reveal additional roles including *confidant* (when students reveal personal information in private communication) and *learner* (when teachers acknowledge that they don't know and embark on seeking knowledge). Teachers as a group exhibited the full range of behaviours, but individually their repertoire was generally smaller.

Stage Two

After the commencement of the observations, a purposive sample of teachers spanning the middle years of schooling was chosen by inviting teachers from six schools in the SILT project to participate in a structured conversation to identify their attitudes to learning and to technology. Thirteen teachers from six schools participated.

Preliminary Findings

Teachers in this study were generally positive about student learning, but half of them admitted that this was not always the case in their own context. All but one felt that technology brought with it a range of benefits to student learning. On the assumption that teachers who enjoy working with technology will explore new uses and create learning opportunities for their students, they were also asked whether they enjoy working with technology in the classroom. As Tab. 1 shows, responses were spread across gender and across primary and secondary settings. Six teachers (3 males, 3 females) stated clearly that they enjoyed using technology, while six others (3 males, 3 females) stated that their enjoyment was dependent on factors such as access and ease of use.

enjoyment	Prim	Sec	Male	Female
definite	4	2	3	3
dependent	3	3	3	3
never		1		1

Table 1: Teacher enjoyment of using technology in the classroom

The teachers might appear to be open to using technology to support constructivist learning and they supported the notion of students being autonomous learners. Yet the classrooms observed displayed a wide range of activities and behaviours from teacher-centred to student-centred, and varying amounts and levels of computer use. Students and teachers in primary and secondary schools appear to have very differing levels of access to computers and in the classroom observations it was rare to see a teacher using technology. Some teachers appear to allow students to take control of their learning with minimal intervention, more because of a lack of knowledge of technology rather than a commitment to constructivism.

There are clearly some contextual factors which affect teacher behaviour. The data were analysed to identify teacher comments which would identify such factors, revealing an important difference in organisational arrangements and timetabling in primary and secondary settings. The timetabling in primary schools allows for longer sessions with one teacher than is common in secondary settings. The primary classrooms, although hives of activity, were also able to spend time in reflection, with one outcome being increased efficiency. In contrast, many secondary schools have computer labs rather than a few computers in each classroom. When classes want to use computers in lab settings, as is frequently the case, scheduling is critical, and a different culture develops. The lab settings themselves often allow little space for other activity, such as writing, and demand a focus on the computer. Congruence between the whole-school culture and the individual teacher's beliefs appears to be important in supporting the use of technology, particularly in the secondary setting, where teachers have less time to interact with each class of students. Community issues included the range of students' prior experience and access at home. In some cases, teachers reported personal concerns such as a need for time to learn, to gain greater technical knowledge or alternatively support to ensure smooth functioning of technology. Professional development clearly must focus on issues of school organisation as well as individual teacher development.

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Different Levels of Internet Integration in University Academic Activities: examples and pedagogical implications

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Abstract: In the four examples of pedagogic integration of Internet in a "multimodal" university situation reported herein, we bring into light an innovative process whose central objectives were improvement of the quality and relevance of the training strategies provided to students. This article will contribute to the characterization of the Internet integration continuum, from enhancing a traditional course with a minimal integration of Internet (level 1) to a complete integration in the form of what has been called a virtual campus (level 3). We suggest that the more or less intensive use of distance communication in the various modalities of integration does not reflect the quality of the learning. Indeed, we are convinced that, whatever the level of integration of Internet to the system, coherence of the proposed activities and pedagogic value of the tools implemented is the most determining factors for success.

1. Introduction: Levels of Internet integration in the university syllabus

The "unimodal" university, that is an institution almost exclusively dedicated to open and distance training or learning, is a familiar form of the use of Internet in university curricula. Students there are mostly involved in courses mediated through remote access. The mission of the unimodal university is clear and exclusive. Here, the integration of Internet is seen as the logical end to the evolution of pedagogical means. Despite this technological bias, the training often continues to rest mostly on the traditional media, even in the most avant-garde universities in this field, such as the British Open University and the Télé-Université (UQAM).

At the outskirts of these dedicated universities, more traditional institutions have begun integrate the use of Internet at different levels in their various syllabi. Those "multimodal" universities exploit the potential fir modern remote communications in some courses or some classes while continuing to dispense courses on their premises by the traditional method. Because of their pedagogic use of Internet, multimodal universities are generally endowed with a much more diversified teaching strategies than are unimodal institutions. The implementation of Internet-based pedagogy is often the result of individual initiatives by energetic teachers eager to enhance their pedagogic arsenal. Also, Internet integration is sometimes viewed by academic authorities as the means to attain some short or long term objectives (e.g. increasing student enrollment, reducing costs, improving the offerings). Infrequently, Internet integration may underlie the need to replace outdated teaching strategies as a means of meeting new requirements in a specific professional environment (Rogers, 2000).

In the four examples of pedagogic integration of Internet in a "multimodal" university situation reported herein, we bring into light an innovative process whose central objectives were improvement of the quality and relevance of the training strategies provided to students. In the first two instances, we describe a first-level integration that can be characterized as the juxtaposition of Internet into a traditional course. The third one pertains to the total integration (level 2) of a complete course in a multimodal university situation. In the last example, we present an integrated device of long distance teaching with Internet (level 3).

2.1 *Practicum*, a case solving system on Internet in a juxtaposition scenario.

We chose the *Practicum* system, which has been in operation for five years at the Faculty of Psychology and Education of the Université de Mons-Hainaut in Belgium, to illustrate the first level of integration of Internet. *Practicum* completes the theoretical part of a course given in class on the learning models given each year to approximately 100 undergraduates. *Practicum* is structured around three functionalities (figure 1). First, a well-defined task, consisting of situation analysis, problem identification, and solution elaboration is provided. Secondly, a set of help tools is given students to assist in the contextualisation of task and approach, and finally there is a distance dialog with the supervisor. Essentially, the system is viewed by the student as an opportunity to put into practice the concepts and principles that have been studied during the theoretical course. This is a classic example of the juxtaposition of Internet into a traditional course.

2.2 "Simul", a medical simulator on Internet in a juxtaposition scenario.

The *Simul* program was developed in the late 1980's for the students of the Faculty of Veterinary Medicine of the Université de Montreal so they could apply their procedural knowledge to the resolution of problems submitted to them in class during the theoretical part of the course. The system has been available to the students for more than 10 years in the context of practical sessions that took place in the computer lab of the faculty. Last year, the system was completely remodeled so it could be put online. The objectives of this transformation were multiple: facilitate the updating of the system, enable the enhancement of interactivity and, most of all, allow distance access to the simulator. This new version of *Simul* is based exclusively on databases, which allows for a personalized monitoring of the students' work and a feedback adapted to each situation. Before being allowed to take the final exam, each student is required to complete, within six work session, all the 15 clinical cases of the *Simul* program in accordance with prescribed steps for resolution of problems in veterinary medicine. A supervisor is made available for the students at specified times to answer questions. Students also have access to the simulator at all times via Internet.

2.3 Learn-Nett, an example of complete class integration to Internet.

This second level of integration of Internet implies a complete restructuring of the pedagogic approaches used in a course. The system allows the creation of a virtual space within which students from five universities in the French part of Belgium and four outside Belgium (Great Britain, Spain, France and Switzerland) can get together to accomplish activities associated to the new technologies in education (project Learn-Nett[1]).

The Learn-Nett project is supported by the European Commission via the SOCRATES program. Activities proposed are structured through a website endowed with a number of functionalities devised to further the pooling and sharing of knowledge. To make it more user-friendly, the site is based on a spatial metaphor: the space is divided in three distinct compartments, one public and two private. In one of the private zones, student groups can create a customized work environment in which they work together on their term work. Supervisors can occupy the second private space that gives them access to all the functionalities available to the students as well as to their own specific tools. Within the student's space, some functionalities, such as the public forum and the news are opened to all, but others, such as the private forums and the synchronous communication space are restricted to specific users. This approach can be assimilated to a project pedagogy in which members of a group create a virtual community with the help of communication tools. The supervisor intervenes to facilitate distance interaction, to encourage students to reflect on their approaches, to assure that the deadlines are met and to stimulate the active seeking of information. This course, which is entirely presented on the Internet, is unique to this university, as the rest of the curriculum is taught in the traditional manner.

2.4 The virtual campus, a fully Internet integrated system

The expression "virtual campus" refers to an integrated system of distance learning. This initiative results from a collaboration between the *Université Louis Pasteur* (Strasbourg), *Université de Geneve*, *Université de Dakar* and *Université de Mons-Hainaut* that is financially supported by the *Agence universitaire de la francophonie*. Its purpose is to offer integral training to graduated students from francophone countries outside of Europe, namely Africa, Southeast Asia, the Islands of Indian Ocean, the Caribbean region and the Maghreb.

The course is divided into six modules of which each module comprises a unit. One unit includes two sequences of activities:, one with self-correction, the other with distance supervision. For example, there isone the *conceptoscope* which consists of a virtual space divided into several rooms, including a center of documentation that offers a basic glossary, an office for each student, a meeting room for each group and a bank of maps for the eventual publication of conceptual maps.

The *conceptoscope* was inspired by the constructivist paradigm. The modules are designed to give students the opportunity to learn through discussion of their point of view with their supervisor with respect to the basic glossary, or with their fellow students inside or outside the group. In addition the modules provide the basis for critical analysis of conceptual maps elaborated within each group. Student activities can then be characterized in three areas: elaboration of a student's position with respect to a definition submitted by the supervisor, comparison of the results from each group and finally, negotiation and dialog within the group to obtain consensus on the definition of concepts with respect to the conceptual maps to be submitted. In passing through these three successive stages, students will experience deepening of their understanding of the concepts and, through discussion of the various points of view, they will more readily comprehend the scope of the semantic field associated to the concepts examined.

3- Pedagogic implications of observations made.

Evaluation of the outcome of these projects provided the opportunity to highlight some interesting observations.

Quality of the apprenticeship depend, above all, on appropriateness of the activities offered to students.

As emphasized by Gillette (1996) and, more recently, by Anderson (2000), no matter the level of Internet integration, the appropriateness of all the activities proposed to students with respect to the objectives of the course seems the most important variable. Hence, the decision should not be made on the basis of more or less Internet, but rather of the complementarity of the different pedagogic activities proposed.

Regarding integration of the first level or juxtaposition, important indicators of learning context appropriateness are the degree of success, the good comprehension of theoretical elements and the capacity to put the knowledge into practice . On the other hand, when training takes place in an environment such as a virtual campus (third level of integration), it is of utmost importance to develop pedagogic scenarios coherent with other current training paradigms on the campus. To meet this requirement, it is essential that the virtual campus be built around a clearly identified pedagogic model and that the functionalities available to the learner be coherent within this model. Access to a human supervisor is more important in the context of a virtual campus environment than when isolated activities are involved. The supervisor may step in spontaneously or at the student's request to provide guidance or supplementary information or to orientate research. The supervisor supplies what some authors (Bioca, 1997) call a social presence, which corresponds to the subject's awareness of another person's presence in the context of distance interaction (Scott, 2000).

Quality of the learning depends on the relevance of the tools available to the students.

Use of the different tools included in *Practicum* has been the object of an exhaustive study (De Lievre, 2000). The results of this study have clearly demonstrated that help tools are used according to the expertise level of the students. Hence, low and high performing students more readily use the tools available, in contrast with intermediate students, who use them significantly less frequently. This observation has been corroborated by other studies (Person et al, 1994) and it can be explained in the case of low-performing subjects by the fact that they are unable to process the situation without resorting to help. The high-performing students realize more fully the benefits they can derive from using the tools. The fact that the use of a certain kind of auxiliary tools can be positively correlated with the expertise of the student it is strong indication that the quality of the training is not entirely based on the nature of the tools available, but also on the subject's capacity to make good use of the tools. The same observations have been made in the case of Simul: students who can process a case more rapidly and more efficiently seem more inclined to use all the tools at their disposal in contrast to other students that fail to grasp the utility of the tools.

In the Learn-Nett system, some tools of dialog seem to have been more frequently employed over others with respect to the evolution of the tasks required. For example, the cafés and the forums were mostly used during the period allowed for the constitution of the group and the selection of the work teams. Later with more personalization of the communication, email became more popular. Very quickly though, the limits of those asynchronous instruments became evident in terms of managing efficiently the process of negotiating special issues relative to common tasks. When it came time to agree on some aspect of the work or to solve problems pertaining to group management, implementation of more interactive forms of exchange appeared indispensable.

Globally, as noted by the authors of the annual report (Learn-Nett, 1999) the use of synchronous communication tools such as the IRC, videoconference (Net-Meeting) and also telephone and personal contact proved crucial at certain times in the evolution of distance cooperation. Those observations seem coherent with others made few years ago (Salgado, 1998) from a quite similar system. The frequency with which synchronous tools were used is, in fact, closely related to the specific evolution of each group. Those who used it most were also the groups that had the most difficulty reaching consensus or, in some cases, those whose collaboration and interactions were the most profound.

The quality of learning depends on the tutor intervention quality and the framework of pedagogic activities.

Studies of the Practicum have stressed the role of the supervisor in the apprenticeship. The results from learners who had access to human supervisors are slightly better than those obtained by learners who did not have this access but the difference observed was not significant. In this context, the proactive intervention of a system supervision (supervising by the program itself) has some effects on the use of tools comparable to those obtained with a human supervisor who could adopt the same proactive attitude. So it seems that, with this type of device, rather than the presence of a human it is the pertinence of the intervention that is most important.

Observing students working with Simul and analyzing the work of a group of students with Learn-Nett has brought to the fore the relevance of supervisor to the great variability in learning quality. These observations lead us to hypothesize that the determining variable in these learning devices is the global level of the framework for the learner's activities. When this is deficient, it seems advisable to plan for a vigorous involvement of the human supervisor, but if the device allows for strong activity framework, the learning process does not seem impaired by less intrusive supervision. As it has been shown by Bandura (1977), social presence is essential to learning by imitation, that is, learning by mimicking the behavior of an expert. The same can be said about other types of learning in which social interactions take place. Such is the case with the socioconstructivist approach where distance interaction with peers reinforces the social presence. Although the effect of social presence on learning has not yet been clearly established, it seems that this factor exerts an influence on motivation and perseverance, as well as on the regulation of activities.

4 Conclusions

The four examples that have briefly presented in this article will contribute to the characterization of the Internet integration continuum, from enhancing a traditional course with a minimal integration of Internet (level 1) to a complete integration in the form of what has been called a virtual campus (level 3). It is important to emphasize that the more or less intensive use of distance communication in the various modalities of integration does not reflect the quality of the learning. Indeed, we are convinced that, whatever the level of integration of Internet to the system, coherence of the proposed activities and pedagogic value of the tools implemented is the most determining factors for success.

Just as the CD-Rom has not killed the book but rather contributed to diversification of our reading habits, we believe that the Internet-enriched university will be different from the institution we know today. By that, we do not imply the all universities will evolve in virtual institutions, but rather that a diversification of the didactic environment will take place.

For these modifications to happen and most of all to make sure they meet the expectations of students, universities will have to demonstrate flexibility and adaptability so that the various pedagogic approaches can coexist harmoniously. The Internet is surely not a panacea for all existing problems in training and education, as has been sometimes said. Nevertheless, it should be considered among the pedagogic tools to be used complementarily with other types of pedagogic strategies.

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A Local Indexing for Web-based Learning Resources

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Abstract: Learning with existing hypermedia-based resources on the Web has become popular and important. However, most resources do not usually have clear description how they should be learned. This makes it difficult for learners to select web-based resources according to their learning contexts. We have accordingly proposed a way to reorganize existing web-based learning resources with indexes representing their characteristics to build a learning resource database. An important issue towards the reorganization is how to do the indexing because there exist a large number of resources and because they may be frequently updated. This paper proposes a new approach called local indexing, which allows teachers/instructors to assess indexes of web-based learning resources from their own points of view. This paper also describes a support for the local indexing and a demonstration system. This support enables teachers/instructors to simply and consistently find out how learning resources should be learned.

Introduction

Over the past several years, an increasing number of hypermedia-based resources have been available on World Wide Web, and it has become a popular approach to use them as learning resources. Learning with such resources becomes more and more important, particularly as the realization of lifelong and distance learning (Kashihara, 1998).

On the Web, there are currently a great number of learning resources with the same topic. However, most web-based learning resources do not have clear description of what kind of learners should use, what kind of learning goal can be achieved, and so on. Learners consequently have difficulty in finding some instructive learning resources.

In order to resolve this problem, we have proposed a way to reorganize web-based learning resources with indexes called resource indexes representing their characteristics to build a learning resource database. In using web-based learning resources, learners would usually think of what to and how to learn. These should be accordingly represented as resource indexes. As for "how to learn", in particular, learning phase is an important index, which is divided into several detailed phases such as augmenting new knowledge/information, deepening understanding of knowledge, applying/stabilizing knowledge, etc (Hasegawa, 1999). We have accordingly provided "how to learn" indexes including the learning phases in addition to conventional "what to learn" indexes.

An important issue towards the reorganization is how to index existing web-based learning resources. In the general approach to this issue, the authorities concerned provide the resources with indexes so that the public users can share. However, this approach would not be realistic since there exist a large number of learning resources and since they may be frequently updated. In this paper, we accordingly propose local indexing, which enables teachers/instructors to assess resource indexes of web-based learning resources from their own points of view.

This paper also discusses how to support the local indexing. The key idea is to allow teachers/instructors to identify "learning phase" indexes in a simple and consistent way, which indexes cannot be often assessed from a glance over learning resources. We have implemented a support system that provides teachers/instructors with a checklist in regard to the structure and function learning resources have, and that assesses the "learning phase" indexes from the marked checklist.

In the following sections, we first describe the way to build a learning resource database. Next, we present the local indexing and support system. Furthermore, we report a preliminary experiment to evaluate the usefulness of the system. In this experiment, we compared "learning phase" indexes that the system assessed with the checklist marked by subjects and "learning phase" indexes that subjects identified with careful reading of learning resources without the system. The results of this experiment suggest that the system can assess "learning phase" indexes, which teachers/instructors would apply to learning resources, in a simple and consistent way.

Reorganizing Learning Resources

Learning with Existing Web-based Resources

Before discussing the way to reorganize existing learning resources on the Web, let us first consider learning with them. In this paper, a learning resource means hyperdocuments, which describe a learning topic within a Web site. It provides learners with hyperspace that consists of a number of Web pages. Learners can explore the hyperspace to learn domain concepts/knowledge (Conklin, 1988, Kashihara, 1997). On the Web, in addition, there are diverse learning resources with the same topic, which could facilitate several learning phases such as augmenting and applying domain concepts/knowledge. Properly using these learning resources according to learning contexts, learners can study the topic from diverse points of view. This is a prominent merit of learning a topic on the Web.

On the other hand, most existing web-based learning resources do not usually have clear description about which learning phase could be facilitated. Therefore, the proper selection of learning resource is not so easy for learners. One way to resolve this problem is to reorganize learning resources so that learners can select a proper learning resource according to their learning contexts.

Resource Index

The reorganization of learning resources requires resource indexes, which are available to learners. There currently exist many Web sites, which collect URLs of web-based learning resources. In these sites, they are classified with resource indexes that mainly represent learning subjects/topics. These indexes allow learners to select learning resources from a "what to learn" point of view. However, such indexes are not enough since the learners would usually think of not only "what to learn" but also "how to learn" especially in which learning phase they should learn. Without indexes representing "how to learn", for example, a learner could select a learning resource suitable for augmenting knowledge about a topic even if he/she wants to stabilize his/her knowledge of the topic.

We have consequently provided resource indexes that consist of "How To Learn" indexes (HTL indexes for short) in addition to conventional "What To Learn" indexes (WTL indexes for short), and have proposed a way to reorganize learning resources. As for HTL indexes, learning phases are most important for supporting learners' selection of learning resources. The learning phases are as follows (Eklund, 1995):

Accretion phase is the one in which domain concepts/knowledge are augmented.

Understanding phase is the one in which known concepts/knowledge are understood with examples, simulations, illustrations, etc.

Stabilization phase is the one in which known concepts/knowledge are stabilized by means of problem solving with exercises.

In addition, some HTL indexes are necessary for differentiating learning resources that could facilitate the same learning phase. Considering web-based learning resources with the same topic, we can see various media for representing the contents such as text, diagram, chart, illustration, etc. We can also see various interactive/real time environments such as simulation, chat, BBS, etc. Such media and communication channels would have an influence on how to learn. In addition to learning phase, we accordingly regard them as HTL indexes as shown in Table 1.

Reorganization

Table 1: Resource Index

WTL Index	Academic Year Subject Learning Topic		
HTL Index	Learning Phase	Accretion Understanding Stabilization	
	Media	Texts only Graphics Animations Sounds	Simulations E-Mail BBS, Chat Others
	Communication Channel	High Immediacy High Interactivity Questions and Answers	

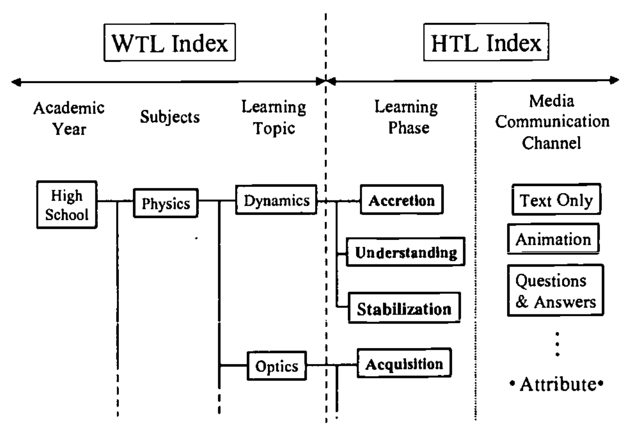


Figure 1: Hierarchy of Indexes

are classified with WTL indexes so that learners can see from a "what to learn" point of view. Next, they are classified

may have two or three "learning phase" indexes. Finally, "media" and "communication channel" indexes are attached

learning phase.

Local Indexing

What is Local Indexing?

An important issue towards the reorganization is how to apply the resource indexes to existing web based learning resources. the general approach to this issue, the authorities concerned provide the resources with indexes so that

. r, this approach would not be realistic since there exist a great number of learning resources and since they may be frequently updated.

It is more realistic that individual teachers/instructors index learning resources from their own points of view. Here

is called local indexing. In the local indexing, each teacher/instructor can index a learning resource from his/her own point of view. Diff

2. In the local indexing, the resource indexes identified by a teacher/instructor are available only to his/her learners. It is not sure whether they are

help learners select some instructive learning resources according to their learning contexts.

tructors to identify the WTL indexes, "media", and "communication channel" indexes since a glance over learning resources gives them sufficient information for the

the indexing often requires careful reading of the contents of learning resources. This paper accordingly proposes a support for the local indexing,

urce indexes except "learning phase" indexes to be assessed by teachers/instructors without support.

Local Indexing Support

Let us next explain how to support the local indexing. Assuming a learning phase, designers of learning resources

ose the structure and function. Assuming *Accretion* a learner

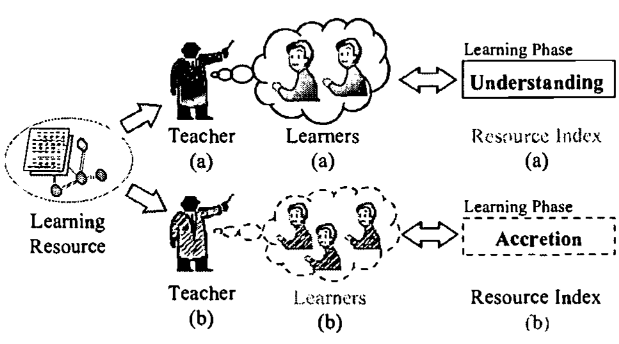
concepts/knowledge, for example, a designer would well construct the contents of a resource with diagrams, charts, etc., to facilitate his/her knowledge

phase assumed (Kalyuga, 1997)

for assessing the "learning phase" indexes.

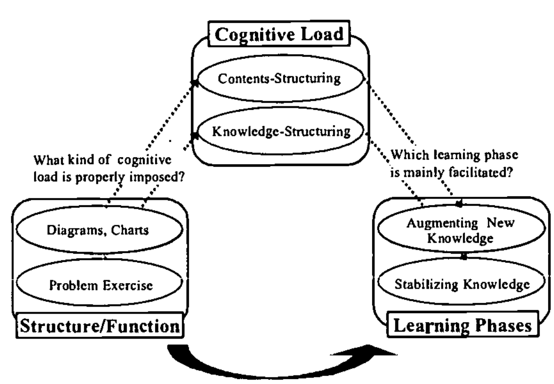
cognitive load that a learning resource imposes on learning process. Exploring in hyperspace provided by the learning resource, learners would read

up a knowledge structure, reflect on to what extent they learned,



Different teachers can index a learning resource with different "learning phase" indexes.

Figure 2: A Key Idea of Local Indexing



Cognitive load explains the correspondence indirectly.

Figure3: Correspondence of the Structure/Function to the Learning Phase

load, which would enhance learning (Chan, 1993, Kashihara, 1995). The cognitive load can be divided into selection, contents-structuring, knowledge-structuring and reflection load (Hasegawa, 1999).

Learning resources are not always intended to provide learners with all of these loads. The designers usually compose them so that specific loads can be mainly provided and specific learning phases can be facilitated. Diagrams or charts, for example, enable a learning resource to mainly provide learners with contents-structuring load in a proper way. On the other hand, what kind of loads should be provided depends on the learning phase assumed in the learning resources. In the learning phase where learners are assumed to augment new domain concepts/knowledge, for example, contents-structuring load should be particularly imposed.

Following the above discussion, the "learning phase" indexes can be assessed from the structure/function of learning resources via the cognitive load imposed as shown in Figure 3. In order to make this indexing possible, we make clear the correspondence among the cognitive load, the structure/function and the learning phase.

Considerations of the structure/function of learning resources is divided into sixteen items, which are classified into seven groups according to the cognitive load that each item enables the resources to impose on learners as shown in Figure 4 (Paolucci, 1998, Thuering, 1995, Wilson, 1989). These items are presented to teachers/instructors in the form of checklist, by which they can assess the "learning phase" in a simple and consistent way. On the other hand, there are three learning phases as shown in Table 1. Figure 4 also shows the correspondence between each learning phase and the cognitive load to be imposed.

Procedure and System

Let us explain the procedure of indexing learning resources, which is executed by the support system. Figure 4 shows an example of local indexing. First, the system requires a teacher/instructor to read the resource roughly and

Structure/Function		Cognitive Loads	Learning Phases
Mark	*Checklist Items (16items)*		
v v	*- Nodes are easy to read.* *- Important information is emphasized.* *- Quantity of information in each node is appropriate.*	Selecting necessary information in a page.	**Accretion** **Score 7/10**
v v v	*- The navigation between the node is easy.* *- Index is easy to back anywhere.* *- Site structure is simple.*	Selecting learning pages.	
 v v 	*- Important information is emphasized.* *- Quantity of information in each node is appropriate.* *- Informative diagram is provided.* *- Text and Diagram are integrated.*	Structuring information in a page.	
v v v 	*- Node layout is stable through all nodes..* *- The navigation between the node is easy.* *- Index of contents is provided.* *- Site structure is appropriate.*	Integrating between pages.	Understanding Score 7/13
v v	*- Informative diagram is provided.* *- Many comprehensible explanations are provided with examples.* *- Interactive environment is provided* *- Site structure is networked* *- Learning history is available*	Integrating information into related knowledge.	
	- Problem exercises is provided *- Interactive environment is provided*	Applying knowledge.	Stabilization Score 2/9
	- Problem exercises is provided *- Learning History is available*	Evaluating learning process.	

Score = Marked Checklist Items• Related Checklist Items (in each phase)

Figure 4: Example of Indexing

to mark the checklist items. In Figure 4, this is indicated by *Mark* column. Next, the system calculates the proportion of marked items to all items that are related to each learning phase, and regards it as the score of the learning phase. The system then regards learning phases, whose scores are higher than threshold a (a=0.6 in this case), as resource indexes. In this example, the leaning phase of *Accretion* is regarded as resource index.

Figure 5 shows the interface of the system, which incorporates the local indexing support as described above. The system has been implemented with Common Gateway Interface (CGI). The right window displays a learning resource that a teacher/instructor tries to do the indexing. The left window displays the checklist. The top frame on the left window provides form fields for him/her to mark the checklist items. The bottom frame displays explanations of terminology included in the checklist items. In using this system, each learning resource and resource index is stored in our learning resource database.

Preliminary Evaluation

Experiment

We have had a preliminary experiment with the support system. The main purpose of this experiment was to

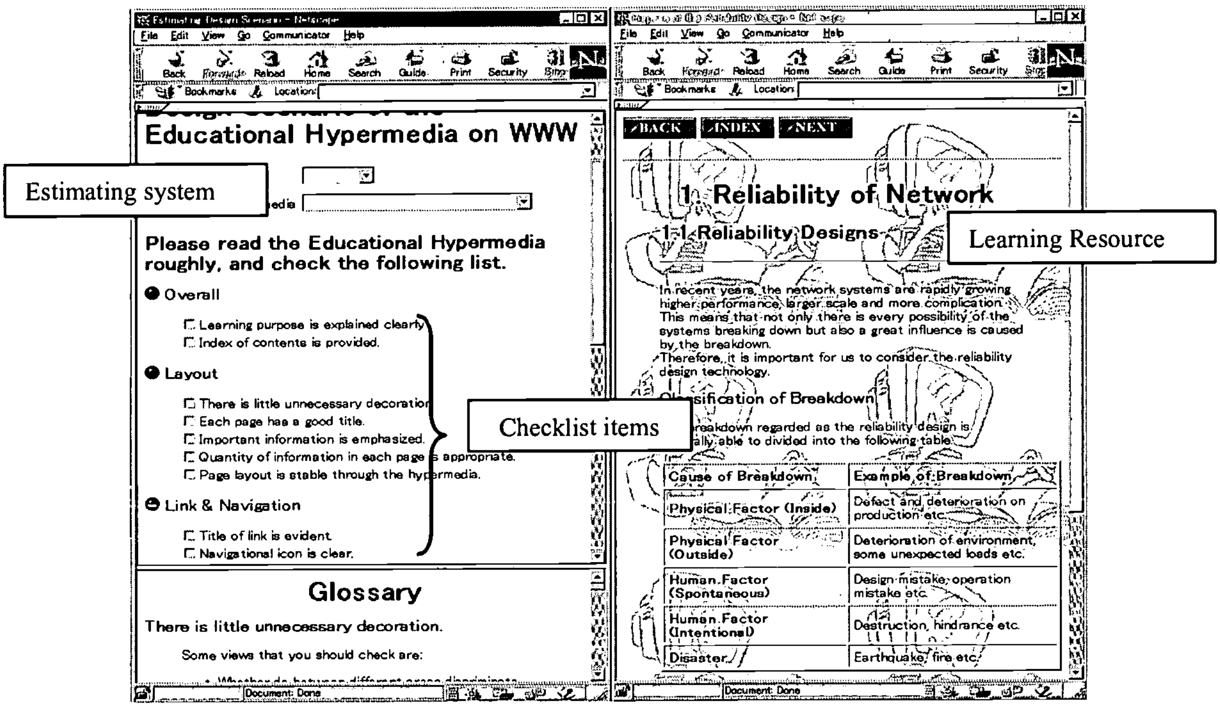


Figure 5: Prototype System Interface

evaluate the usefulness of the local indexing support. Comparing the "learning phase" indexes that the system assessed with the checklist marked by each subject after reading a learning resource roughly (system-indexing for short) and the "learning phase" indexes that each subject identified after careful reading of the contents of the resource (subject-indexing for short), we ascertained the usefulness of the local indexing support. The correspondence of system-indexing to subject-indexing means that the system can assesses "learning phase" indexes, which teachers/instructors want to apply to learning resources in a simpler and more consistent way.

Table 2: The Learning Resource for Experiment

Resource A: Eco-Life Guide "The Issue of Global Warming" http://www.eic.or.jp/ecolife/t001.html
Resource B: Kyoto-Earth's "Environment/Global Warming" http://www.pref.kyoto.jp/mitre21/cent/kankyo/h9.html

Table 2 shows two learning resources used in the experiment, which were described about a learning topic of "Global Warming Issue". Subjects were 10 graduate and undergraduate students in department of engineering. Because the topic was well-known to the subjects, the results of pretest indicated that they had sufficient domain knowledge and they could be regarded as teachers/instructors.

Results

Table 3 shows the results of this experiment. The vertical axis means whether the system regarded each learning phase of each resource as resource indexes or not (System-Index or System-NoIndex for short). The horizontal axis means

Table 3: Result of Experiment

	Subjects-NoIndex	Subjects-Index
System-Index	7	10
System-NoIndex	35	8

741

the subjects regarded each learning phase of each resource as resource indexes or not (Subjects-Index or Subjects-NoIndex for short). Each value in the table means the number of cases that fulfilled both indexing states. For example, there were ten cases where both the system and subjects regarded learning phases as indexes. We then performed Fisher's exact probability test in Table 3. As a result, there was a significant relevancy between system-indexing and subjects-indexing ($p=0.0042$), and these orders were positively related with a correlation ($f=0.40$). It indicates that system-indexing agreed with subjects-indexing approximately.

Conclusion

In this paper, we have described a learning resource database that reorganizes learning resources on the Web with resource indexes. The paper has also proposed the local indexing and support system, which allows each teacher/instructor to simply and consistently index existing learning resources from his/her own point of view. In addition, we evaluated the local indexing support with the system. In this experiment, we compared system-indexing to subject-indexing, making sure that it is useful.

In the future, it is necessary to improve the reliability and simplicity of the local indexing. Especially, we would like to develop a system which extracts the structure/function of hypermedia automatically and which indexes the resource index more easily. We would also like to make it public.

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Web Usability Criteria: the SCANMIC Model

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Despite the fact that evaluation is very important during the web site development process and after a web site is being published, designers are facing problems in identifying the right criteria for the evaluation purposes. Although there are many guidelines and literatures on web design and evaluation, each of them varies in terms of quality, coverage, and suitability. Furthermore, not all criteria can be easily measured especially those that are subjective. The purpose of this paper is therefore to illustrate the process of identifying web usability criteria from the content analysis of current literature on web design and development. In addition, the results of the study are also presented including the completed list of the identified criteria that are grouped into 7 categories, screen design, content, accessibility, navigation, media use, interactivity and consistency . This paper ends with the discussion on main issues of the outcome of this study as well as its limitations.

Developing Infrastructure in Developing Countries: A Role for Faith-based Organizations in Technology Transfer in Kenya

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Abstract: Though developing nations encounter difficult obstacles to economic development, education institutions and telecommunications infrastructures as well as policies can provide ways to increased participation in, and benefits from, the world economy. With its significant social capital and international network, the Presbyterian Church of East Africa (PCEA), through the Presbyterian University in Kenya, may have an opportunity for contribution to Kenya's developing economy. In this study we examine the state of Kenya's economy alongside formerly underdeveloped countries that have benefited in the recent past by the globalization process. Are there similarities among the countries to suggest that Kenya could become another "Tiger" economy? In the absence of effective government leadership, can a non-governmental organization (NGO), such as the PCEA, use its social capital to promote infrastructure projects that result in economic growth for the country?

Globalization and Poverty

An urgent moral, political and economic issue today is poverty in the less-developed countries. Globalization promises these countries economic growth and improved quality of life for both rich and poor. New technologies that enable globalization "promise not just big improvements in local efficiency, but also the further and potentially bigger gains that flow from an infinitely denser network of connections, electronic and otherwise, with the developed world." (Economist 2000)

Globalization, as described by Friedman (Friedman 1999) and others, is a realistic model of the post-cold war system. This concept eliminates the idea of a "Third World" in the sense that anybody anywhere can contribute to the productivity of an economic enterprise. The new infrastructure provided by information and communication technologies and complemented by changes in government policies has enabled this global economy. Countries such as S. Korea, the Philippines and Ireland have recently been models for the gains that countries can make if they have the means to educate workers to participate in the global network. In today's environment, many suggest that whole nations of people will fall by the wayside if access is not provided for those lagging behind. Economic growth is the answer to correct the marginalization; but growth is not an easy prospect for countries trampled by war, disease, malnutrition, illiteracy, drought, corruption and dire poverty.

Faith-based institutions and technology transfer

Faith-based institutions have been the deliverers of new technologies for centuries, most visibly in health care and education. Missionaries and clerics around the world have worked to alleviate suffering, bring literacy, and assist in disaster relief. Friedman's model doesn't exclude, just doesn't mention the possibility of, contribution to globalization by faith-based organizations. Can a faith-based organization be effective in promoting the entrance of a developing nation-state such as Kenya into the new system of globalization through building of education/technology infrastructure?

There are many efforts in place where international support organizations are trying to understand and implement the best policies and practices in economic development. These not-for-profit organizations' investments, e.g. the United Nations and the World Bank, are enormous. As providers of humanitarian aid they are bridging a gap that exists between those who can help themselves and programs provided by a government. Even in the U.S. where the GDP per capita is high, there are volunteers with the United Way, Goodwill

Industries, Habitat for Humanity and countless other initiatives that provide man-hours and funding to aid fellow citizens. Add the contributions of organizations operating internationally like the Red Cross, Rotary International and the Peace Corps, then local churches, synagogues and other religious-based organizations, to realize the vast array of groups helping others with both immediate needs and provision for the future.

Nation-states that are lagging in productivity have even more urgent priorities for their national budgets than does the U.S. But, an important link to economic development is universally thought to be education. In the recent past, priority has been given to primary education in developing countries. Now, there is a generation of students who have achieved both primary and secondary education levels and find that there are a pitiful few slots available in their countries' higher education systems to accommodate their further educational needs. (Useem 1999) There is great demand for more and Kenya is no exception.

Along with the demand for higher education, Kenya is experiencing an exodus of professionals who have already earned university degrees. Research institutions and health facilities are losing major contributors who are emigrating to the U.S. and South Africa due to poor pay and lack of incentives from the government. Can faith-based organizations provide support to the universities in order to build the economy?

Presbyterian University Development

The Presbyterian University in Kenya began as an effort to offer local education to seminary students in training for the pastorate of PCEA congregations. Students have been traveling to Atlanta, Georgia in the U.S. to study since the early 1970s, an expensive, disruptive undertaking for those who made the commitment. And there are still far too few pastors to meet the needs for leadership given the explosion in PCEA congregation numbers. The provision of this education locally makes sound economic and cultural sense. The recent expansion to the degree program—pharmacy and communication—will educate even more students. But the addition of computer technology and its associated training, both to the infrastructure and to the curricula, is the area we see that needs to be incorporated before more buildings are constructed.

The Presbyterian University is supported cooperatively by the Presbyterian Church U.S.A., as well as educational institutions in the U.S. Princeton Theological Seminary along with the Interdenominational Theological Center in Atlanta are involved in providing funds as well as instructional support. We envision the further addition of the Georgia Institute of Technology and its vast talent in the area of computer, network, and Internet technologies. In order to become an effective, efficient higher education institution, this private effort must be balanced by government policies that are supportive to the requirements for an adequate telecommunications infrastructure system.

Conclusion

Evidence of education and telecommunications infrastructure within a country positively correlates with economic growth. To increase this infrastructure, there must be expertise for technology transfer. Education and health care have been the principal domains of religious organizations' mission work in the past. Enlistment of the Presbyterian Church worldwide to assist in this development effort—to provide higher education and technology infrastructure—suggests a new frontier for faith-based organizations in the future.

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Adopting an Instructional Pedagogy for Constructive On-line Learning

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Abstract: The paper describes how an essentially instructional pedagogy was modified for use in an on-line learning MSc programme which espoused a constructivist approach to study. We adopted and adapted San Diego State University's I CARE approach in a distance learning programme offered in Egypt and in Hong Kong. The benefits and problems of this approach are explored, and issues raised of how on-line materials can be deployed as resources for conventional face to face students.

Web-based instruction technologies have been adopted in the Higher Education community and are currently redefining the boundaries between conventional and distance learning. The Global Campus project which was established in May 1999 between the School of Computing Science of Middlesex University (MU) in London and the Regional Information Technology and Software Engineering Centre in Cairo (RITSEC) is currently exploring these boundaries. The goal was to provide an MSc programme in Business Information Technology in the distance learning mode, in a form suitable for on-line study. The pedagogy adopted followed a constructivist approach (Isackson 1999) from the design of learning materials to the support tools (asynchronous and synchronous) for students to manage their study, and for interacting with each other and with tutors.

Adopted Materials Structure

The *I CARE system* (Hoffman & Ritchie) pioneered at San Diego State University, was adapted to provide an infrastructure for the main body of web materials. It is a five-step instructional model, named to stand for *Introduction, Connect, Apply, Reflect* and *Extend.*
The *I CARE* materials are split into sections (Hoffman & Ritchie 1998):

- The *Introduction* serves to place each unit in the context of the course as a whole, and should include clearly stated objectives
- The *Connect* section is primarily for presenting new information
- The *Apply* section is the practice section of each unit
- The *Reflect section* gives students an opportunity to reflect on their newly acquired skills and knowledge.
- The *Extend* section has many possible functions: it can provide closure, prompt further exploration and learning, assess students' skills and knowledge...

A departure from the original I CARE system was that the C was changed from 'Connect' to 'Content', as it was thought that *Content* would have a more obvious meaning for students. Additionally a different, less linear flow was adopted as it was felt that diversions from content should be allowed so that students could apply their new knowledge immediately.
Typically the *Content* section presents a fairly linear development of the material with short 'in-line' exercises to summarise or test understanding. Occasional hyperlinks to the *Apply* section (see Fig. 1) offer the opportunity to move away from the narrative into activities with a wider, more exploratory scope. These may be computer-based, such as programming or design exercises (see Fig. 2), or paper-based, such as examining an exemplary case study, or web-based, such as visiting relevant web-sites. Their purpose may be to embed newly-gained knowledge or to motivate the introduction of the next sub-topic. By contrast, hyperlinks to the *Reflect* section reveal questions designed to reprise recently-learned material in a reflective or synoptic way. Many of these may look like the descriptive components of typical examination questions, so they are useful revision aids. The *Extend* section contains a short Review Quiz to assist tutors in monitoring student progress and may also contain additional material provided by the author to allow keener students to explore beyond the confines of the syllabus. Figure 2 shows a

typical page for a module in the MSc BIT programme. It shows some of the buttons with text labels indicating their use.

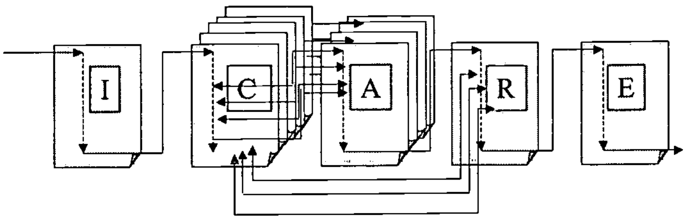

Figure 1: Order of study in Global Campus 'I CARE' Model

WebCT was used to implement the I CARE model and for enhancing learner interaction by the use of its interactive facilities, but other components were also involved. This mixed approach involved use of complementary materials, e.g. CD-ROMs to substitute for on-line access. The CD-ROMs contain all the course material except for the activities, which the students have to complete online. The weekly pattern of learning involves student use of the learning materials, coupled with a classroom tutorial conducted at a local learning support centre (LSC) with locally employed tutors.

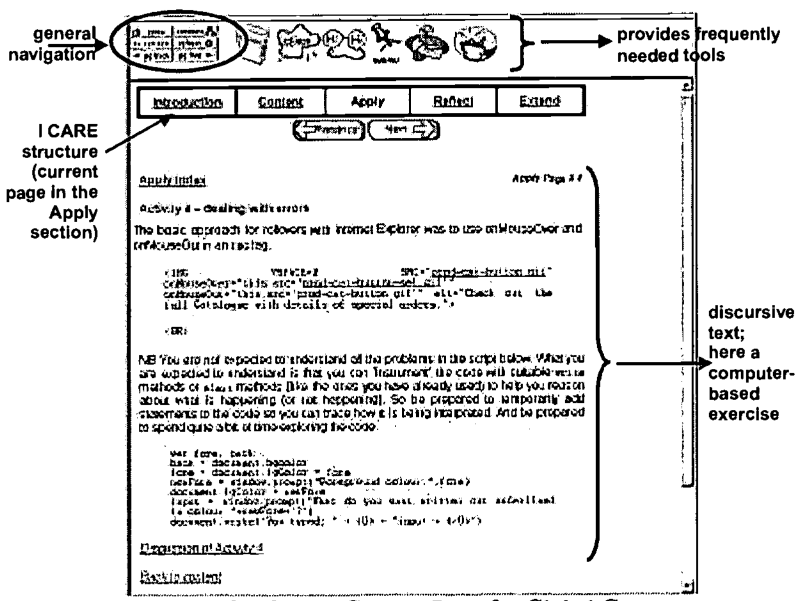

Figure 2: Typical WebCT Course Content Page for Global Campus

The Global Campus course components attempt the transition from a behaviourist to a constructivist approach in the design of web based learning materials and from tutor centred to student centred learning. The components that support this constructivist approach are:

1. The I CARE WebCT material with its non-linear, interactive structure which encourages discovery by the learners either individually or collectively.
2. The WebCT interactive facilities (synchronous/asynchronous communication tools-bulletin boards, virtual chat rooms and virtual whiteboards) which provide enhanced interaction, potential for negotiated learning and the sense of belonging to a learning community.

The Impact on Distance Learning Students

Global Campus students are well schooled (sic) in traditional learning methods dictated by the requirements which a physically-present lecturer may place on their time and effort. And traditionally, a lecturer might expect that it is relatively easy to gain and retain their students' attention, but more challenging to engage their cognitive and critical faculties. Removing the lecturer (as Distance Learning models presuppose) brings about a startling situation because the attention-getting strategies become irrelevant and the need for cognitive and critical commitment more immediate and important. Distance learners must become *active* learners and they need to learn how to do this more-or-less straight away.

The initial response of many students was to print all the material so that they could read it offline. The project team attempted to accommodate this by providing a single file containing all the *Content* material which could be more efficiently printed. The other material (*Apply*, *Reflect* etc.) was not made available so that students would be driven back to the website (or CD-ROM) to complete their work. As the course progressed and students became more accustomed to the format, the desire for paper copies waned. The next step was to make two-way communications between staff and students, and amongst students as natural as raising your hand in class, or asking your buddy how the coursework is going.

In Global Campus the primary mechanism for this is through contributions to the bulletin boards and 'feedback' via electronic mail. This has not been as effective as had been hoped since students seem reluctant to commit their thoughts and enquiries to writing. To facilitate Computer Mediated Communication a number of steps have been taken:

(i) At the beginning of each course an induction programme is run by Middlesex staff at which:
- Students are shown, step by step, how to log onto WebCT so that they will have the confidence and knowledge to work alone.
- WebCT is introduced, in particular the electronic bulletin boards, chat rooms, quiz sections, calendar and print options.
- At the end of the session, students are asked to email the feedback account to confirm that their accounts work.

(ii) All email feedback is made responsive by acknowledging emails and following up quickly.

(iii) Assignments explicitly involve an on-line element. Here students review and critique other students' essays as one of the assignment deliverables.

(iv) The Middlesex lecturer conducts synchronous *Chat* sessions.

(v) The local LSC tutors are charged with an observational role and are encouraged to report back frequently.

Knowing the lecturer as a human being should help to lower the barrier. This could be achieved by arranging a face-to-face visit during the course or perhaps using introductory 'friendly' video clips embedded in the materials.

The Impact on 'face-to-face' Students

The face-to-face mode of study for MSc BIT modules running in the UK is now labelled as 'resource-based'. Thus home students have the same materials as their remote peers. This has provided us with a control group, which can be used to judge the impact of change, both to the syllabus and the running of a module.

The active learning requirements placed on the distance learning students are in some ways enhanced and in other ways militated against in the case of face-to-face students. On the positive side, the lecturer is readily available as a human being who can be engaged with. Thus the chat rooms and other devices are more willingly used and feedback is easier for them to produce and for us to gather. On the negative side, the lecturer is tantalisingly available so that the impetus for active learning is attenuated and the route to passive learning is well signposted. This will only change when lecturers are able and willing to adopt more forcefully a learning support rather than a tuition role.

The Impact on Staff

The biggest initial transition for the lecturers is the requirement that information and attitudes that were once conveyed by gestures, jokes and off-the-cuff observations must now be painstakingly rendered into text or some other explicit visual format. Special attention needs to be given to:

(i) the lucid delineation of the learning outcomes of the unit.

(ii) a more precise (or at least realistic) view of the time and effort requirements of different pieces and types of work.

(iii) greater clarity about the nature and scope of assessment.

Perhaps the most profound effect of the developments that Global Campus has undertaken has been the embodiment of the curriculum as a tangible (at least electronically) resource. There is approximately 9 Mbytes of hypertext for each module and the precise learning intentions of the lecturer are explicit. Staff members need to come to terms with the requirement to maintain and update the material as a part of their normal pedagogic duties.

Conclusion and Future Developments

The paper describes the pedagogy adopted in the Global Campus project. Within a period of eighteen months the programme has been deployed in Cairo, Hong Kong and London and over two hundred students are currently learning to manage their learning with the support of local tutors. When the Global Campus version of the *I CARE* model is combined with WebCT for on-line use, students have available to them well-structured learning resources according to an explicit constructivist pedagogy and a set of tools to assist them to manage their learning.

Some areas where future developments might take the project include:

- Modifications to the ICARE format. The *Content – Apply – Reflect* format resembles a traditional 'lecture' format sufficiently closely that it was easy for authors to transform their materials. However, to give more emphasis to the active learning required of students, a constructivist model that would focus initially on the (active) learning tasks set in *Apply* and *Reflect*, with the *Content* being used as a starting point for student exploration may be better.
- More engaging, more interactive on-line learning aids, such as visualisations or simulations, require further designer and programming resources being made available to authors. To make this possible and successful the adaptive and communicative capabilities of the technology need to be harnessed to support a fully reflective learning environment.
- More use needs to be made of on-line learning aids if tutors are to be placed in a supportive rather than a leading role in student learning. For instance, formative feedback is still focussed around formal assessments and ways need to be found for tutors to engage with students in more informal contexts. This requires the active involvement of students of which our initial attempts, via chat rooms and intra-student assignment reviews, are only a beginning.

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Integrated Pedagogigal Profile and the Design of Web-based Learning Environments

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Abstract: In this paper we will present the characteristic features of a method for description and evaluation of learning environments which pursues to the improvement of the traditional questionnaire-based methods and to the integration of the varying points of view of design, support for learning and evaluation. This method that we call Integrated Pedagogigal Profile (IPP) can be seen as an advancement of the profile of pedagogical dimensions presented by Thomas Reeves, but with some significant reconstructions. Our solution is based on the reconstruction of the dimensions and the creation of a fuzzy picture that can give an overall sight into the many aspects of learning environment, yet not giving a false impression of preciseness. This dynamic picture which integrates the mentioned points of view in interdisciplinary fashion is achieved by gathering the individual results and representing these by circles the opacity of which is related to the size of the sample, thus forming a general picture of the essential features.

Introduction

The aim of this work is to present a method for description and evaluation of learning environments which pursues to the improvement of the traditional questionnaire-based methods and to the integration of the varying points of view of design, support for learning and evaluation. This method can be seen as an advancement of the profile of pedagogical dimensions presented by Reeves (Reeves 1997), but with some significant reconstructions.

Currently the literature concerning constructivist approach to learning, learning environments or web-based learning environments entails various formulations for normative principles of learning, such as those of Jonassen, Salomon & Perkins or De Corte (Jonassen 1995;Salomon & Perkins 1996; De Corte 1995). What is lacking is the methodology for the evaluation of these principles. Usually the fundamental argument for the use of certain principles in the design of studies has referred to the purposefulness of the methods. However, the conceptual apparatus with which to evaluate what kind of learning environment fits the purpose in particular cases has been quite inadequate for practical work, because the understanding of the general concepts in such a level that enables accurate evaluation requires expertise in the field of educational science. In this work we will first discuss the problems of currently used methods and the theoretical grounds for our attempt to tackle these problems. This is followed by an in-depth example of our method.

Current Problems in Design and Evaluation

There are several reasons why the systematic evaluation of learning environments should be improved. Reeves lists four essential flaws in this area in his article "Evaluating What Really Matters in Computer-Based Education". 1) Marketing the effectiveness of the technological innovations has surpassed the evaluation of their effectiveness 2) the quantitative evaluation of CBE has often been reduced to simplistic figures with extremely limited utility, such as the amount of money spent on hardware and software, the ratio of students to computers, or the amount of time students have access to CBE within a fixed period of time 3) the evaluations that have been previously conducted have usually been presented in the format of social science research reports which are not very accessible for wider audiences 4) the comparative studies have treated the instructional alternatives unproblematically as holistic entities with meaningful differences (Reeves 1997). Hirsjärvi has expressed the weaknesses of questionnaires as a research method which concur with observations of Reeves. The studies based on questionnaires are considered typically superficial and theoretically modest. There are also some specific flaws, she spells out. First, there is no possibility to make sure how seriously the participants of the study have answered the questions. Second, it is not clear how apt the questions were from the point of view of the participants. The misunderstandings are hard to control. However, the questonnaires have real advantages, first and foremost their efficiency (Hirsjärvi 1997).

The problematics in this field can be summarized in the following manner. Qualitative methods and their methods of representation (such as social science research reports Reeves mentioned) are informative, but time-consuming. On the other hand quantitative methods, such as questionnaires, are user-friendly but superficial. Thus, our task has been to develop methods that would be efficient enough to be used in everyday educational practice, yet improving the informative value compared to the Likert-style questionnaires.

Theoretical Backgrounds

The points of view that we have attempted to integrate into our method can be characterised by the different functions of the method. First, the method and the mode of representation have descriptive function describing the qualities of learning environment by using bipolar scales. This idea has its origins in Osgood's method which is known as the 'semantic differential' (Osgood 1957). Reeves uses analoguous pedagogical dimensions in his profile (Reeves 1997), which we have attempted to develop further. Second, the method can be used as a Likert-style format of questioning and tries to capitalise its advantages while improving some of its defects. Third, the method can be used as a tool of explication in the design-process as well as in the learning-process. This function is derived from Donald Norman's conception that intelligent activity is based on the external expression of thoughts (Norman 1993).

One theoretical point of view inherent in our model arises from the criticism of the comparative method mentioned by Reeves. Either the instructional alternatives have been treated as cohesive entities which are opposed against each other, or these paradigms have been broken down to essential features which are similarly in opposition. These kinds of comparations are often presented in the context of justifying why the new paradigm should be adopted and the old abandoned. While these comparisons give some advice for evaluation of existing learning environments, they suffer from the values embedded in them –the new paradigm is seen as representing 'good' and the old paradigm as 'bad' or even 'evil'. This approach does have serious limitations and may also have serious practical consequences if applied carelessly.

When this kind of good/bad-distinction is present in the evaluation, it also leads to a situation where the 'good' qualities are actually treated as necessary conditions for optimal learning. Either all these conditions are met or the learning environment is less than optimal. This approach also easily advocates a normative picture of a learner who is continuously active, self-reliant, reflective, intentional, immersed etc., whatever the qualities in the particular list happen to be regardless of whether this kind of human being could even exist. Constructivism is in threat of becoming vulnerable to the same critique it has presented to the earlier tradition if it presents one and only one ideal for a learner, when the purpose has been just the opposite –to support different kinds of learners as well as possible. Following from these problems one methodological commitment in our work has been to find a more neutral stance which would enable assessing the different instructional alternatives according to the purpose of the learning-activity.

The problem of controlling misunderstandings in the Likert-style questionnaires that Hirsjärvi points out is partly caused by the singular nature of the assertions with which one is supposed to estimate one's agreement. Ambiguity is an unavoidable feature of natural language which is epitomised when an expression is interpreted in isolation. However, even natural language is regular as the meaning of expressions is related to their context, or language-game in philosopher Ludwig Wittgenstein's vocabulary. The more a person gets hints of the context of expression the more probable the correct interpretation becomes. (These issues have been previously discussed by the authors related to the problems of speech recognition (Hautakangas & Ranta 2000).) Thus the developed method should provide improved means for interpretation, if this flaw is to be decreased.

One characteristic problem in the design of web-based learning environments seems to be that one is attempting to create new practices at the same time with the tools for the practice with only limited help from the general principles or ideals of learning. This means that the design process begins with an inevitably blurred vision of both the learning environment and its tools and the ways of learning that will emerge by using it. Thus, there is a need to support the explication and clarification of such vague idea. Norman says that the skill to use systematically the external modes of representing knowledge, such as writing, notes or visualization, is an important prerequisite for overcoming the limitations of intellectual activity.

• It helps an individual to join information obtained from different perspectives and to improve the cohesion and consistence of the conceptions and explanations.
• Writing and visualization of information is a process which contains many cognitive iterations.
• It helps to surpass the limitations of person's cognitive resources by releasing the capacities of memory into other use.
• The significance, coherence and general meaning of the explicated information is easier to evaluate than the internal ideas of the mind.
• Explication provides a kind of basis on to which one can build new or more structured thoughts and on which the creation of thoughts is easier.
• External representation gives other people a good opportunity to engage in the collaborative development of the idea or thought and the building of new thoughts. (Norman 1993)

Characteristics of the Integrated Pedagogical Profile

As said earlier, our method is based on the Osgood's semantic differential which utilizes the bipolar adjectives. More specifically we attempt to make an advancement to the profile of pedagogical dimensions presented by Reeves. In this section we will concentrato on discussing one of the basic ideas of Reeves and give a detailed account on how our method is generated from this idea by taking one dimension as an example. Reeves is breaking down the general instructional alternatives to 14 pedagogical dimensions in his article. These are presented in the opposing ends of a scale. There is an example of one of the dimensions in the picture below. Our approach is to consider this as a partial definition of the concept 'teacher role' which defines the applicable range of the concept by using dichotomical limits as the ends of the scale.

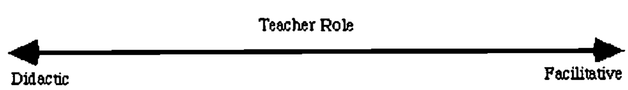

Figure 1: An example of pedagogical dimension (Reeves 1997)

However, even if the concepts by which 'teacher role' is defined are presented in non-negative terms, which is one of the traditional requirements for scientific definitions (Niiniluoto 1986), the presentation has defects. The concepts in differing ends do not represent genuine opposites in the context of learning, which they should if the scale is supposed to cover the whole range of the phenomenon which is to be evaluated. Thus, the first step in the generation of our method is to rethink what the concepts representing the oppositions should be. First, the concept 'facilitative' does not represent an extreme case, which would rather be 'none', which is the case in pure self-study. The other end is a harder case. The concept should represent a situation where the teacher has a total control of the learner and his thoughts. One advocate for the concept would be 'totalitarian' which has also other connotations but for the time being it will suffice. After this we have a new scale.

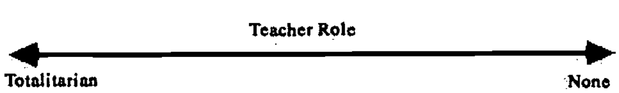

Figure 2: A reconstructed scale for teacher role.

To consider this as a research method, one does have a concept which can be used to pose a question (e.g. "What is teacher role in learning-environment x?") and the scale with which teacher role can be positioned. This is still a straightforward application of Osgood's method which uses adjectives on the ends of the scale to capture the differences (Osgood 1957). However, the next logical step would be to apply these basic ideas by operationalising these concepts into empirical level. And one should notice, as Hirsjärvi points out, that the operational definitions are not used to specify the entire meaning, but the method for measuring (Hirsjärvi 1997). An example of the operationalisation into questionnaire-level could be:

"I was able to make my own schedule for the course"	<----------------------------------->	"The schedule of the course was fixed."

Also what lacks from the account of Reeves is the dimension of time. As learning is a process, the methods of describing and evaluating learning in the learning environment have to include the dimension of time as well. This means that the appropriate amount of support that the teacher is giving in the learning process can and often does vary through time. This principle is traditionally described as 'scaffolding'. One should notice that in the learning-process time can also be seen as cyclical. A learner enters the learning environment many times, he is each time a little more experienced in the goal-oriented activities he participates in.

Now, what are the advantages that are received from this kind of method? 1) It allows one to describe the dimensions of learning environments more neutrally. It provides a support for evaluation of whether described qualities of learning environment are purposeful in a particular context and to particular goals, without making the scale itself biased. Thus, the instructional alternatives can be evaluated in different contexts. 2) The described structure gives more information to support a correct interpretation of the assertions compared to the Likert-style questions where the operationalisation has to lead to singular expressions. One can use the assertions in both ends of the scale and the information that they represent the opposites to interpret the assertion as well as the internal logical order of different questions. In addition, giving judgments is an activity that requires skill, and it may be anticipated that when the methods are first used the judgments of novices may differ greatly. 3) In the design-process the systematical use of dimensions pushes the designers to pass judgment on different aspects of the learning environment. The profile gives a common ground for the discussion in the design-team. As the reasons for individual judgments which can differ from designer to designer with different backgrounds are discussed thoroughly using the explicated profile as a point of reference a shared understanding of the characteristics and objectives of the learning environment is easier to reach. I.e. Nonakas & Takeuchi's familiar idea of the tacit knowledge of the participants getting explicated (Nonaka & Takeuchi 1995) may be achieved through the use of the method. Thus, the design process becomes more transparent and structured, and the experience and created best practices can be used as new prototypes or guidelines in future work.

The use of a systematic profile means also that different aspects of learning environment, such as usability (Nielsen 1993), content, creation of new learning-practices etc., can be focused on in controlled fashion which enables a better organization of the working-process. And as one reminds also that designing learning environments is structurally a project, focusing on the essentialities is as important as it is in research. This is highlighted in many works on project management and knowledge management by authors such as Goldratt or Davenport & Prusak (Goldratt 1997; Davenport & Prusak 1998).

One should also note, that the tool itself is evolving. In our current project we have listed so far 49 concept-pairs which are preliminarily grouped using Jonassen's qualities of meaningful learning as general concepts or categories under which the multitude of different concept-pairs representing different points of view are structured. The use of this pattern brings out the dependencies and inconsistencies in this pattern, which, if treated as a picture, is inavoidably unsatisfying because the research itself involves the points of view of different disciplines. The evolution of this pattern should, however, bring out information about the essential features that should be taken into account in particular contexts.

Possible Critiques and Future Prospects

One obvious question that may arise from the critical reading of the described method is whether these 49 or more bipolar dimensions could exhaustively cover the whole phenomenon of learning in such manner that by summing up the singular dimensions we could get a valid picture of the process of learning in its totality. Another question is whether every single dimension should be regulated in order to reach an ultimate optimum of learning. The answer to these questions is no, and that there is no point in attempting to achieve such goals. As learning-process is tied to a particular context and situation one cannot hope to end up with general laws that could be applied in somewhat mechanical fashion. And it is not possible to evaluate whether there is a best practice of learning even if the context and objectives are known, rather, one can evaluate between better and worse practices that can be described and evaluated with support of other methods such as expert evaluation of the performance etc. Also, our goal is to find out what features turn out as most important factors in different contexts in order to guide the learning-processes to directions that have proved successful.

Related to this Reeves faces critique by using a method of visualisation where he makes a profile of the dimensions of learning environment by linking the different values together with a line, even if the phenomenon is not continuous and the categories are not exclusive. Thus, the method of visualisation is also an important aspect of the methodology. Our solution is based on the creation of a fuzzy picture that can give an overall sight into the many aspects of learning environment, yet not giving a false impression of preciseness. This picture is achieved by gathering the results of the questionnaires and representing these by circles the opacity of which is related to the size of the sample. By combining the results into one picture one gets a rough but informative picture of all answers. From this picture one can find the emerged clusters of answers which are darker and also pick out the exceptional cases (if considered meaningful) that can be easily distinguished from the general case.

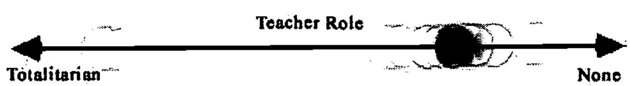

Figure 3: An imaginary example of the method (n = 30).

And as the results may be gathered as the time passes in the learning-process the visualisation can be presented by an animation which brings into focus the dynamic change in the results, i.e. the dynamic invariance which is a familiar concept already from the history of science (Routio 2000). This animation is analoguous to the visualisation used in the weather forecasts.

Our challenge is to find out the valid scale which determines the opacity of an individual answer. This means that by research where we apply multiple methods we have to find the saturation point for the number of answers in order to set the darkest value of scale. Until that the visualisation can only be used as a relative scale which varies accoring to the number of answers.

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Creating Constructivist Learning Environments Supported by Technology: Six Case Studies

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Abstract: Findings from these case studies are the result of a research and development study, *Applying Technology to Restructuring and Learning (ATRL)*, carried out by the Southwest Educational Development Laboratory. This project was designed to provide descriptive models of constructivist learning environments supported by technology and used a grounded theory approach to discover what was truly going on in the areas under study (classrooms). The project, which focused particularly on schools with high populations of traditionally under-served students, involved an intervention study with a two-tiered design. *Tier One* was a collective case study of approximately 150 classroom teachers. *Tier Two* was composed of detailed case studies for six individual teachers. The exploration of their experiences, challenges, beliefs, practices, and thoughts during the process provide a "rich description" of the process of creating constructivist learning environments supported by technology. Contact the author for a copy of the full research report.

Background

Six schools were selected to participate in this study, one in each of four states in South Central United States and two within the state of Texas, one of them rural and one urban. Three broad questions guided this research study and created a framework for investigation and analysis: (1) What do constructivist learning environments look like in practice, particularly in classrooms with high populations of culturally and linguistically diverse students? *Will a single model emerge?* (2) How can teachers be assisted in developing constructivist learning environments supported by technology? *What school context issues or teacher qualities influence this development and what role does professional development play in bringing about this development?* (3) How does technology facilitate the development of a constructivist learning environment? *How do teachers use technology and how does technology allow or promote a change in the way they teach?*

Procedures

Data were collected for each of the 150 teachers in this study and selection of the six case study teachers was made through preliminary analyses of all the data collected during the first year of the study. From the analyses, ATRL staff identified five teachers who emerged as creating examples of constructivist learning environments supported by technology and whose experiences reflected a variety of responses to those goals. A sixth teacher's experiences contrasted to the others and served to exemplify what many teachers may face in their school or district – limited resources, time, funds, and support. These teachers were also selected to represent a variety of student populations from diverse cultures, grade levels, and a variety in the amount of technology available in their classrooms. They represented different styles and approaches to creating constructivist classrooms. They also represented different stages of the change process, different cultural and geographical settings, and differing district policies regarding technology and the management of technology. The teachers talked about their background, understanding of their students, teaching philosophy, teaching strategies and the way that they learned to use technology and constructivist practices.

Models of technology assisted constructivist classrooms

Initially, ATRL researchers believed that all constructivist approaches could be captured and documented and that one model of a constructivist learning environment would emerge as a result of the same interventions. However, analysis of the observation data and interviews with six case study teachers indicated that there was no single model or prototype of a constructivist learning environment supported by technology. Instead, classrooms fell along a continuum described as: low, medium-low, medium-high and high constructivist models supported by technology. There appeared to be constructivist approaches that were replicable, but no single model that was replicable. Teachers seemed to select approaches that fit most closely with practices they had used in the past and combined them to create new instructional strategies. The variations in practice grew to create a wide range of classroom environments using technology. In general, the introduction of technology brought about significant changes in teacher and student roles as well as overall classroom management.

The case study teachers exhibited the following models of technology assisted constructivist classrooms:

(1) The "Project-Based" model had small, collaborative groups of students studying a general topic. They collected information from multiple sources and created multimedia projects for sharing the results of their inquiry.

(2) The "Collaborative-Learners" model allowed study of different aspects of a single topic. Students worked in teams to take advantage of activities and resources found at multiple learning stations. Students were in charge of how their group accomplished its tasks.

(3) The "Student-Focused" model relied on understanding students and their individual learning styles. Lesson plans included opportunities for students to use art, music, drama, and other hands-on activities to supplement reading and writing activities.

(4) The "Wishful-Thinker" model produced hope and several good ideas but few concrete results. There was little time to plan activities or implement them. Extra school-assigned responsibilities, lack of access to computers in the classroom, low technical and administrative support, and other external constraints impacted this model.

(5) The "Learning-Centers" model focused on creating centers for a mix of subjects including language arts, social studies, science, art, and health, and computers. Students worked individually or collaborated with each other at the different learning centers.

(6) The "Cross-Grade Collaboration" provided an opportunity for students to work with students at other grade levels for unique learning activities and specialized projects.

Findings/Summary

It appeared that confidence or comfort with technology was more important than technology expertise. Teachers who recognized the potential of technology's instructional promise, despite their own limitations with technology, demonstrated greater success in creating technology-integrated classrooms. While teachers who had only one computer changed their practice, that change was minimal compared with the changes observed in classrooms with more than one computer.

With the presence of technology, teachers become cognizant of the need to change their instructional practice. For many of the project teachers, implementing technology became à catalyst for instructional change and once they made a decision to let students use technology, change appeared to flow from this decision. These teachers learned how and when to relinquish control so students could teach each other how to use the computer. Once control was loosened and teachers saw that students worked well with technology and that their work improved as a result, they began to loosen control in other areas, granting students' greater autonomy in their work. This process was a gradual one but resulted in the locus of activity shifting from the teacher to the student. The student role, in turn, was transformed from a spectator to the protagonist in the learning process.

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Teaching, Learning and Computing: What Teachers Say

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Abstract: This paper examines the results from the *Teaching, Learning and Computing (TLC)* survey (Becker, H.J. & Anderson, R.E, 1998) administered to the *Applying Technology to Restructuring and Learning* (ATRL) project participants. The TLC results were examined to shed light on the benefits of the ATRL professional development intervention and also to help inform the three research questions under consideration in this study: (1) What do constructivist learning environments supported by technology look like in practice? (2) How can teachers be assisted in developing constructivist learning environments supported by technology? (3) How does technology facilitate the development of a constructivist learning environment? A copy of the full research report can be obtained from mheath@sedl.org

Background of the study

The *Applying Technology to Restructuring and Learning (ATRL)* project was a five-year project funded by the US Department of Education, Office of Educational Research and Improvement and carried out by the Southwest Educational Development Laboratory's Technology Assistance Program. The primary purposes of the project were to document how teachers and their teaching practices changed as they integrated technology into their classrooms and to document the role that technology played in that process. A major activity of this project was the design, development, and delivery of 72 hours of professional development that modeled constructivist learning environments supported by technology.

Six schools from across the five states of the Southwest Educational Development Laboratory region were selected to participate in this study. Site selection was based upon the following criteria: (1) High concentrations of economically disadvantaged populations based on the percentage of students qualifying for free and reduced lunch. (2) High concentrations of culturally and linguistically diverse students. (3) Rural and urban settings in the U.S./Mexico border region, Mississippi Delta region, and the Indian nations. (4) A commitment from administrators and 25 classroom teachers to support the creation of technology-rich learning environments that employed instructional approaches consistent with constructivist learning theory. Teachers either volunteered for participation or were recommended by their principals were some of several criteria were used for selecting the site schools.

Three broad questions guided the research study and created a framework for investigation and analysis: (1) What do constructivist learning environments look like in practice, particularly in classrooms with high populations of culturally and linguistically diverse students? *Will a single model emerge?* (2) How can teachers be assisted in developing constructivist learning environments supported by technology? *What school context issues or teacher qualities influence this development and what role does professional development play in bringing about this development?* (3) How does technology facilitate the development of a constructivist learning environment? *How do teachers use technology and how does technology allow or promote a change in the way they teach?*

The research component of the ATRL project was a *two-tiered design. Tier one* was a collective case study of the approximately 150 classrooms whose teachers participated in two years of the study and who attended 72 hours of professional development sessions developed and delivered by the ATRL project staff. The unit of study in tier one was the classroom. Data were collected for each of the 150 teachers in this study, including demographic data, classroom observations (using a highly structured observation protocol), sample lesson plans, teacher personal profiles, teacher self-assessments of computer skills, responses to professional development sessions, informal interviews, e-mail correspondence, and field notes. Analysis of this data helped inform how teachers changed their teaching practice and the role that technology played in that process. *Tier two* was a collection of six exemplary case studies selected from the 150 project teachers and whose practice exemplified learner-centered classrooms. Each teacher selected represented a different style and approach to both teaching and integrating technology as well as representing different stages of the change process that they have individually experienced across the two years of the project. An exploration of their experience, beliefs, practices, and thoughts during the process provides a "rich description" for understanding the process of creating constructivist learning environments supported by technology. Discussion of the case studies can be found in another paper: *Creating Constructivist Learning Environments Supported by Technology: Six Case Studies* included in the Ed-Media 2001 proceedings.

The *Teaching, Learning, and Computing* (TLC) survey (Becker, H.J. & Anderson, R.E, 1998) was one of the instruments used in *tier one* of the study. The TLC survey asked teachers to describe their best practices, teaching philosophies and uses of technology. The purpose of the survey was to compare ATRL project participants to a national sample of teachers and computer-using teachers. The TLC results were examined to shed light on the benefits of the ATRL professional development intervention and also to help inform the three research questions under consideration in this study.

In an earlier report, ATRL teachers were compared to a TLC national probability sample that contained 2251 teachers from all subjects (grades 4 - 12), 60% who were computer users in the class in which they felt they most often accomplished their teaching objectives (Becker, Ravitz, & Wong, 1999). In this earlier comparison, ATRL project teachers reported having access to technology at a higher rate than the national sample: computers in their classrooms (81.7% vs. 62.2%, access to a printer (98.1% vs. 77.8%), access to high speed internet from classroom (71.2% vs. 25.6%) and access to e-mail (97.1% vs. 51.9%).

For more accurate comparison purposes for this report, 104 TLC teachers were selected from the large national sample who taught in middle and elementary schools, in rural and town settings, and with low income and minority populations and who taught in those same states as the ATRL teachers. In future analyses we will also compare teachers who have received similar amounts of professional development but for this report we focus on teachers, who work in similar settings, not who received similar treatments. The ATRL group contained 102 teachers, 90% who were computer users in the class in which they felt they most often accomplished their objectives, and had just completed 72 hours of professional development. The amount of professional development that TLC teachers received was not determined.

Findings

Analysis of data to help inform research question one "What do constructivist learning environments supported by technology look like in practice?" revealed that there was no single model of a constructivist learning environment supported by technology. However, these learning environments appeared to share a number of common characteristics. When compared to baseline observation data, students in these classrooms had become more active, autonomous, and appeared to be highly engaged with the subject matter or learning content. Oftentimes they worked collaboratively with peers to solve a problem, presented findings or completed a project and used technology to accomplish their tasks. In such an environment the curriculum was structured in such a way to allow students greater flexibility and authority in terms of their own learning. The teacher, while an integral part of the classroom, acted more as a producer, rather than a director, setting up the learning situation and then allowing students to use the means necessary to arrive at a certain end.

Responses to the TLC survey told us about the types of and the frequency of computer use by ATRL teachers. Our earlier report, which compared ATRL teachers to the TLC national probability sample of teachers (not controlling on the variables mentioned above) showed that a far greater proportion of ATRL teachers increased their use of computers. Compared to five years ago, twice a greater percentage of ATRL teachers than the TLC national sample reported trying new software much more now (42.2% versus 21.7%). More than twice a greater proportion of ATRL teachers than the TLC teachers were using email 3-4 times a week (56.9% versus

24.7%). ATRL teachers were using computers more to much more for class preparation than the TLC teachers (90.1% versus 71.6%) and were also using computers for non-work activities more to much more (88% versus 69%).

Not only did ATRL teachers appear to report increased computer use; their objectives for use appear to be more consistent with a constructivist view of instruction. Using the smaller "comparison" sample from the study, Table 1 compares ATRL teachers to the comparison sample from the TLC study, using the controls, in their objectives for using computers with students. Percents are for teachers who said they used computers in the class in which they felt they most often accomplished their teaching objectives. As the data illustrate, ATRL project teachers listed the more constructivist objectives as being among the TOP 3 more often than the comparison group. Presenting information, working collaboratively, and communicating electronically were rated among the more constructivist objectives by the TLC's authors.

Table 1: Percent of teachers in each category reporting their Top 3 Objectives for computer use

	ATRL (104)	TLC sample (102)
Mastering skills just taught	21%	15%
Remediation of skills not learned well	15%	21%
Expressing themselves in writing	21%	18%
Communicating electronically with other people	**16%**	**2%**
Finding out about ideas and information	24%	22%
Analyzing information	18%	15%
Presenting information to an audience	**23%**	**10%**
Improving computer skills	**24%**	**12%**
Learning to work collaboratively	**36%**	**16%**
Learning to work independently	28%	23%
Other	**16%**	00%

Interestingly, while the N is low among the TLC teachers who taught in control conditions (low-income, minority, in region) when we further distinguish teachers who were identified for TLC using probability sampling, (contrasting these with the TLC teachers identified in the "purposive sample" of high technology schools and reform programs) we find that those in the purposive sample expressed considerably less constructivist compatible objectives, even compared to teachers from the TLC probability sample. This suggests those major reform and technology settings in these low-income and largely minority communities are substantially less constructivist than even the normal teaching. The evidence is that ATRL has taken a different path from other technology and reform efforts in these communities. Compared to the TLC "control" sample, that includes reform and technology use, ATRL teachers were substantially more likely to report a "top" objective of communicating electronically (16% vs. 2%), presenting information to an audience (23% vs. 10%), and learning to work collaboratively (36% vs. 16%).

To help inform research question two "How can teachers be assisted in developing constructivist learning environments supported by technology?" analysis of changes in teachers' practice indicated that changes were based in part on the professional development sessions provided for them. Since the ATRL project provided 72 hours of professional development over two academic years of the project, the expectations were that project teachers would score higher than the national sample on many of the TLC items. Site reports and classroom observations showed that teachers were able to use the learner-centered and technology management strategies that were modeled in various professional development sessions. ATRL project teachers indicated that the constructivist approaches modeled in the professional development sessions helped them understand how they could manage their classrooms using some of the same strategies. Furthermore, responses to TLC items as shown in Table 2 indicate that professional/staff development influenced their teaching practice through changes of their understanding of learning and the use of technology. Also, responses indicate that the person who gave them the best ideas about teaching knew a lot about computers.

Table 2: Comparisons of TLC teachers and ATRL teachers on the impact of professional/staff development.

TLC Item	ATRL	TLC
Staff development/workshops have influenced their teaching practice	77.4%	52.2%
A change in their understanding of learning has influenced their teaching practice	73.8%	69.6%
Computer/technology opportunity and experience has influenced their teaching practice	78.7%	50.7%
The person who gives them the best ideas about teaching knows a lot about computers	50%	37%

Results of the TLC analysis also helped to inform research question three "How does technology facilitate the development of a constructivist learning environment?" ATRL teachers indicated that they used computers in the class where they felt more successful. They also indicated that they allow students interest influence the choice of lesson topics and that computers play a substantial-major role to changes to students assignments.

Fifty seven percent of ATRL project teachers reported that computers played a substantial or major role in changing their teaching on the TLC survey, as compared with only twenty-eight percent of the comparison sample. Table 3 reports the comparison of ATRL teachers to the comparison sample in the various ways in which computers changed teaching practice: organization of space, organization of class activities, curriculum priorities, and teaching goals.

Table 3: Comparisons of TLC teachers and ATRL teachers on how technology has changed teaching practices.

TLC Item	ATRL (104)	TLC (102)
I use computers in the class where I feel most successful	90.2%	60.1%
Compared to 3 years ago, I let student interest influence lesson topics	Much More now 31.4%	Much more now 15%
How much of a role have computers played in changes to student assignments?	Substantial-Major Role 60.7%	Substantial-Major Role 30.8%
How much of a role have computers played in changes in your teaching practice	Substantial-Major role 57.3%	Substantial-Major role 27.5%
Computers affect the way you organize space in your classroom	Big change 30.4%	Big change 17.10%
Computers affect the way you break up your class period into activities	Moderate-Big change 61.4%	Moderate-Big change 31.8%
Computers affect your beliefs about curriculum priorities	Moderate-Big change 54.9%	Moderate-Big change 37.5%
Computers affect your goals in teaching	Moderate-Big change 54.9%	Moderate-Big change 45.4%

Discussion

Most ATRL teachers had little or no experience using technology with constructivist practices in their classroom prior to the ATRL professional development intervention. While many of the participant teachers initially expected technology-skills training in the professional development sessions, they instead received a much richer technology curriculum-integration learning experience with meaningful authentic learning experiences and greater learner control. One of the goals for the professional development was to create activities that used limited numbers of computers rather than having a computer available for every person. The logic was that if teachers had to teach with a limited number of computers, it would be more meaningful for them to participate in sessions with limited computers. The object was to help teachers learn how to manage limited resources instead of becoming an "expert" in any single computer application. Each of the staff development sessions was supported by constructivist learning theory and took into account teachers' understanding and beliefs about how students learn. Each session utilized inquiry, problem-based teaching and learning along with commonly available software found in classroom settings. Sessions also modeled instructional strategies or classroom management strategies that supported technology assisted constructivist learning environments.

Changes occurred as teachers became increasingly confident and comfortable using technology. There appeared to be a link between teachers' comfort or confidence with technology and their use of technology with students. The computer skills self-assessment and the TLC survey indicated that participating teachers increased their use of technology with students. In baseline reporting, only 50 percent of teachers reported using the computer with students on a regular basis. By the end of year two, 75 percent reported regular computer use with students. Technology, when used with students, seemed to play a role in the creation of constructivist learning environments. Analysis of the computer skills self-assessment data, the TLC survey, field notes, teacher interviews, and informal observations indicated that when technology was used, it helped teachers shift practices toward more constructivist approaches. Indeed, such an observation is consistent with other research linking technology use and pedagogical practices (For example, Jonassen, Carr, and Hsui-Ping, 1998).

In general, observations also showed that successful technology integration and high technology use took place in those classrooms where there were four to six computers available for student use. On the other hand, the presence of four to six computers in a classroom was not a guarantee that technology use or constructivist practices took place. For example, one teacher found that six computers were too many to manage. She explained that it totally "disrupted" her classroom organization with students working on too many activities. She also found it difficult to handle technology issues while trying to carry out instruction. In her case, technology was forcing her to change her teaching practice in a way that was unexpected and undesirable. However, another teacher who had ten computers had previously been a computer teacher in a lab setting. He could successfully manage several computers and enjoyed having students working on multiple activities.

As they learned to use technology, teachers became conscious of themselves as learners, of what technology could offer them, and became more cognizant of best instructional practices using technology. Furthermore, as teachers became more comfortable with technology, they were more likely to let students use it. Once teachers allowed students to use technology and saw that many students had a certain amount of expertise they were more likely to cede control of technology to students. Once this control was loosened and teachers saw that students worked well with technology and that their work improved as a result, they began to loosen control in other areas, granting students' greater autonomy in their work. This process was a gradual one but resulted in the locus of activity shifting from the teacher to the student. The teacher became less a repository of knowledge and more a general manager of classroom operations. The student role, in turn, was also transformed from a spectator to the protagonist in the learning process.

Summary

Technology adds yet another skill set that teachers must master. As Sandholtz et al. (1997) point out, "The addition of technology can exacerbate or enhance the already complex challenge of teaching" (p. 183). While the addition of technology did complicate many of the ATRL teachers' lives, professional development activities that modeled ways to integrate technology helped teachers learn both new instructional strategies while learning and using technology. Supporting research (Brand

1998; Education Week, 1999) shows that technology curriculum-integration rather than technology skills training should be the primary focus of technology-centered staff development. A national survey of teacher's use of digital content (Education Week, 1999) reveals that sixty five percent of teachers who received eleven hours or more of technology integration training say they feel "much better" prepared to use technology than they did twelve months ago. Unfortunately, in practice, only twenty nine percent of teachers receive six or more hours of curriculum-integration training.

Conclusions indicate that professional development for in-service teachers must be a top priority, especially professional development that emphasizes the effective integration of technology into the curriculum. The ATRL professional development intervention helped serve that need by providing a total of 72 hours of technology integration training over a two-year period. Instruction in those professional development sessions focused on and illustrated how technology supports educational objectives via instructional environments such as collaborative problem solving and cooperative learning activities. And most importantly, activities were designed that engaged teachers both intellectually and professionally.

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Teaching Cognitively Complex Concepts: Content Representation for AudioGraph Lectures

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Abstract: This paper investigates a solution to support the learning of cognitively complex concepts, through the recording, annotation and online delivery of multimedia lessons. Recording lessons for online delivery has the advantage of utilising all of the pedagogical skills of the lecturers and teachers involved. To facilitate the retrieval of appropriate teaching material, the lessons are annotated using a notation called the Flexible Structured Coding Language, FSCL, which facilitates a rich and precise description of these concepts, in a natural language-like format. Different streams of meta data are produced to describe the lesson's properties, like cognitive type and media type. The approaches presented are set in the context of the IEEE draft standard on Learning Object Meta Data, LOM.

1 Introduction

The TILE project at Massey University is developing a "Technology Integrated Learning Environment" for the on-line delivery of education and training material, in a flexible and pedagogically effective manner. The architecture of this learning environment is described in another paper submitted to this conference (Gehne et al., 2000) and is not discussed in detail here. One component of this project however, is the provision of on-line lectures, which have been recorded by the educators in a multimedia format, using the AudioGraph tools (http://www.nzedsoft.com/). These tools have been developed over the last five years (Jesshope et al., 1998) and have been used extensively in the on-line delivery of both internal and extramural university teaching (Jesshope, 1999 and 2000a). There has also been an evaluation of the use of these tools by an independent researcher (Segal, 1997). The TILE project is concerned with the flexible and adaptive delivery of this media. We describe here, one approach to organising the learning material by annotating it with meta data, which will be queried, either explicitly by the student or implicitly through the knowledge that the system holds about a student, in order to optimise the student's learning processes.

A characteristic of these online teaching resources is that they deal with the presentation of cognitively complex concepts and are not restricted to the transfer of simple procedural knowledge. The cognitive sciences have not yet provided the pedagogical task analysis necessary to structure such computer-based teaching resources (McArthur, 2000). We must therefore, rely on lecturers and teachers to deliver the teaching material for cognitively complex concepts. We can not, as is done for simple procedural knowledge, construct a lesson from single, basic components but, quite rightly, allow lecturers to record complete lessons. In order to provide a collection of teaching material, which is easily accessible to both learners and teachers and which is searchable and customisable, we need to provide effective mechanisms to discriminate the various components of these lessons.

The IEEE Learning Technology Standards Committee, working group P1484.12, has developed a draft standard for Learning Objects Meta data (LOM, 2000), specifying both its syntax and semantics for use in technology-supported learning. We use this standard as a framework for the discussion of mechanisms for content description and of the units of description, referred to as *learning objects* in the LOM standard. From there we follow on by presenting our own approaches to content description of learning objects. We conclude the paper with a description of further work.

2 Content Description Mechanisms

The LOM standard addresses a wide range of issues relating to technology-supported learning applications like security, privacy, commerce and evaluation. The purposes of the standard include: 'to enable learners or instructors to search, evaluate, acquire, and use learning objects', 'to enable sharing and exchanging of learning objects across any technology-supported learning system', 'to enable developing learning objects that can be combined and decomposed in meaningful ways', and 'to enable computer agents to automatically and dynamically compose personalised lessons for an individual learner'. The entries in the standard's base scheme for meta data relate to these objectives. For example:

- Interactivity type (entry number 5.1 in the base scheme) allows distinction between 'active' (information flows from learner to resource) and 'expositive' (information goes from resource to learner) documents.
- Learning resource type (5.2) describes the cognitive type of the resource, e.g., exercise, experiment or self-assessment. This is similar to the 'cognitive media roles' as defined by Ram et al (1998).
- Description (1.5), keywords (1.6), coverage (1.7), and classification (9 with various subheadings) all relate to the description of the content of the learning resource.

The LOM standard gives suggestions for the types of the data elements in the base scheme. The data values for entries describing the interactivity type should be taken from a set of restricted vocabulary ('active', 'expositive', 'mixed', 'undefined'). For the learning resource type an open vocabulary of single, descriptive terms is suggested ('exercise', 'simulation', ...). The LOM standard refers to future work on a common representation of data and suggests, in the meantime, the use of formats such as XML to structure the data.

In the context of our TILE project we are interested in the detailed description of the content of a learning resource in a computer-accessible format. We now evaluate what the LOM standard and other approaches provide in terms of content description.

- The LOM standard gives us a framework for the description of very useful information *in relationship to the content* of the learning resource. Information like interactivity type, resource type, semantic density of information (5.4) or difficulty (5.8) facilitates the selection of appropriate material. Being keyword based, this type of information is easily accessible.
- One type of content description within the LOM standard is the classification approach (9) using taxonomies (9.2.2) or keywords (9.4). While this provides a high-level description of the content of a learning resource and facilitates a contextual relationship between resources, this does not provide a detailed description of content in the sense that we are interested in (which is the description of cognitive processes, interactions, and interdependencies).
- Another form of content description within the LOM standard is a textual description (description, 9.3), which, being free-form text, has all the power of a natural language to describe the contents. The drawback here is that the automated extraction of meaning from this textual description is not possible (Heinrich, 1999). A search for keywords only within textual descriptions leads to unsatisfactory results (Davenport, 1996) and the amount of background knowledge necessary to provide the right context for understanding natural language is prohibitive (Sowa, 2000).
- Ram et al. (1999) suggest the Procedural Mark-up Language, PML, which 'uses cognitive media roles to flexibly specify the knowledge structures, the underlying physical media, and the relationships between them'. Being based on XML, PML uses tags for the mark-up of information. Within the tag structure, the actual descriptions are given in free-form text format. This means, that for our purpose of content description, we face the same issues as with the LOM standard. Tag or keyword based information is easily accessible but not expressive enough; free-form text format is expressive enough to describe complex contents but not accessible enough for automated processing.

After this discussion on content description, we now want to address the issue of learning objects and in particular the application of content description to learning objects in the TILE project.

3 Learning Objects

The LOM standard defines a learning object as 'any entity, digital or non-digital, that can be used, re-used or referenced during technology-supported learning'. The base scheme of the standard gives the aggregation level (entry 1.9) of a learning object. It specifies that a learning object can vary in size from a single piece of raw media to a collection of HTML pages up to a complete course. The descriptions facilitated by the LOM standard are applied to the learning objects. There is no possibility to link a description to a specific position or section within a learning object.

In the PML approach by Ran et al. (1999), a PML document contains media tags, which are references to external files. These files can have various formats like video, audio or text. Via their media tags the external files are linked to knowledge nodes. As the authors write, they are working in domains, which are concerned with the description of procedural knowledge. Therefore the external files will mostly display single objects (like a faucet, as in the example in the PML article) or simple procedures ('re-light the pilot flame'). The approach is to make the single multimedia objects very small and to link them into a hypertext network.

McArthur et al. (2000) write, in the context of interactive learning environments, that the focus will shift from teaching procedural knowledge to systems which can provide assistance in learning cognitively complex tasks. To explain such tasks we need a longer, more coherent explanation, not just single pictures and brief procedures. Hence our desire to capture complete lessons from the teachers and lecturers and to deliver this material within an appropriate framework that allows the searching for, or the adaptive presentation of, its component parts. This discrimination should be based on the semantic composition of these lessons. For if we cannot split the presentations into their atomic parts, we cannot combine them automatically into a pedagogically valuable whole, targeted to a specific learner with a particular learning style or ability. We therefore need to make use of the pedagogic skills of human teachers in capturing complete lessons and then provide a mechanism for describing the composition of the elements *inside of* these units.

If we look at these cognitively complex tasks it seems that the current approaches given by LOM and PML are not sufficient. PML requires splitting a multimedia presentation into very small parts, which can not provide a coherent argument to explain cognitively complex procedures. LOM allows large (and therefore possibly more comprehensive) learning objects but facilitates a description of these only at object level and not within the object.

4 Our Approach

Our approach to support the technology-supported learning of cognitively complex concepts is based on the following elements:

- Record complete lessons using the AudioGraph tools;
- Capture different streams of meta data and associate these both with and within the media elements;
- Describe the lesson content using the Flexible Structured Coding Language, FSCL (Heinrich and Kemp, 1999).

4.1 AudioGraph Lessons

The AudioGraph is a tool, which brings multimedia technology to the educators rather than having the educators direct the multimedia production through media experts. The direct nature and ease of use of the tools allow the educators to capture both procedural knowledge as well as cognitively complex concepts. The tools use synchronised images, text and handwriting with direct capture of sound bytes (voice). The presentations therefore, have the presence of lectures, or face-to-face communication, and hence the ability to capture whole lessons instead of combining single multimedia data elements on web pages. The process of recording a presentation is similar to that of presenting in a face-to-face mode, except that the user presents to the computer screen. Once the lessons have been captured, web sites with a simple hierarchical structure may be generated automatically. The lecturer may use simple static graphics, such as images or presentation slides, or may animate diagrams using vector or image-based graphics, to capture the more complex interactions within the material being presented, while the whole time, interleaving this with voice-based descriptions. Examples of AudioGraph material delivered using a fixed course structure that does not adapt to student progress or queries can be found at (http://www-ist.massey.ac.nz/~crjessho/comp-arch/). AudioGraph material, in fact, has all of the advantages of a video presentation but, unlike video, can be full screen and can be downloaded at modem speeds.

While the use of this material has been successful in university teaching (Jesshope, 2000b), feedback from students has shown the need for adaptive or selective presentation of the material. And here, AudioGraphs share the disadvantages of video media, namely the difficulty in indexing or semantically capturing the contents of a unit of presentation. Thus we need to link our meta data and content descriptions to specific positions or segments *within* the lessons. We want to be able to refer a learner to an exact segment of a lesson, which is relevant to the learner's current needs.

4.2 Streams of Meta Data

As suggested in the LOM standard, by PML or by Shikano et al. (1998) we want to capture meta data such as cognitive type or media type for our learning objects. Because our learning objects are lessons and we describe within these lessons our approach has to be different. As already indicated, when looked at from the outside, a lesson can be likened to a video document. If we look inside the lesson, we see that the information that is presented by the lecturer uses different perceptual modalities. At one stage the voice of the lecturer will carry the information, at another stage a graphic will explain a concept, at yet another point in the lecture, textual information will be given. If we want to support different learning preferences regarding visual or auditory information, we have to record the medium of delivery of information throughout the lesson. It is not enough to specify the whole lesson as a video document.

The situation regarding cognitive types is similar. Each lesson will contain a sequence of cognitive elements, arranged by the lecturer and influenced by their didactic style. Thus, in a lesson, a definition and then an explanation might follow a teaching example. We must therefore mark the segments representing the different cognitive types. This segmentation for cognitive types can be distinct from the segmentation for other aspects like the media types. By describing each lesson by their different aspects, such as cognitive type, media type or lecturer's hints to the students, we arrive at parallel streams of meta data. Using these description streams we are able to extract lesson segments according to the preferences of learners, like a segment giving an auditory presentation of a particular example on a topic regarded as important by the lecturer.

4.3 Description of Lesson Content

As discussed earlier, approaches like the LOM standard describe the properties of and not the content of a teaching resource. Where they allow the description of content, they do that in form of free-form text, which is very difficult to process for knowledge extraction. In the TILE project, we work on describing the content of our lessons in a computer-accessible format. In the first instance we want to facilitate the retrieval of the material presenting the appropriate contents, in longer term we want to explore the answering of learner questions based on our content representation (see Heinrich and Kemp, 2000, for our initial ideas).

Besides the keyword approach, ontologies (see e.g. Decker et al., 1999) and topics maps (2000) are used to describe domain knowledge in the context of multimedia documents. We follow a natural language like description approach using FSCL (Heinrich et al., 1999) which gives us a number of advantages:

- FCSL descriptions are natural language like and can be understood by any human reader.
- The vocabulary of the FSCL language can be easily extended by the user.
- FSCL descriptions are based on a formal grammar and are therefore accessible in their structure using well understood parsing techniques.
- FSCL descriptions can be attached to segments of any multimedia document.
- FSCL facilitates both qualitative type description (as we need it for describing complex content) and quantitative type description (as needed for description of streams of meta information).

In searching for appropriate teaching material for the particular needs of a learner we can combine these FSCL content descriptions with the streams of meta data discussed above.

5 Description Steps

In the current phase of our project we are working on the description of existing AudioGraph lessons. Using a tool like Snapzpro (http://www.snapzpro.com) we are able to convert an AudioGraph lesson into a video document and hence use an existing application, PAC (Heinrich et al., 1998), to apply FSCL descriptions to the video.

As already described, our approach to description is based on streams of meta data and on content description. To produce the streams of meta data we perform a quantitative style of coding. For each stream we define the required vocabulary:

- Cognitive type: definition, explanation, example, proof, theory, exercise, solution, introduction, summary, revision, conclusion;
- Media type: visual-text, visual-pictorial, auditory-narrative, auditory-other;
- Lecturer's hints: important, complimentary, exam-related.

For each stream we work through the lesson to produce the relevant descriptions. The way in which this coding is performed differs. For cognitive types we code in an exhaustive, non-overlapping style. That means we have to cover the whole timeline of the video with exactly one type. For media type we also code exhaustively but allow overlapping. We describe each point of time in the video with a media type, but this time we are not restricted to exactly one media type. We can create overlapping segments, for example, when an audio narrative of the lecturer stretches across two segments of textual and pictorial information. The coding for lecturer's hints is non-exhaustive. These hints will be spread across the lesson and there is unlikely to be a hint at every point of time in a lesson.

The description for content uses a qualitative type of coding. We construct description sentences, which can be attached freely to any lesson segment or point of time. The vocabulary for the content description is largely domain dependent. Over time we will be able to provide a generic core vocabulary which then will be extended by domain specific terms. We are working on a range of issues regarding the content description:

- What is the best approach to extract the content description, should it be based on the narrative, textual or pictorial information or probably a combination of all? Currently we transcribe the lecturer's narrative and base our description on that transcript.
- Working on the lecturer's narrative we have to distinguish carefully between content description and meta information. A statement like 'remember that in a recursive data structure there is no predefined size' contains two elements of information. The word 'remember' indicates a cognitive type information of revision, which we want to separate from the actual lesson content, which is the statement about the size of the recursive data structure.
- The current FSCL allows the formulation of statements like 'recursive data structures can be implemented using recursive calls to a procedural function'. Based on word categories such a statement can be parsed into its subject, verb and object components. To present the type of the cognitively complex content that we are working with, FSCL has to be extended, for example to recognise conditional statements.

At this stage the description process is a completely manual one, based on existing lessons. In the longer term we want to develop a procedure to facilitate the description. Included in this procedure should be guidelines for how to arrive at good content and meta information description. Parts of the description process should be automated, for example the AudioGraph document structure knows about media type and audio transcripts are optionally used as an aide memoire for recording speech. Eventually therefore the processes of recording an AudioGraph lesson and of describing it should be combined and partially automated in order to produce better quality descriptions and a considerable saving in time.

6 Conclusion

Using AudioGraph to record lessons gives us the advantage of a rapid and easy-to-use mechanism for the creation of learning material in cognitively complex areas. We think it is important to rely on the pedagogical abilities of lecturers and teachers to present learning material instead of trying to synthesise this material from single elements. We employ various description techniques to make our collections of lessons accessible. Two important aspects of our approach are that we attach descriptions to specific segments inside our lessons and that we describe the content of these lessons in a form amenable to computer analysis. Attaching descriptions to segments inside the lessons allows us to refer the learner to the appropriate section within a lesson instead of just referring the learner to the lesson as one learning object. Describing the lesson content, not just on a keyword basis but in a rich natural language like way, allows us to find the course material which exactly deals with the concepts the learner is trying to comprehend.

7 Status of the Project and Future Work

A specification and feasibility study for the TILE project client/server architecture has already been completed and is described elsewhere in this conference (possibly!). This architecture allows us to build up large collections of teaching material, which can be accessed and monitored quite easily by both on-line and off-line users (Gehne 2000). The work described in this paper will use student models, past history, student preferences and eventually direct questions, in order to present the student with the appropriate material contained within the TILE educational repository. We are currently working on creating content descriptions and streams of meta data using FSCL to facilitate this. One of the next projects steps will be to investigate how the FSCL description (including their segmentation information) can be integrated into the LOM framework.

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Learner-Formulated Questions in Technology-Supported Learning Applications

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Abstract: In this paper we look at learner-formulated questions in technology-supported learning applications. Traditionally, technology-supported learning applications request input from the learner. The learner's response is used to assess the knowledge of the learner, to define a navigation path through the material or to construct a learner model. With our work we want to add another form of interaction between learner and system, where the learner can pose questions to the system in similar fashion as to a human tutor. The paper discusses ways of dealing with these learner-formulated questions, question formats and existing approaches. It then introduces our approach for learner-formulated questions which is based on the Flexible Structured Coding Language, FSCL. We present two specific approaches, the syntax-based and the semantic-based approach. After a discussion of these approaches we conclude the paper with an outline of future work.

1 Introduction

This project is looking at learner-formulated questions in the context of online technology-supported learning applications. We focus on two main goals:

- Learners should have the possibility to pose questions to a technology-supported learning application.
- These questions should be formulated in the language of the learner.

Technology-supported learning applications traditionally have features in which the application is requesting input from the learner in the form of multiple choice tests or yes/no questions. The response of the learner is used to assess the knowledge of the learner, to define a navigation path through the material or to construct a learner model. We have no intention of replacing these features. Instead we want to add another form of interaction between learner and technology-supported learning application. We want to give the learner the possibility of posing questions to the computer system in a very similar way as asking questions of a human tutor. Instead of being only reactive, the learners can actively request information from the system, independently of the confines of the system.

To achieve our goals we have to define a format in which the users can formulate questions. If we want to mirror the student–tutor situation we need to have a format which is 'natural' for the learner. Ideally we would use natural language which is our natural form of communication, is expressive and flexible, and is familiar to the learners.

Once we allow the learner to pose questions to the system in a 'human understandable' format, the system faces the task of responding to these questions. Before looking at the different possibilities for question formats we want to describe the various possibilities for interaction between learner, technology-supported learning application and human tutor:

- In a first scenario the learner formulates a question which is linked to a specific position in the teaching material. The question is then submitted directly to a human tutor. The tutor provides the answer which is stored together with the question for pursual by the learner and for future reference by other learners.
- In the second scenario again the learner formulates a question which is attached to a specific position in the teaching material. This time, the question is not directly transmitted to the human tutor. The computer system analyses the question first for syntactic and semantic characteristics. It compares the question against previously

asked questions. If a semantically equivalent question and answer set is available, this set is returned to the user without intervention of the human tutor. If only a semantically close question is stored (or no related question at all), this question is passed on the human tutor. The tutor assesses the suitability of the semantically close question and answer set, edits where necessary and proceeds as in scenario one.

- The third alternative is parallel to the second scenario for posing the question and comparing against previously asked questions. Yet instead of passing an only semantically close or a new question to a human tutor, the system generates an answer. The question is matched against a knowledge repository, a suitable answer is generated and returned to the learner. In this scenario the question – answer dialog is performed without involvement of a human tutor.

The work we are describing in this paper addresses the second scenario. The approach we use for formulating the questions is compatible with a related content representation technique, which should allow us to move into the third scenario. In the next section we discuss related approaches to user querying before we introduce our techniques.

2 Review of Related Work

In the first scenario we have described, the questions are evaluated solely by the human tutor. The system assists the dialogue only by transmitting questions and answers between learner and tutor and by keeping a repository of previously asked and answered questions. The idea of collecting questions/answers and making them available to later users was employed in the context of a portal server for the first time in the medical prototype portal "Infomed-Austria" (Maurer et al., 1999, www.infomed-austria.at). In the context of technology-supported learning applications this approach has been implemented in GENTLE (Dietinger et al. 1998 and 1999, www.gentle-wbt.com), using natural language for questions and answers.

To move to scenarios two and three we need to have a 'computer understandable' format for the questions. Searching through documents on a keyword basis is not semantically rich enough (Davenport, 1996). Beside its semantic restrictions, a keyword mechanism is not the desired type of interaction for our work as we attempt to mirror a human-to-human communication. Natural language processing faces a range of problems like lexical ambiguity, ambiguous sentence structures or context dependencies, which yet have to be overcome (Smeaton, 1997, Sowa, 2000).

The AskJeeves approach (Basch, 1999; www.askjeeves.com) allows the input of any natural language question. It uses a proprietary parsing technology to interpret user queries. The queries are matched against templates and a knowledge base containing millions of previously asked and answered questions. The answers to questions are produced by human editiorial staff (Basch, 1999; Chowdhury, 1999). AskJeeves returns to the user previously asked questions with related meaning or keywords. Selecting one of these questions leads to web pages providing answers. The repertoire and understanding of AskJeeves is very impressive yet for our needs not specific enough. In contrast with the AskJeeves context we work within specific domains where we want to allow the users to enquire not mainly about terms but about cognitively complex concepts. The following two examples illustrate these points:

- What is the difference between MPEG and JPEG?

AskJeeves focuses both on the domain specific keywords contained in the question and on question generic terms. It returns questions relating to 'MPEG' or 'JPEG' (regarding the understanding of these or other computer related terms; regarding the download of MPEG music files) and to comparisons (yet not for MPEG and JEPG but for internet shopping sites). In our context we need to provide a much more specific answer which directly relates to a comparison between MPEG and JPEG formats.

- Can JPEG files be converted into MPEG files?

For this question AskJeeves gives some of the same answers as for the previous question (as links to downloads of music files). Additionally, it offers reference to conversion programs (relating to Macintosh and PC platforms). Again, we need to be more specific and want to provide different, more relevant answers to both example questions.

3 Learner-Formulated Questions Based on FSCL

As outlined above we want to provide a mechanism in which learners can pose questions to a computer system in a user-friendly, 'natural' way, similar to addressing a human tutor. We want the computer system to 'understand' these questions, to compare these questions to a database of previously asked and answered questions, and to respond with semantically equivalent or close question and answer sets. We base our approach on the Flexible Structured Coding Language, FSCL (Heinrich et al., 1999). FSCL is natural language like, has a flexible, user-extendable vocabulary, which is arranged in categories, and a fixed grammar based on these categories. FSCL offers a subset of natural language, which is rich enough to express complex content and structured enough to be accessible to automated processing.

To develop a 'natural language-like question system' we first collected natural language questions and reviewed the grammatical structure of English language questions. We extracted the most important question structures and investigated how we could formalise these structures based on the FSCL coding language. We developed two parallel approaches, one syntax-based and one semantic-based. In the following sections we outline this work in more detail.

3.1 English Language Question Structures

We have analysed a set of 500 sample questions and studied books on English grammar (Wardhaugh, 1995, Klammer et al. 1992, Alexander, 1988). Within the space of this paper we can only very briefly describe the main question structures we have identified. For the discussion of these question structures we need to define some key terms:

- Auxiliary verb: a word used in conjunction with verbs ('do', 'have', 'may', ...).
- NounPhrase: a word phrase of one or more nouns (or pronouns) which can contain adjectives and conjunctions ('a good compression format like MPEG').
- ActionPhrase: one or more predicates where a predicate consists of a verb (including auxiliaries and adverbs) plus a noun phrase as its object ('... is playing MPEG video').
- WhPhrase: an interrogative word ('who', 'where', 'what', ...) phrase which can contain a noun phrase ('how many compression formats ...').
- AdditionalClause: a declarative sentence introduced by a conjunction ('... before the application is playing the MPEG video').

We now use these terms to describe some of the question structures (and give examples in Figure 1). Our first group of questions, the general yes/no questions, have two basic forms (the brackets denote an optional part):

(A) <auxiliary verb><nounPhrase><actionPhrase>[<additionalClause>]

(B) <auxiliary verb><nounPhrase><object>[<additionalClause>]

The second group of questions we want to introduce are 'wh-questions'. These questions start with an interrogative word. They differ from a yes/no question by asking for missing information rather than simply requesting confirmation or denial of information supplied in the question. Some common formats of wh-questions are:

(C) <whPhrase><actionPhrase>[<additionalClause>]

(D) <whPhrase><auxiliary verb><nounPhrase>[<additionalClause>]

(E) <whPhrase><auxiliary verb><nounPhrase><actionPhrase>[<additionalClause>]

We regard imperative declarative sentences as a third group of questions. While not strictly speaking questions these sentences are useful in our context as they elicit information:

(F) <verb><object>

3.2 Principles of a FSCL-Based Question System

FSCL is built on a number of principles which we have adopted and partly modified for this work.

- Vocabulary: The FSCL vocabulary is fully defined by the FSCL user. Usually, words are taken from the specific application domain the user works in. The words have to be associated with the FSCL categories. They can be arranged in hierarchies to facilitate retrieval of description sentences and are stored in a database. The FSCL question system retains these core features with one exception. In the question system we distinguish between application domain-specific (as in the original FSCL) and question-specific vocabulary. Analysing our sample questions and the English language grammar we can identify a range of words which are question-specific, regardless of the application domain. Examples are the question words 'where', 'what' or 'which'. As a consequence we predefine these words in the question system vocabulary.
- Categories: The categories are an important concept in FSCL as they allow the definition of a fixed grammar without pre-determining the vocabulary. We retain the category idea but add question specific categories for reasons as outlined in the vocabulary section.
- Grammar: Again we retain the FSCL approach of defining a LL(2)-type grammar based on the category identifiers as terminal symbols.

Type (A):	'Was the video started before the player was realised?'			
	'Was'	'the video'	'started'	'before the player was realised'
	<auxiliary verb>	<nounPhrase>	<actionPhrase>	<additionalClause>
Type (B):	The question 'Is MPEG a new technology?'			
	'Is'	'MPEG'	'a new technology'	
	<auxiliary verb>	<nounPhrase>	<object>	
Type (C):	'What happens when the application starts the player?'			
	'What'	'happens'	'when the application starts the player'	
	<whPhrase>	<actionPhrase>	<additionalClause>	
Type (D):	'What is Java?'			
	'What'	'is'	'Java'	
	<whPhrase>	<auxiliary verb>	<nounPhrase>	
Type (E):	'When was MPEG introduced?'			
	'When'	'was'	'MPEG'	'introduced'
	<whPhrase>	<auxiliary verb>	<nounPhrase>	<actionPhrase>
Type (F):	'Give two examples for compression formats!'			
	'Give'	'two examples for compression formats'		
	<verb>	<object>		

Figure 1: Examples for the basic question formats

- Semantic tree: FSCL description sentences are parsed and then stored in semantic tree format. This format is comparable to abstract syntax trees as found in literature on compiling techniques. The semantic trees don't give the parse structure but the semantic structure of a sentence by displaying the subject – verb – object relationships within the sentence. The question system uses semantic trees to represent the question structures and the semantic trees are the basis for comparison of questions. The comparison of two semantic trees contains two interwoven processes. A comparison of the tree structures looks for the existence of the same sentence parts at equivalent positions in each tree. The actual words in these parts are compared for identity using features of the vocabulary definition like the word hierarchies.

3.3 Syntax-Based Approach

The syntax-based approach for our question system follows closely the grammar structures given in section 3.1. The main focus is to capture the syntax of these questions. The original FSCL categories have been retained and two new word categories, 'W – WhWord' and 'U – Auxiliary', have been added. The new grammar builds on the original FSCL grammar. The original grammar was designed for declarative sentences and is now used for the additional clauses. New grammar rules are introduced to deal with the question specific structures (like question word phrases) and newly introduced elements (like action and noun phrases). The semantic tree for the syntax-based approach has nine levels. Figure 2 shows two questions in their semantic tree representation.
The syntax-based approach has the advantage that it allows the recognition of a wide range of simple and relatively complex question structures. The comparison of different questions is prepared. The semantic tree format identifies the role of every word in a question sentence. As in the original FSCL approach, two questions can be compared by comparing their tree structures and their words in equivalent tree levels and positions.

3.4 Semantic-Based Approach

The semantic-based approach focuses on the meaning of questions. We looked through our sample questions and grouped together questions which ask for the same or closely related concepts. These questions can have different syntactical structures while being semantically similar:

'In terms of compression which of MPEG or JPEG is better?'
'Why is MPEG better than JPEG?'

These questions can have equivalent syntactical structure but use different question-specific vocabulary to ask for semantically equivalent concepts:

'How is MPEG similar to or different from JPEG?'
'How does MPEG compare with JPEG?'

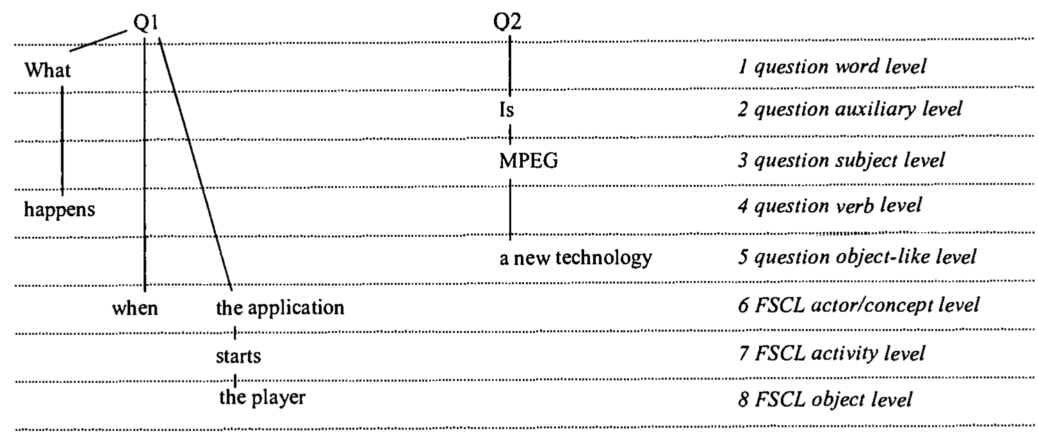

Figure 2: Semantic trees for example questions using syntax-based approach

Using this approach we have identified twelve generic question types. For each question type semantically equivalent and close question variations have been defined. The question types cover the basic formats of yes/no, interrogative word and imperative statement questions as described in Section 3.1. Again we follow the principle idea behind FSCL of using word categories as the basis for the grammar definition, yet the original FSCL is not integrated as closely as in the syntax-based approach. Among the category definitions are three generic categories (for nouns, verbs and adjectives) to contain the domain vocabulary. The other categories represent the components of a question specific vocabulary. For example, the category 'whatWord' contains (at least at this stage in the project) only the word 'what'. Another interrogative word like 'which' finds its place in its own category 'whichWord'. This is different to the syntax-based approach where all interrogative words belong to just one category of 'WhWords', as they all take the same place regarding the syntax of a question. Another category in the semantic-based approach is 'greaterWord' which contains a collection of comparison words with similar meaning ('better than', 'greater than', 'better', 'better between'). As in the other approach, a LL(2) grammar is defined on the category identifiers. The semantic tree spans seven levels. Figure 3 gives examples of semantic trees for two of the generic question types.

The strength of the semantic-based approach lies in grouping questions of similar or close meaning. Questions within a group are translated into the same semantic tree structure which indicates their relatedness. The comparison of trees is simplified. Compared to the syntax-based approach the range of question structures covered and the power of expressing domain concepts is less at this stage.

3.5 Prototype Systems

We have implemented prototype systems for both approaches in Java. The prototypes contain the predefined question-specific vocabulary and they allow the users to enter their own domain specific vocabulary. Based on the vocabulary, the users can formulate questions. These questions are checked for syntax and, if syntactically correct, stored in semantic tree format in a database. Any new question is compared to other questions stored already in the database. The user is presented with the semantic tree format of the new questions and a listing of any relevant existing question.

4 Conclusion and Further Work

We have achieved the first steps towards learner-formulated questions in online technology-supported learning applications. Based on a review of sample questions and English language grammar we have identified the main question structures used. We then followed both syntactic and semantic approaches to formalise these question structures. These approaches are based on the Flexible Structured Coding Language, FSCL. We use question specific categories of words and generic categories, which can be filled by the user with vocabulary for their specific domains. Grammars are defined based on categories and allow parsing for the structure of the questions. Syntactically-correct questions are stored in semantic tree formats to facilitate the comparison of questions for

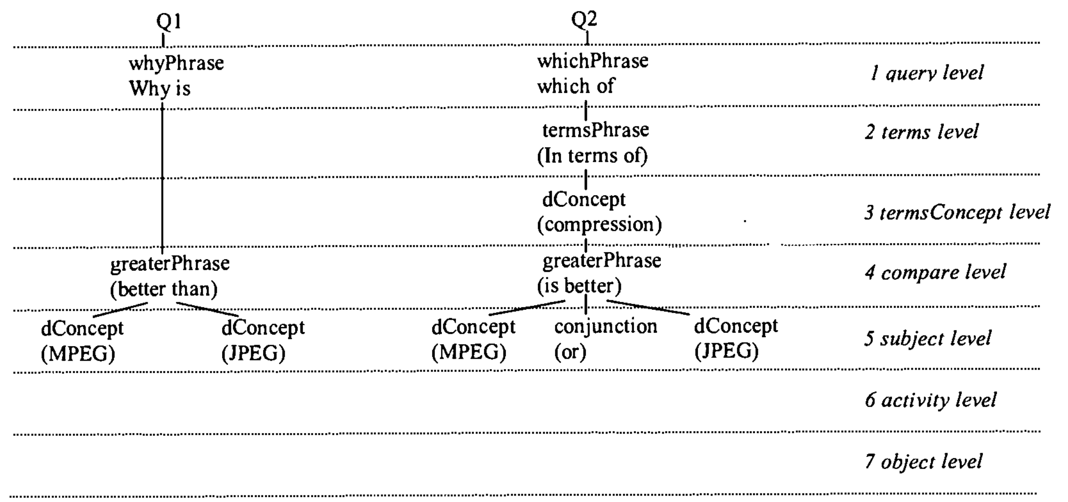

Figure 3: Semantic trees for example questions using semantic-based approach

semantic equivalence and closeness. The questions we deal with are natural language like. We have implemented prototype systems tò allow for testing of our ideas.

The next step in our work will be to combine our syntax-based and semantic-based approaches. We want to be able to deal with the variety and complexity of question structures from the syntax-based approach and have the grouping of questions for semantic relatedness from the semantic-based approach. We then need to collect a substantial body of questions for testing our question structures and measures of relatedness. In the longer term we want to move towards the third scenario we have introduced where answers to questions can be deduced from domain-specific content representations using FSCL.

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Accessing Best-Match Learning Resources in WBT Environment

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Abstract: In this paper, we analyse a so-called access to Best-Match learning resources in a WBT environment. We overview existing solutions and propose a new technical solution which extends the topic map functionality with a number of important features. This solution is based on a concept of so-called knowledge cards combined into a semantic network. The mechanism essentially utilizes such important property of semantic networks as a possibility to infer Learning Resources using semantic relationships.

1. Introduction

Traditionally, Web Based Training (WBT) (Gaines et al. 1996) system is supposed to maintain a training process available "anytime anywhere" by means of the World Wide Web technology.

Nowadays, WBT attracts more and more attention as a tool for so-called "training on personal demand" which utilises different training scenarios than a classical WBT (Shaw et al. 1996). The following scenario covers a representative number of the training on personal demand applications. An employee needs a training on a particular subject to acquire additional knowledge, and is aware about a WBT server containing a relevant information.The employee access the server to find most relevant training material, to work through these material and to communicate with the subject experts and with other learners working on similar materials.

Implementation of the "learning on demand scenario" obviously requires a special tool for *accessing best-match learning resources*.

There are two well-known technical solutions which potentially my fulfil the requirements for accessing best-match learning resources: *search engines* and *topic maps*.

Currently, search engines are capable of performing very intelligent and customisable searches that retrieve the most relevant documents or parts of documents that fit a certain *query*. However, search function often cannot be applied for selecting best-match learning resource simply because query languages are not capable of defining such crucial thing as "learning goal".

On the other hand, topic maps are used to present a comprehensive conceptual overview of learning resources provided by a particular WBT system. This approach allows browsing and searching on meta-level rather than browsing of individual documents. However, application of the topic map concept put a serious additional work load on authors who are responsible for providing comprehensive topic maps of learning resources in a WBT environment.

In this paper, we propose a new technical solution which extends the topic map functionality with a number of important features. This solution is based on a concept of so-called knowledge cards combined into a semantic network (Lambiotte et al. 1984). This concept has been implemented as a component of multipurpose WBT system called WBT-Master (http://coronet.iicm.edu/wbtmaster/know.htm).

2. Knowledge Cards

A *Knowledge card* is a description of particular concept (i.e. *semantic entity*). For example, a semantic entity "Database technology" may be seen as a knowledge card.

Practically speaking, each Knowledge Card may provide access to a number of *associated Learning Resources*. For example, a course on "Relational Data Model" may be associated with the Knowledge Card "Relational Data Model", some other Learning Resources may be associated with the same Knowledge Card.
Knowledge cards may be interrelated into a *semantic network* using different types of relationships: "is a part of", "is a kind of", "synonym for", etc. For example, the knowledge card "Relational Data Model" may be related as "is a part of" to the knowledge card "Database Technology". The knowledge card "World Wide Web" may be related as "is a kind of" to the knowledge card "Hypermedia Systems". The knowledge card
Training" may be related as "is a synonym for" to the knowledge card "Computer Supported Collaborative

All possible semantic relationships are predefined in a special system thesaurus where the relationships are also provided with a numeric assessment of so-called *inference probability*. The inference probability is an assessment of "how much" a particular knowledge card is related to another knowledge card, and vice versa, in the semantic network. For instance, the inference probability between two knowledge cards can be set as 1.0/1.0 for the "is a synonym for" relationship.
Whenever an author contribute to the server with new material, he/she is supposed to associate it with one or more Knowledge Cards or create a new Knowledge card and place it into a proper position within the semantic network. Of course, it can be also done by a specially designated member of the server administration team (Knowledge engineer).
As a starting point, learners are not supposed to browse through countless learning resources. They are supposed, in a simplest case, to browse the semantic net consisting of previously defined Knowledge Cards.

3. Infer Procedure

The infer mechanism essentially utilizes the other important property of the semantic network (Nosek et al. 1990) - a possibility to infer Learning Resources using semantic relationships.
Whenever a user access a knowledge card, the system automatically infers all Learning Resources which are associated with this particular Knowledge Card and with Knowledge Cards related to this one.
For example, suppose that there were no resources associated with the knowledge card "Computer Science", but a number of other card (say, Databases, Programming, etc.) were defined as "is a part of" Computer Science. Accessing the "Computer Science" knowledge card will result in the resources inferred from other related cards

4. Conclusion

Generally, first experiments with the Knowledge Card system demonstrate a rather good functionality and acceptance by users. User evaluation questionnaire and analysis of the server log files show that users definitely prefer a personal knowledge card to be an entry point to the whole system. Authors generally like the situation when they can simply contribute to the server without paying much attention to accessibility of the material. Note, the contribution is automatically associated with the author's personal knowledge card which, in turn,

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Someone Initiated - Someone Understood

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Abstract: In the United States Department of Defense Education Activity (DoDEA) preK-12 school system, new instructional materials (e.g., textbooks) are adopted in each curriculum area every 6 years. As part of the adoption, vendors are required to provide an overview concerning the philosophy, goals, and organization of their materials, and to provide staff development. This type of program has required teachers to assemble at a site in Europe or the Pacific for five days of intensive training. Due to a limited number of participants and the high costs associated with travel and lodging, DoDEA decided to examine alternate ways to deliver the overview component of the training. The major focus of this paper is to describe the process DoDEA and three vendors used to develop what we call the online book walkthrough.

Introduction

Due to a limited number of participants and the high costs associated with travel and lodging, DoDEA decided to examine alternate ways to deliver training. It was decided that some of the training could be done more effectively and cost efficient as web-based instruction. We were the "someone" implementing the project. The web-page developers were the "someone" who would need to understand our requirements and build systems that met our expectations.

Imagine for a moment that you are working with developers who have various levels of expertise related to developing web-based training. In the past their success depended on their graphics ability, their HTML coding skills, or their knowledge of a web development package. Accessibility issues, users with limited web access, and issues of consistency in design might not have been major issues in their development projects.

During the initial planning stages, we assumed that the web-page developers had a basic understanding of how to design interactive learning modules and were knowledgeable of basic issues in human-computer interface (HCI) and accessibility. We soon learned this was not the case. Slow download times, old systems, lack of sophisticated graphic or sound cards, lack of Internet experience on the part of some our teachers, and the limited access to Internet connections in some of our schools were limitations with which the web-page developers were unaccustomed to deal. Two of the three web-page development teams found these constraints, especially those related to bandwidth and hardware limitations, difficult to deal with and design for. The third developer, whose background is in art, his primary medium being metal, found the constraints to be creative challenges.

Despite the differences in development experience and the organizations they worked in, all three developers possessed common elements. While they were experienced in web development, they had little or no knowledge of instructional design, nor much experience with accessibility issues. This lack of knowledge turned what we originally thought would be a fairly simple task that could be completed within 6 months into a rather involved effort that ran 14 months.

Assumptions In Our Thinking

As work on the online book walkthrough began, we became aware of flaws in our thinking based on our original assumptions:

- Because we were working with experienced web developers, we thought that they would understand basic computer interface design issues and accessibility considerations.
- Once provided with an analysis of the users and their environment, the developers would design systems to meet the users' needs.
- The quality of materials we intended to present to our users was based on higher expectations than those with which some of the developers were accustom to dealing.

What We Got

As work continued, we received various drafts, which included among other things:

- Gross inconsistencies in design
- The use of non-standard HTML
- Graphics, animations, and sound files which either had no relevance to the content or added no meaning to the lessons.
- Systems designed in a purely linear fashion
- Dead links
- Confusion as to what were hot links and what were not
- Graphics without accompanying ALT text
- User requirements and standards that we provided were not taken into consideration
- Little or no testing had been done on some of the early modules

Current Status

The teachers have been given access to the book walkthroughs. They have been given surveys to complete containing questions related to ease of use and to their comfort level in using online training. Since this pilot project is still underway, information related to cost and to teacher feedback is in the collection phase.

Would we do it again?

Representatives of the vendors believed that their people knew what they were doing. As it turned out, although these representatives had many years in education and training, they had little or no knowledge on how to develop web-based instruction, but they were willing to learn.

This experience has brought benefits to DoDEA and to the vendors. We learned a lot about each other. Lessons learned were not a result of mandates by others, but rather the result of a better understanding and acceptance on the part of the developers regarding reasoning behind the design considerations. At this point we feel that, if "someone" (we) initiated a new project, "someone" (these developers) would understand our requirements and expectations for excellence.

Yes, we would do it again. To insist on a standard of quality and excellence is to provide our teachers with the level of excellence we believe they, as professionals, deserve. We feel that the time we spent and our perseverance was well worth it.

Understanding the Quality of Students' Interactions through Computer Conferencing in Higher Education from the Social Constructivist Perspective

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Abstract: This paper discusses the processes of interactions among learners in higher education through computer conferencing, and provides information regarding the quality of their learning experience. In order to investigate this phenomena, the social constructivist perspective with the metaphor of "persons-in-conversation" was undertaken as a conceptual framework. The attributes of computer conferencing and its relationship to social constructivism, point to interactions as essential processes through which negotiation of meaning and co-construction of knowledge occur. To address the scarcity of research using qualitative interpretive methods in computer conferencing, constructivism as a referent for the research method was used. The principles of grounded theory was employed in the analysis of computer transcripts resulting in the emergence of seven themes. In order to verify the hypothesis pertaining to the themes, additional questions were formulated and students' end-of-semester evaluation was used. Analysis suggest that the activities occurring within the themes are dynamic interactive processes against which students' conversation take place.

Purpose of the Study

This study aims to address the fundamental question: "What is the quality of interactions and the subsequent learning experience among learners in higher education in computer conferencing?" In order to investigate these qualities, the social constructivist perspective was undertaken such that the metaphor of "persons in conversation" (Ernest, 1995, p. 480) provided a framework for the study. Within this framework, the extent to which a community of learners is established is investigated within which, the nature of discourse within the community is analysed.

Motivation for the study

As a graduate student, the first author had the opportunity to take on-line courses that were supported with computer conferencing and the world wide web. This particular course under study was conducted wholly on-line. This was a new learning experience for her and she subsequently went on to assist the second author in moderating the on-line course. The second author is engaged in designing and facilitating on-line learning courses using social constructivism as a referent for her teaching in which the focus of the educational experience is on the web of interaction between the facilitator and her students and among students. The result of their exposure to on-line education led to their interest in research in this area of teaching and learning.

Significance

A review of recent literature shows that the principal issues where studies into computer conferencing has largely been conducted relate to application oriented issues (Mason, 1992), and evaluation into the quality of an on-line conference (Romiszowski and Mason, 1996; Gunawardena, Lowe and Anderson, 1997). These include investigations into the amount and patterns of participation showing the interrelationship (or threads) among messages submitted to a conference (Ahern, Peck and Laycock, 1992; Howell-Richardson and Mellar, 1996; Hillman, 1999), comparative patterns of participation among learners from varying backgrounds (Levin, Kim and Riel, 1990), and participation satisfaction regarding the medium of communication. Mason (1992), in reviewing methodological approaches used in evaluating CMC, reports that the majority of studies came out of a quantitative/positivist paradigm, using techniques such as survey questionnaires, interviews, empirical experimentation and computer-generated statistical manipulations which do not shed much light on the quality of learning taking place.

Recent researchers however, have begun to investigate into more specific aspects of students' learning, including higher order learning (Fabro and Garrison, 1998), critical thinking (Bullen, 1998; Anderson and Garrison, 1995; Garrison, 1991; Newman, Webb and Cochrane, 1995) and social interchange among learners (Gunawardena and Zittle, 1997; Rourke, Anderson, Garrison and Archer, in press). These studies have exposed the small number of research, and the need to examine quality issues with regards to students' on-line learning.

In relation to this, few studies have sought to analyse the transcripts of students' on-line conferences for the purpose of investigating the quality of interactions and the quality of their learning experience using social constructivism as a referent for the investigation. This study follows initial studies carried out by Gunawardena, Lowe & Anderson (1997) and Kanuka & Anderson (1998) on professional development conferences with learners of roughly equal skills and knowledge in which they sought to analyse the processes of interaction among participants. This study seeks to investigate and understand the on-line construction of students' knowledge in higher education, through an analysis of their conference transcripts, end-of-semester evaluation and further questions which were formulated from hypothesis generated from the analysis.

Conceptual Framework

Using social constructivism as a referent in investigating students' educational experience, two interrelated elements are seen as essential to the investigation of the quality of the learning experiences: the establishment and presence of a community of learners, and the nature of discourse within the community. Within this framework, education is seen as a social learning experience (Garrison, 1993) in which negotiation of meaning and co-creation of knowledge occur. Operationally, we define interaction as the experience during which two or more parties engage in a collaborative effort to negotiate meaning and to form a unified knowledge. In the context of computer conferencing, interaction and communication are essential processes through which learning occurs. Kaye (1989) states that "conferencing is primarily about interaction" (p. 16).

The importance placed on interaction points to the fact that two kinds of knowledge creation take place in a shared learning experience such as that in computer conferencing. Knowledge is created at both the social - the level of the community - and the individual who also creates his or her own understanding. "Social constructivism regards individual subjects and the realm of the social as interconnected" (Ernest, 1995, p. 479). This means that at all times, knowledge is both social and individual in a way that Tobin and Tippins (1993) describe as "a dialectical relationship existing between the individual's contribution to knowledge and the social contribution" (p. 6). For Dewey (1938), education is based on the interaction of an individual's internal and external conditions. This means that interaction and the situation during which one experiences the world cannot be separated because the context of interaction is provided by the situation. This idea of communication suggest the intersubjectivity between the individual, other people and the surrounding environment. As Vygotsky (1978, cited in McIsaac & Gunawardena, 1996) postulates, one's social environment is a critical factor in one's cognitive development. As such, knowledge should be seen as a matter of conversation and of social practice (Rorty, 1979 in Philips, 1997).

Following this conceptual framework, interaction and communication take precedence over individual learning in this on-line community of learners.

Research Design and Procedures

The research approach was underpinned by a constructivist theory of knowledge in which the aim of the inquiry is to investigate and understand the quality of the learning experience on-line. A constructivist epistemology views knowledge as a construct of individual's understanding (Guba and Lincoln, 1994). When individuals come together, such as in a learning environment, their construction undergoes continuous revision due to cognitive conflict which occurs as a result of different constructions among individuals. Through the hermeneutical/dialectic process, knowledge becomes more informed and sophisticated.

In view of this study which aims to investigate the processes of social negotiation and co-construction of meaning, this methodology is considered the most appropriate. It recognises individual's construction of knowledge to be an interpretation and not a correspondence to an external reality (Von Glasersfeld, 1990).

This on-line unit is a postgraduate unit for science and mathematics teachers. Nine students undertook this unit, including the first author, and it was moderated by the course instructor who is the second author. The students come from Canada, Vanuatu, New Zealand and various parts of Australia; however, except for the student from Canada, all other participants were residing in Australia during the course of the unit.

The research questions, both original and emergent, formed the basis for the methods by which data were collected. The data were pieced together to answer research questions that evolved. Consequently, the research questions and research methods were emergent and self-reflexive. The research methods include transcript analysis using the principles of grounded theory, participants' end of the semester evaluation, and open-ended questions which were formulated from the hypotheses generated from the transcript analysis.

Transcript Analysis: First, a critical review of a currently available interaction analysis model was conducted in which it found that Gunawardena, Lowe and Anderson's (1997) model to be the most promising start for their concept of interaction is based on the principles of social constructivism. This model traces the construction of knowledge in social learning through five phases. Second, the researchers went through the conference transcript once in order to familiarise themselves with the manner of interaction among the students. Having observed the patterns of interaction among the students, the data was found to be incongruent with the categories from the model. Rather than impose the categories (from the model) onto the data at the early stages of analysis, the researchers felt that it would be more useful to let the categories emerge from the data. Literature on social constructivism and grounded theory were used to analyse emerging patterns, themes, phases, and concepts relating to the social construction of knowledge. From the transcript analysis, hypotheses were formed in which participants' end of the semester evaluation was analysed to verify the hypotheses.

Open-ended questions: This instrument was used in order to further confirm or disconfirm the hypotheses formed through the transcript analysis. From the transcripts, it appeared that some phenomena pertain to all participants while others pertain to certain individuals. As such, two categories of questions were formulated, one relating to all participants, and the other, different questions relevant to the respective participants. From these questions, student's perception regarding their learning experience was also investigated.

Findings and Implications

Analysis from the transcripts and end-of-semester evaluation point to the existence of seven themes pertaining to the ways students learn on-line. These themes represent dynamic activities occurring within them with each theme relating to the other interactively. In assuming the metaphor of "persons in conversation", the transcripts represent students' conversation with each other on-line; as conversations do not take place in separate phases, so too the themes which emerged from their conversation are not distinct and separate. The seven themes are: the learning environment, community of learners and the social presence of others, students' background and prior knowledge, reflective thinking, peer-learning and students-centred learning, constructing knowledge, and the role of the facilitator. Within the social constructivist framework in which this study was conducted, these themes can be grouped further into two main categories: *learning communities* and *discourse within the community*.

In order to make meaning from students' conversation and henceforth, their learning experience, the relationship between the themes in the respective categories can be understood from the perspective of theoretical codes (Glaser, 1978). Theoretical codes allow for themes to be organised so that the relationship between the themes can be clarified in order to understand the processes of students' learning experience. Seen in this perspective, the initial role played by the facilitator appears to have set *the learning environment* that enabled a *community of learners* to be formed. Within the community, students' *background and prior knowledge* became apparent, was emphasised and played a key role in their discourse. Together, these form the total background against which students' discourse took place. This environment in which interaction transpired is the *learning community.*

In relation to their *discourse in the learning community* as reflected in the Activity Room, students *reflect* on the readings in relation to their own experiences as well as their colleagues' responses in relation to the readings. From their reflections, they then share their experiential knowledge and put forward their responses to the readings, and occasionally to their colleagues', using different forms of *communicative strategies*. Thus, there was increase in *peer-learning* based on one another's experiences and perspectives. It is worth noting that the learning community and the discourse within the community are not separate and distinct categories; the community both affects the discourse, and is affected by the discourse, creating a dialectical relationship.

Community of Learners. One of the second author's intentions when she designed this unit was to develop a community of learners within which peer-learning and student-centred learning would occur. In view of this, she guided the first two weeks of discussion which enabled a community to be formed. Immediately following the second week, students' interaction with one another could be seen to take place within the learning environment that she created. Later on, against this environment and through peer-learning, they established their own environment for conversation. The importance of the learning environment for the development of a community could be seen from this student's end-of-semester evaluation, "The fact that we introduced ourselves and a little historical information set up a rapport between the group. This allowed me to feel more at ease, particularly as I don't have a strong technological background." Students' personality as revealed in the self-introduction activity initiated by the facilitator, is important in helping students know who their colleagues are, and the way in which they will consequently communicate with one another. As this student said "I started the unit cautiously. I was testing the waters because I needed to know who my coursemates were as they would influence the way in which I contribute to the activity room."

The importance of a community of learners is also seen to be significant to students' interactions in the following ways: (a) It helped to create an equitable learning environment. Students do not feel threatened by one another's ideas and are able to share their knowledge freely. (b) It enabled for social exchanges among students in addition to the more formal discussions. Through their social chats, students learn from one another. This was acknowledged by the facilitator when she said, "I really enjoyed the brief personal interactions...which makes me think that it is valuable enough to have it in the activity room and not as an e-mail. After all, this is part of the learning process, as it is not only in the information exchange[s] but also in the personal exchange[s]" (Activity No. 115). (c) Students do not feel themselves isolated in their learning experience, and regard one another's experiences and ideas as resources towards their own learning.

However, while most students felt satisfied with the informal learning environment, there were others who felt that a more formal situation would be more suitable for learning. Thus, they do not view their colleagues' social chats as sources of knowledge, but instead regard them as mere general chatter. One student indicated that her colleagues' " responses became more of a general chat...they were too colloquial."

Evidence of students collegial attitude towards one another can also be seen from the way in which they use the activity room for purposes beyond formal discussions. In addition to the social exchanges, they also share their classroom ideas, on-line resources, support each other in their learning difficulties especially those pertaining to technology, and encourage one another. The transcripts reveal that students who are learning on-line for the first time generally needed more support from their peers than those who are more experienced with this form of learning. However, they differ in their perception regarding the support they received from their peers.

Discourse within the community. Students' conversation indicate that they are strategies which they used in order to communicate their ideas to one another depending on their intent and the context within which they are used. It is also true that the purpose of their conversation sometimes result in unintended outcomes, or lead to other forms of conversation. The transcripts reveal that three groups of students exist with regards to their on-line learning experiences, beliefs and attitudes in relation to the use of technology in the classrooms.These factors are seen to relate to the types of conversation and strategies they used in order to promote their ideas and opinions.

Students in group one are experienced teachers with more than 15 years of teaching experience. Generally, they are also experienced on-line learners with a positive attitude towards the use of computers in education. In their discourse, they often discuss the readings in relation to their prior experience as well as use them as justifications for their opinions. They are confident learners eager to put forth their arguments. The questions they posed to their colleagues are generally intended to obtain ideas and resources for their own classroom practices. They form the biggest cohort of students. Students in group two are both first-time on-line learners who are respectively naïve in matters pertaining to computers, and have no teaching experience. However, they are eager to learn from their colleagues and are open to new ideas. This can be seen from one of their transcripts, "...[I am] interested in capitalising on the use of educational software in enhancing learning and understanding and [I] hope to learn from all of you" (article no. 12). The consequence resulting from their lack of experience see them discussing the topics either from a personal perspective, or from a theoretical viewpoint. The questions they pose to their colleagues are often intended to deepen their understanding regarding the topics, and to clarify conflicts of understanding. In posing their questions, they also challenge the beliefs of their colleagues. Students in group three lack experience in computers and are sceptical regarding their practical use to improve teaching and learning. Regardless of the group in which students belong, they acknowledge that they learn something new from each others' experiences.

The importance of students' prior experiences establish their starting point with regards to their learning. Students' starting point is significant as it reveals where their current knowledge and beliefs are at the beginning of the semester in relation to where they subsequently are at the end of the semester, and the kinds of interactions that occur in the activity room to create this change in understanding. It has been well documented in literature (Ernest, 1995; Tobin and Tippins, 1993; Von Glasersfeld, 1990) that students' prior knowledge and beliefs act as both a motivation and constrain to their learning. When students are faced with a concept, model or theory, they bring their experiences to bear on this information; if the information falls within their existing frame of understanding and is adequate in the context in which they are created, the information is accepted as viable. However, if their prior experiences inform them that the piece of information is not likely to be workable, it is resisted. From their conversation, it appears that students' cognition is more open to embrace new knowledge not currently held than it is to change incorporating the differences; this can be seen both from their resistance to change as well as from the scarcity of new knowledge which comes from a shift in their cognition.

In terms of discourse from a social constructivist standpoint, students generally created opinions rather than engage in active conversation and negotiation of meaning with one another. That is, they generally proposed their own different views rather than seek clarification or challenge one another's views through active conversation. However, closer analysis of the transcripts show that tacit negotiation was continually occurring even when participants were apparently agreeing with one another (Gunawardena, Lowe and Anderson, 1997).

These findings in relation to the two categories suggest that: 1) a sense of community sets the learning environment that enables for the sharing of multiple experiences among students. These experiences in turn, act as a rich pool of resources towards students' learning leading to their construction of new knowledge. 2) in order that students collaboratively build and integrate new knowledge into their existing framework, or change their existing framework, instructors should formulate ways in which to transform their tacit negotiations into more active interactions through negotiation and discussion among students.

*This research was conducted while Dr Maor was working at the Science and Mathematics Education Centre, Curtin University of Technology.

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Supporting Beginning Teachers: A Web-based Collegial Enterprise

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Abstract: This paper describes the design, development and evaluation of a website designed to ameliorate many of the problems encountered by beginning teachers. The site allows new teachers, and preservice teachers on school practice, to communicate with each other through a discussion board, and provides access to a range of resources including lesson plans, videos of exemplary teaching, annotated lists of useful websites and frequently asked questions. Such access may help to lessen the feelings of isolation and lack of support felt by many beginning teachers, and provide a link between the practical realities and constraints of the classroom and the more innovative, research-based methods and strategies teachers learn while at university.

Introduction

The beginning teacher experience can be as daunting in Australia as it can be in the rest of the world. One new teacher recounts the experience of her first teaching appointment in an outback high school:

> I had an idea of what it was going to be like … I just prepared for the worst. I had in the back of my mind 'Well, OK it's not a very attractive place'. When I did fly over, I looked out and all I could see was the mud flats. I got off the plane and it was hot and it was red pindan, just red dirt, and you could see for miles. I just thought, 'Oh this is awful'. I didn't like it. I thought 'There ut no, there weren't any beaches. And there were signs everywhere that said 'Beware of the Crocodiles'.
>
> The school? The first day. It was pretty tough. It was sort of 'Oh, I can't stand this'. I almost chucked it in. I found the students had a lot of behaviour problems. Their first impression was that I was a student teacher. They didn't see me as a qualified teacher. They were very testy a lot of the times and I suppose being my first job, it was tough. I found that I didn't get too much support from the staff either. I was totally left in the dark. I didn't really have much support.
>
> When I came here there was just nothing. I didn't have any resources. All the stuff that they did have at the school that was anything to do with maths, the stuff from the Ark. It was ancient yellow stuff, cobwebs and things, from the 60s and 70s that they had been using. I didn't know where to start. I didn't know what to do. As far as budgeting and costs and knowing what to buy, and no one else had any idea. It was up to me to decide. 'Well, you're the maths teacher, you need to decide what you need for your classes. What do you think the kids need?' So I was making phone calls down to Perth … I needed some help …

(Interview with Louise, first year teacher appointed to a remote outback school in Western Australia.)

The sense of geographical isolation and professional isolation illustrated in this excerpt, are common phenomena for beginning teachers in Australian schools. Added to this is the paramount issue that all beginning teachers face—managing their classrooms. The anxiety can only increase when faced with the other issues of lesson preparation, motivation, assessment, social relationships with students, teachers and parents, pedagogical and content knowledge (Kent, 2000) and the current demands with the use of technology in teaching (Strudler, McKinney, & Jones, 1999).

Generally, on the completion of their teacher education courses, neophyte teachers display the modern beliefs and practices that those courses aim to achieve. But it is not surprising that the complex and difficult issues that beginning teachers are faced with cause many of them to retreat to the safe beliefs and practices that reflect traditional approaches (Raymond, 1997; Simmons, Emory, & Carter, 1999).

So how can teacher education courses develop and sustain modern beliefs and practices that are robust enough to cope with the critical realities of classroom teaching? One approach is to refine the curriculum in teacher education courses in ways that better reflect the contexts in which new teachers will find themselves. For example, *Investigating Teaching Strategies in Mathematics Classrooms* (Herrington, Sparrow, Herrington, & Oliver, 1997) and *Learning about Teaching* (Mousley, Sullivan & Mousley, 1996) are CD-ROM resource designed to situate preservice mathematics teachers in contexts that reflect real life instructional and assessment issues for teachers in K-12 classrooms. Another approach, which is the focus of this paper, is to provide a technology-based support mechanism for beginning teachers that is characterised by collegiality and reflection on practice (Peterson & Williams, 1998).

Mentoring programs and web-based teacher networks have been suggested as approaches in which beginning teachers can be supported through these concerns, where together with other novice and experienced teachers, they can reflect on their own developing beliefs and practices, and view and share the experiences of others (Weasmer & Woods, 2000).

The MEOW (Mathematics Education on the Web) website

MEOW (Mathematics Education on the Web) (http://www-scam.cowan.edu.au/MEOW) is a web-based approach developed to support beginning and preservice teachers of mathematics. When fully functional, the website will provide support for different groups of preservice and practising teachers. In particular, new teachers will be able to access the site to keep in contact with their former classmates and instructors, to share ideas and lesson plans with others around the world, and to access valuable resources.

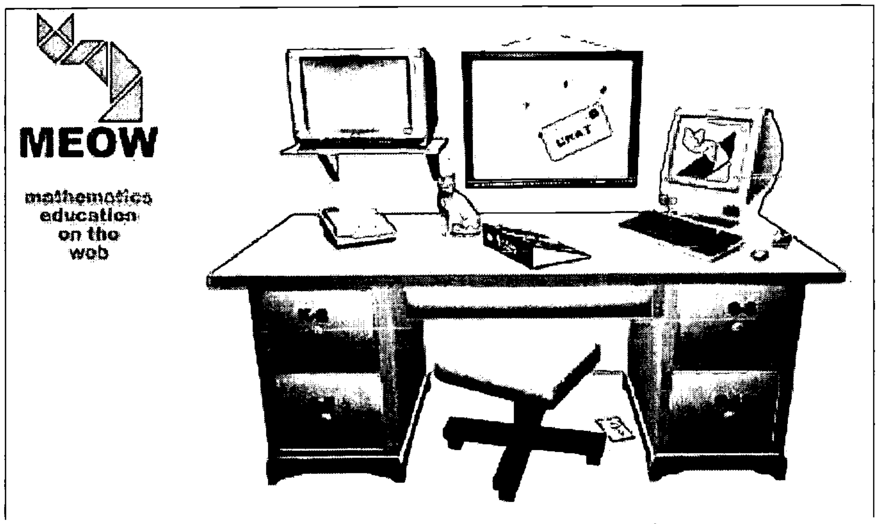

Figure 1: The main interface of the MEOW website

On the website, resources and communication elements are accessible from a central interface which represents a well-equipped office (Figure 1). Teachers quickly learn where resources are located and can intuitively select the appropriate location in much the same way they access resources in a real office (Hedberg, Harper, Wright, & Farr, 1996).

Clicking on various elements of the interface—such as the telephone, the television, or the computer—gives access to different resources. Specifically, the site provides the following elements:

Discussion board: When teachers click on the *notice board* in the office interface, they connect to a discussion board where they can talk with their colleagues about problems or issues they are faced with in their mathematics teaching. They can present a description of something which might be worrying them, ask for suggestions on how to deal with a problem, or simply share ideas and thoughts with other teachers. Such a resource reduces the isolation felt by many new teachers, and gives them an alternative avenue of support to their workplace colleagues. Such support might also help to alleviate the anxiety reported by new teachers when they are directed to teach in a manner at odds with the methods taught in their teacher training courses.

Lesson plans: Clicking on any of the *desk drawers* gives access to a variety of lesson plans classified by year levels, by content and by processes. Teachers can click on any lesson by title and be given a description of how to use the activity with their students. Each lesson plan has an introduction, a description of the activity together with a list of any materials that are needed (some of these, such as 1cm grid paper, can be downloaded and printed from the website). For example, Figure 2 shows part of a lesson plan within the strand of *pattern*, suitable for Years 3-5. Ideas for extension activities are also provided with the lesson plans.

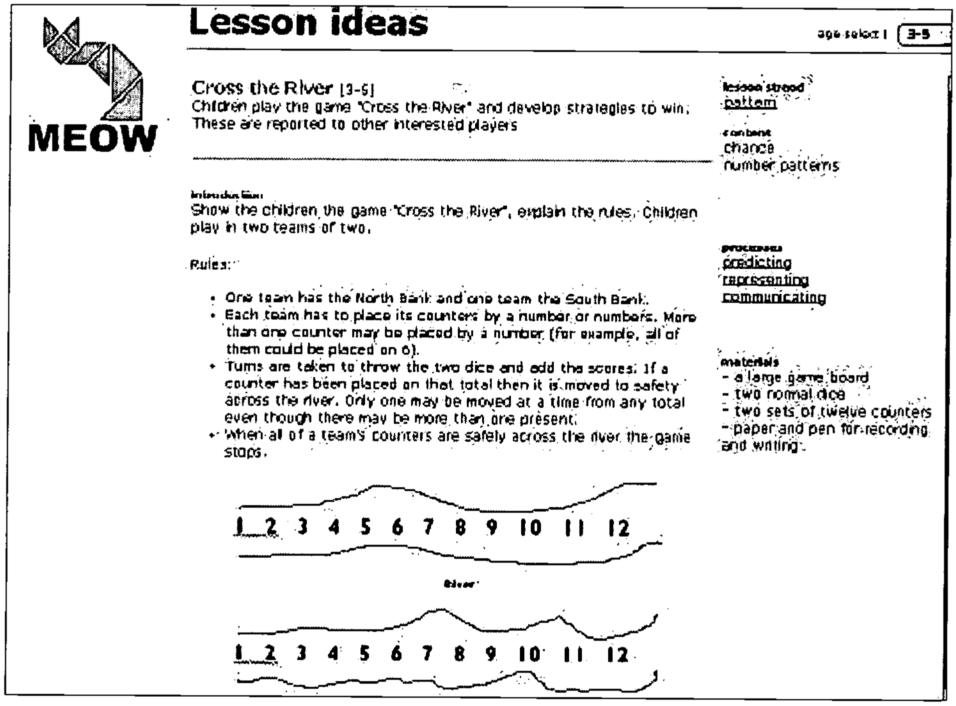

Figure 2: A sample lesson plan from the Years 3-5 drawer

Contacts: Clicking on the *telephone* on the desk enables teachers to access contact details of their former instructors if they wish to contact them direct to discuss any issues they may have in their mathematics classrooms.

Web-based resources: Useful URLs: Clicking on the *computer* on the desk gives teachers access to web resources beyond the MEOW site (Figure 3). There is a wealth of resources available for teachers on the web (such as lesson plans, mathematical resources, factual information, etc.) and students and teachers are encouraged to add recommended sites to the list. Each URL link is annotated by the contributor giving reasons for its recommendation, and this helps to prevent the page from becoming simply a list of hyperlinks.

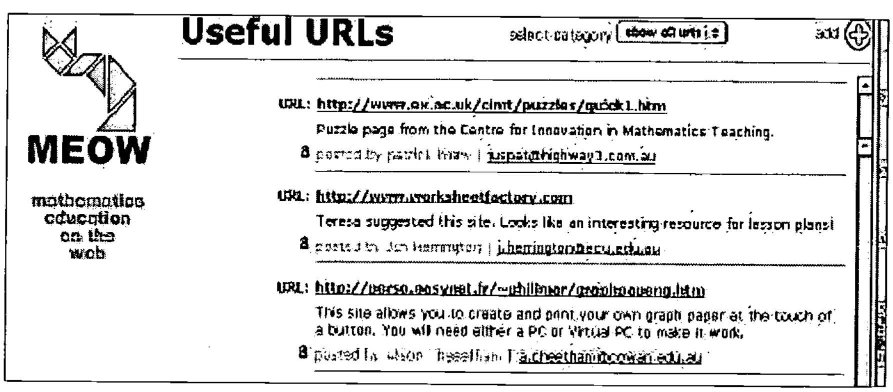

Figure 3: Teachers can access a wealth of resources on the web through the Useful URLs page

Exemplary teaching: If teachers click on the *television* in the interface they are given lists of teaching and assessment strategies from which to choose, such as group work, problem solving, investigations and portfolios. Selecting any of these strategies allows them access to a streamed video of an experienced teacher demonstrating the strategy in a real classroom. Teachers can also view short videos of the teacher discussing the strengths and weaknesses of the strategy and also a student's perspective. There is also a description of the strategy in text format. For example in Figure 4 below, a short video can be accessed to demonstrate the use of role play in the classroom, and teachers can also watch videos of an interview with the teacher and a student from the class. A description of role play as a teaching strategy is also provided.

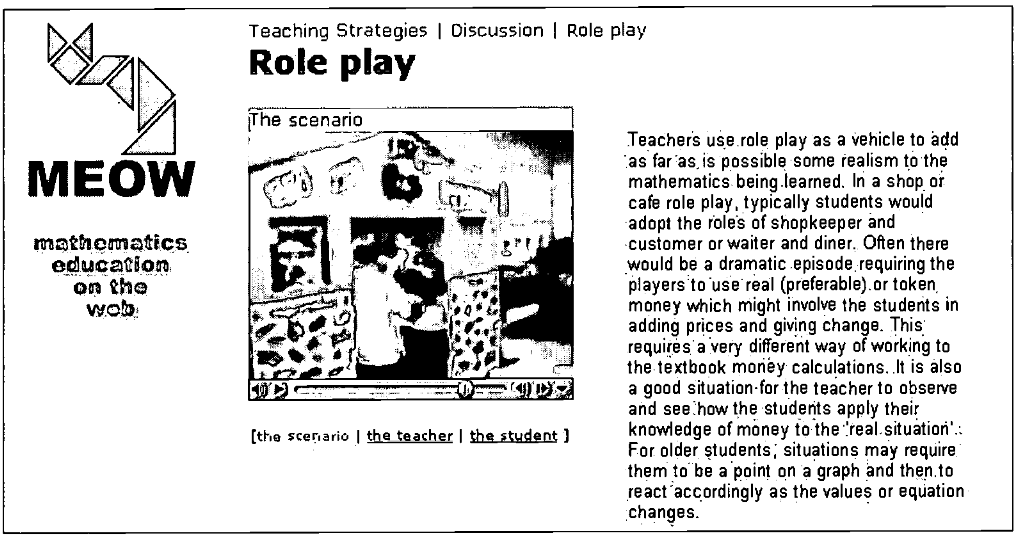

Figure 4: The exemplary teaching section includes short videos and interviews, with text descriptions

Common problems: The *folder* on the desk, when clicked, gives teachers access to many common problems faced by beginning and preservice teachers. This takes the form of a *Frequently Asked Questions (FAQ)* site, and the questions and suggested answers are taken from the discussion board and summarised for easy access.

Reflective support

The benefits provided by this resource for beginning teachers are numerous: they have immediate access to required information; they are able to collaborate in a virtual community and be relieved of the sense of isolation so often experienced; they can contribute to the database by posting successful lesson plans and other materials of their own; and they can share the information passed in the chat sessions without having to formally participate.

While the MEOW site provides a great deal of 'just-in-time' support, it is also designed to support beginning teachers in a more reflective way. Boud, Keogh and Walker (1985) define reflection as: 'those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations' (p. 19). These authors stress that such reflection must not occur solely at the unconscious level: 'It is only when we bring our ideas to our consciousness that we can evaluate them and begin to make choices about what we will or will not do' (p. 19). The site enables reflective practice by providing a variety of resources from which to gain alternative perspectives on any teaching task, and by providing exemplary performance and the modelling of processes, enabling students to reflectively compare their own performance to that of experts. Communication technologies also allow students to establish communication in the language of the culture, and to share stories and anecdotes of their experiences.

Preliminary evaluation

While the site has not yet been evaluated with beginning teachers, it has been evaluated formatively with a small group of eight target preservice teachers. The evaluation comprised observation of students using the site in small groups, a questionnaire and a focus group discussion. Students were asked to use the site and then to complete the questionnaire. At the conclusion of this session, all the students came together for a discussion of the issues.

The findings from the questionnaire were uniformly positive with students valuing as *Very helpful* or *Helpful*, the majority of support elements provided on the MEOW website. (Of the five respondents, only one response item fell outside these parameters.) In the focus group discussion, some problematic issues were raised, such as the uncertainty that schools would have reliable and ready access to the Internet. However, if such practical difficulties can be overcome, the students pointed out the value of cross-fertilisation of ideas between practising teachers, preservice teachers and university instructors. The students suggested that the video demonstrations of teaching and assessment strategies were particularly useful in providing practical demonstrations of the theory learned in their coursework during teacher training. Finally, the suggestion was also made that other discipline areas could use the site as a template and provide similar support (particularly useful for elementary school teachers).

It is proposed to conduct an interpretive, summative evaluation after the site has been fully developed and made available to beginning teachers. The investigation will focus on whether the site is used reflectively, the value of the lesson plans and other resources in strengthening teachers' mathematics pedagogy, and the value of the communication elements of the site in enhancing a sense of collegiality and reduction of isolation.

Conclusion

Achieving successful induction for teachers may result in reducing the current high attrition rates of beginning teachers and as other successful programs have found, may provide a positive influence on the beliefs and practices of their more experienced school colleagues (David, 2000).

The beginning teaching experience can be daunting. Adopting traditional methods of teaching and assessment from their own classroom experiences and discarding the methods advocated in teacher training courses may provide a safe and comfortable environment that enables one to survive the demanding pressures of the first year experience. A web-based resource such as MEOW has the potential to provide a bridge between the practical realities and constraints of the classroom and the more innovative, research-based methods and strategies that teachers experience at university. The website can provide a dynamic and reflective set of resources for new teachers, and importantly, provide the support that helps to overcome what can be immense geographical and professional boundaries.

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Distributed Adaptive Learning Systems

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Abstract: The long range goal of the investigators is to design and implement a computer network based intelligent system called a Distributed Adaptive Learning System (DALS) that measures the learning characteristics of individual learners and presents the information they seek in a form created dynamically to optimize their learning. A small scale version of a DALS utilizing only four learner characteristics and three methods of presenting information to the viewer will be constructed as a first step toward this goal. Features of a full-blown DALS will be incorporated into the model system. The three investigators bring the expertise and experience in the core disciplines needed to implement this simplified system; but to realize a full-blown DALS will require many additional expert collaborators. What is learned from this work will form the foundation for future research and development in Distributed Adaptive Learning.

Introduction

There are three components in every instance of human learning: what is to be learned, the learning venue and the learner. The authors define a generalization of this simple schema by labeling the three elements Knowledge – Agent – Learner respectively (this is our KAL model) and then broadening the meanings of the three terms to Knowledge Space, Agency and Learner Space. Because our target is network resident, technology facilitated learning, we envision the Knowledge Space as a sophisticated, intelligent database, the Agency as a collection of intelligent software agents that implements learning venues and the Learner Space as a set of Learner Filters each of which contains the learning characteristics of a single learner in the system. These elements are dynamic so each may change from the results of, or during, a learning episode.

Distributed Adaptive Learning System

The software system implementing this KAL learning model over a network is called a Distributive Adaptive Learning System (DALS). Design of a DALS raises a number of immediate questions: What characteristics/parameters affect human learning the most? How should 'knowledge' be organized to enhance or optimize learning? What are the best venues in which to learn?. Addressing these and the myriad issues they bring up led the authors to design the general DALS reported here.

Knowledge Space

We employ concept hierarchies, called Knowledge Networks, to represent the content to be covered in a DALS learning episode. A pointer-free implementation of these Knowledge Networks is constructed by a three step approach (Lee,Y. & Geller,J., 96). The Knowledge Network is represented as a conceptual framework where agents are able to determine the level of abstraction for a given topic, interpret relationships between topics, monitor the learning process and evaluate learner progress. To respond to different learning preferences, different ways of presenting the same Knowledge Network are incorporated as Knowledge Views. These Knowledge Views are matched with the Learner Filter variable values and an appropriate view is presented to the learner.

Agency
Multiple agents collaborate to achieve adaptive learning. There are three types of agents: learner agent, presentation agent, knowledge agent. The learner agent monitors the learner's learning patterns and ability to grasp a particular concept. The knowledge agent knows the content and its relation to other content. The knowledge agent determines what is presented to the learner. The presentation agent determines how the information is presented to the learner in each specific situation. All agents are considered to be equal partners with the learner so the complex interactions between humans and agents are mixed-initiative interactions (Allen, J.F., 99). The Agency provides the control structure for the DALS.

Learner Space
A basic tenet of the DALS development is that humans are genetically engineered "learning machines" with unique learning capabilities. Hence, aspiring to individualized learning must be grounded in an understanding of the factors that influence human learning. These factors are treated exhaustively in the literature. For example, Biner identifies demographic variables (Biner, P. et al., 95), Miller identifies field dependence/independence variables (Miller, G., 97) and Cox reports on learning styles (Cox,D. & Huglin, L., 00). In an attempt to create a learner centric, generic learning system, the investigators make the following assumptions:

1) There are a significant number of variables known to play a critical role in human learning
2) These variables can be identified and partially ordered according to their impact on learning
3) Some of these variables can be measured accurately and reliably
4) Individual learners can be characterized by a profile of these measurable variables
5) These variables have values with greater or lesser degrees of stability over time
6) A set of values of these variables implies a learning mode preference
7) Technology offers the opportunity to exploit these ideas to optimize individual learning

A DALS transmits information from/to the learner using filters to control the interaction between the learner and the system. Our filters, called Learner Filters and Knowledge Views, are implemented as plug-and-play components using knowledge base and multi-agent technologies. As a result of the interoperability, comparability and exchangeability of these components, the DALS can be dynamically reconfigured by selecting filter components specific to different knowledge domains and learning venues. Depending on the Learner Filter values, multi-agents select different Knowledge Views from the Knowledge Space to effect a learning episode.

Implementing a DALS

Using subject matter content from a Discrete Structures course, the authors plan to implement a simplified version of a DALS. The Learner Filters will be comprised of the four profile variables Thinking Style, Intrinsic Motivation, Academic Stress and Social Presence. Knowledge Networks will be constructed for the chosen subject matter, and Knowledge Views will be created for Guided, Discovery and Game Learning. Learner Filters for participants in the class will be used to select the Knowledge Views.

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Enthusiasm Meets Experience: Collaboration of Two Communities through Computer Conferencing

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Abstract: In this paper we report on a course format where a group of in-service teachers works together with a group of computer science and mathematics majors via a computer conferencing system. Most of the time participants studied using the Internet but at the end produced and presented a seminar paper together in pairs. This type of a course has now been given twice which, interestingly, produced different outcomes. The teacher group did not turn out to be more discursive or more active in moderating. The teachers participated in a larger number of discussion topics while the students concentrated on those that were compulsory. However, an analysis of the discussion threads shows that both communities took equally part in most of the longer discussions which suggest that the course goal of sharing multiple perspectives was fulfilled. Computer conferencing was shown to alleviate the problems of participating and running the courses.

Introduction

The Finnish national educational strategy emphasizes the importance of teacher training and suggests more extensive ICT (Information and Communication Technology) training for them (Ministry of Education, 1997). After the basic ICT courses such as text processing, multimedia production and information seeking on the Internet, there should be possibilities to go further (Sinko & Lehtinen 1998). Typically, the responsibility is left to the university continuing education centers which arrange courses for interested teachers to apply more advanced technologies, such as conferencing systems.

We are interested in bringing together not only in-service teachers, but also make this community to collaborate with pre-service teachers and other university students interested in educational technology. There are many similar efforts worldwide. Norton and Sprague (1997) studied on-line collaborative lesson-writing between pairs of in-service and pre-service teachers. Brehm (1999) has outlined factors for this kind of activity which is also called telementoring. Casey (1999) advocates virtual international seminars for pre-service and in-service teachers together with graduate students. He even states that virtual seminars and global interconnectivity as "...the most significant innovation that I have experienced to improve the quality and depth of student involvement in seminars" (Casey 1999). All above report on benefits for those taking part, especially for those younger participants, namely pre-service teachers and students.

In this paper, we report on a slightly different possibility of introducing new Internet technology to in-service teachers. In our approach, the teachers are brought together with a community of young university students majoring mainly in computer science (some of them, however, are pre-service teachers to major in mathematics). In this way we hope to produce synergetic effects by combining the experience of the in-service teachers with the technological knowledge and enthusiasm of the computer science students. The particular course where this co-operation takes place is a common effort of the Department of Computer and Information Sciences and the Department of Teacher Education at the University of Tampere. Although part of the same university these departments are situated in two different cities, 100 kilometers apart, which lead us to utilize Web-based computer conferencing as an essential element of our course.

Background of the Study

The course under study ("Internet-based learning environments") is a voluntary second-year course for students majoring in computer science but is recommended to those interested in human-computer interaction and to those majoring to become mathematics teachers. This seminar type course has run every autumn since 1997. The course starts with lectures that take five weeks. During that time the selection of seminar topics is also carried out (week 3) and the pre-discussion on each topic on the Web commences (weeks 4-8). The final face-to-face seminar sessions takc place during weeks 10-12.

We have reported elsewhere on our early experiences on this kind of "Web-extended" seminar course format (Hietala 1999). The benefits envisaged are as follows: more extensive and broader discussion of the topics, opportunities for the more shy students to participate, and time to get to know the other interested parties of the topic (community forming). The Web discussion has the same topics as the actual seminar presentations but the students are advised to carry out a free and more open-minded discussion than in the actual topic. Each discussion has two moderators (students giving the seminar paper) who are responsible for the starting, moderating and wrapping up the Web discussions (along the ways suggested by Bonk and Reynolds (1997)). In the seminar presentation the students are required to be a more focussed, maybe also illustrating their main ideas by demonstrating one or two Web-based learning environments. The moderating activity is taken into account in grading the students.

The Course with In-service Teachers

Here we report on two courses (autumns 1997 and 1999) where the course at our department was linked to the same course given concurrently (by the same lecturer) to a group of in-service teachers extending their information technology studies at the Department of Teacher Education. Now an idea arose to team up one in-service teacher with one student to prepare a seminar presentation together.

The benefits anticipated were the following. First, for the in-service teachers this new kind of a course might bring about a new "fresh" point of view to collaborate with a younger university student. Moreover, in the more technical topics and in the transfer of their presentation onto the Web (as an HTML document) the expertise of a more technically oriented student might be beneficial. On the other hand, the university students receive a discussion partner who is older and more mature and brings experience from the real school life. Furthermore, the opinions and work of the students might now lead to something more real than just another seminar paper for their university professor to read. On the whole, it was hypothesized that it would enrich the seminar discussions if we had voices in the participants from not only the community of Computer Sciences Department students but also from the Department of Teacher Education and especially those teachers who already had school work experience.

One problematic issue for all seminar students is typically how to select a seminar topic. On the latter course our participants were given the choice to suggest topics of their own, but this opportunity was not very much utilized. So the topics were mainly given by the lecturer. As a novelty of our geographically distributed seminar the selection of topics (one to moderate and present, two to be an opponent, or as we prefer to say, a designated commentator) took place within our conferencing system. We will come back to this in the next section. After obtaining a partner to their work they made contact, mostly by e-mail but sometimes also by telephone, and started the work. The first thing to do was to prepare and publish their initial thoughts on their subject - in other words, to start a discussion thread within the conferencing system.

The discussion period on the Web takes four weeks and after that the face-to-face seminar sessions commence. At the end of the course the in-service teachers are required to be present at the University to give their presentation together with their partner. Many participants reported this was the first time they actually saw their partner. As an experiment, one session in 1997, comprising two seminar presentations, was carried out using video-conferencing facilities, the pairs presenting being 100 kilometers away from each other.

The Conferencing System Used on the Course

Our conferencing software comes from the CoWoGLe (Conferencing on the Web for Group Learning) project that investigates the use of Web-based lightweight conferencing systems especially as part of university level course work (Hietala et al. 1997). The pedagogical goal of our use of the Web discussions on seminar type courses is to guide the student discussion process into more argumentative and disciplined. One interesting feature that we hope to support this are the comment types in our conferencing system: our students were required to first decide the type of their comment and only after that write their comments. They are also requested to indicate the source of their comment. Comment types (also called as thinking types) encourage *reflection-in-action* (Duffy et al. 1998) because they make the student think about his/her contribution with relation to the other postings in the group (more on this kind of procedural facilitation see Hietala, 1998).

Another pedagogical strategy that our system supports is called *post-before-read* (Hiltz 1993): all students in a small group must state their own perspective to the initial start-up posting of the group moderator, and only after that they can see what others have written. This enhances the equal participation and maybe entices a broader set of issues to be covered in the subsequent discussions.

The Web technology could also help to manage a course in the problem of selecting a seminar topic mentioned earlier. Same number of students from these two groups was admitted to the course from the two locations. Remember they do not even meet each other at first. The conferencing system allowed them to select the topics they were interested at first-come-first-served basis starting the selection process exactly at the same time where ever they were located. We hoped that similar interests brought the pairs together. (Figure 1 shows the situation).

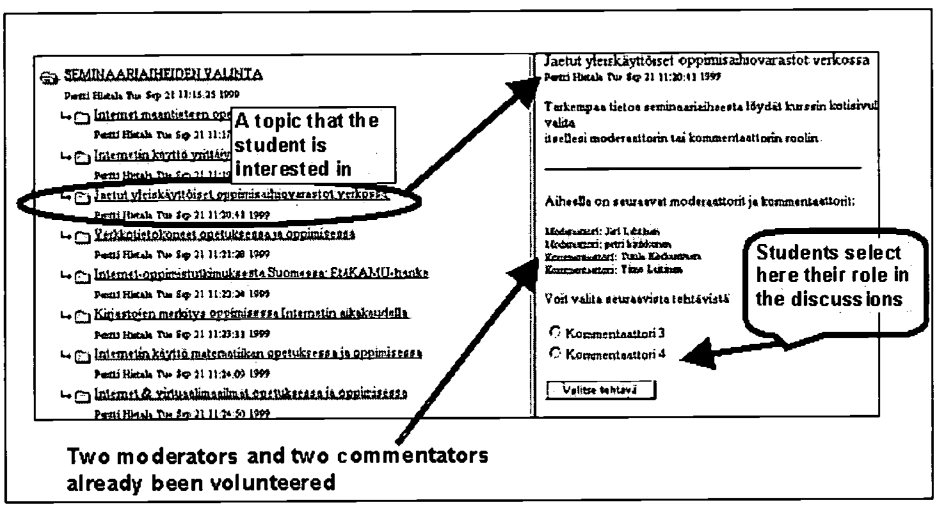

Figure 1. Student selecting his/her topic for the seminar.

Now, after having logged into the system, students would navigate to the list of seminar topics (on the left), they would click open the topic they were interested, and make a selection (on the right) of what roles were available there, that is, choose to be either a moderator, or a commentator. Within the conferencing system, we can also check that the two moderators come from these two different groups.

The Study

On these two courses under study there were 36 (1997) and 28 (1999) participants. The in-service teachers mainly taught at elementary level, although there were a few mathematics teachers at secondary level. Most of them were active in their schools in ICT and their major incentive for participating the schooling was to better utilize ICT in their daily work, not to earn grades as a graduate student. They had already 15-credit week training in ICT (especially geared for teachers) but these studies came from different universities so they background knowledge was not very homogeneous. Also the cities where they taught varied. Although most of their training for this 35 credit week ICT studies (of which our course was also part) took place in the city of Hämeenlinna (almost 100 kilometers from Tampere) some of them came from rather far (from Helsinki or even from Joensuu, 400 kilometers away!) This shows their dedication to this new type of training; however, it of course brought along problems in scheduling the seminar sessions.

The university undergraduates were mostly computer science majors, with 20 % of them majoring to become mathematics teachers (i.e. were pre-service teachers). They had already one course on educational technology.

Discussion Topics

We can see in Table 1 that popular topics in the Web discussions were both broad and "up-to-date" ones while those technical or detailed did not receive so many postings. Issues that can be seen to interest either in-service teachers or computer science majors came to the top. The most popular threads contain already in their title words that already arouse interest, namely the words "critical" and "possible".

The "deep" discussion chains (up to level 12 and 8, respectively) suggest that our goal of aiming at sustained progressive discussions was met. Content analysis of these chains supports this observation.

Year 1997 (total 919 comments in 18 topics)	Year 1999 (total 581 comments in 15 topics)
The most popular discussions on topics: Internet on the elementary level (86), WWW and virtual reality (68), WWW and learning games (63) **The smallest discussions on topics:** MUD/MOO and teaching (26), guided paths on the WWW (29), Web books and teaching (31)	**The most popular discussions on topics:** Internet and the Instruction of Finnish (81), Internet and the basic computer skills (46), School strategy, curriculum and Internet (45) **The smallest discussions on topics:** Internet and teaching history (23), Internet and physics teaching (25), International class projects and the Internet (26)
"Deepest" discussions on topics: - up to level 12: Critically selected information from the Internet (Internet at elementary level) - up to level 11: Visualization is possible (Science learning and WWW)	**"Deepest" discussions on topics:** - up to level 8: The Internet itself is a solution (Internet in language teaching and learning) - up to level 7: The level of writing... (Internet and the Instruction of Finnish)

Table 1. The discussion topics

Discussion Activity in the Two Groups

Let us next see how the discussion contributions of the two communities were distributed. As we can see in Figure 2 the discussion and moderating activity on both courses exceeded the compulsory (one comment per week in each of the three designated discussion groups) for all groups, but there were differences. Teachers were more active in the 1997 course while the student group produced clearly more contributions during the 1999 course. The student group turned out to take more actively care of their moderator roles.

The teacher group, however, was more active in the "Free commenting" i.e. in other topics than their compulsory moderator and discussant topics. This was true both years. For example, in 1997, teachers made on the average 6.61 contributions as free commentators while the students made 4.39 comments. This shows clearly that the teacher group wanted to obtain a wider view of the genre "Internet-based learning environments" and had contributions to offer in most of the topics. Students, on the other hand, concentrated on fewer topics (mostly those compulsory).

Let us analyze a little closer the longer discussions, i.e. those sub-discussions which contain five or more contributions. It turns out that 66 % (1997) and 55 % (1999) of them are balanced in that way that neither of the two communities dominates the discussion by having more than 70 % of the discussion entries. In our opinion this suggests that one of our course goals - sharing multiple perspectives - actually did occur. Moreover, in these longer sub-discussions there were an equal number (29) that was started by a teacher or a student participant in 1997. In the year 1999 students started 23 (teachers 15) of these longer discussion chains. Although thus the year 1999 shows student dominance (see also Figure 2) we think that this gives evidence that both parties were rather equal in producing interesting contributions to the overall discussions.

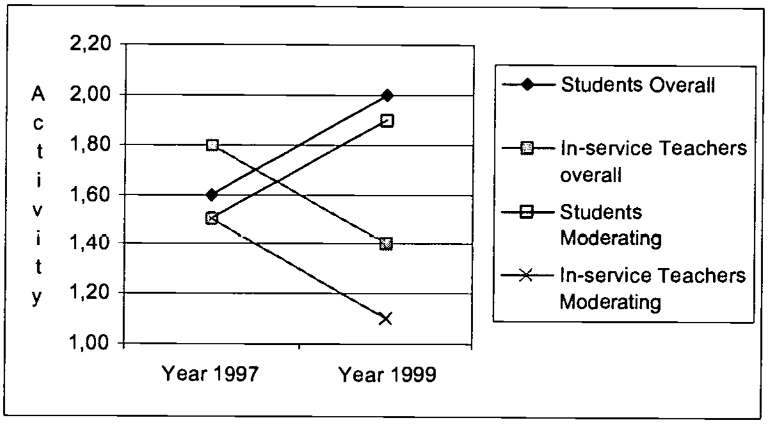

Figure 2. The discussion activity (all discussion postings / compulsory postings)

Finally, both groups seemed to base their postings to personal experience: over 60 % of the comments in either group were given the source type "My own opinion". The next popular source types "My own idea" and "Discussion with others" were used far more seldom. The source labels "From lecture", "From literature" or "From Mass Media" obtained the lowest usage. This shows that the content of the discussion was more of an exchange of experiences than elaboration of issues raised during lectures. Also, our Web discussion guidelines encouraged carrying out a free-form exchange of opinions related to the seminar topics.

Feedback from the Participants

Feedback was collected at the end of the two courses. It was mainly favorable, e.g.

"The course was interesting because it was the first experience of studying using the Web ... In my opinion the separation between these two cities brought extra colour and feeling of reality." (student/1997)

Most of the critical comments focussed on the seminar organization. Of course, teachers who came from far had more problems than the students did. After Web discussions the participants had also developed a better understanding of the topics and were "looking for more" in the face-to-face sessions.

"It was an OK course but I did not feel that the mixing up pairs with teachers and student was meaningful. Sure it worked relatively well but the teachers are working people and the arrangements would have been easier with a local pair. However it was interesting to get to know the conferencing system!" (teacher/1999)

All in all, the latter course seemed to arouse more critical comments on the collaboration, from both the students and the teachers. It is quite evident that there can be problems in communication with a person who is of different age, of different working background and from a different location.

Concluding Remarks

In our opinion, the approach described above turned out to be rather successful. According to our analyses, the quantity and quality of the seminar discussions benefited from having two communities being brought together. Especially the teachers' participation into a wider set of discussion topics and the fact that majority of the longer discussion threads were equally populated with both teacher and student participants suggests that our goal of both communities having the chance to learn from each other seems to have succeeded. Our analysis did not show dominance of one group in the discussions although more detailed content analysis is needed for definite results. In the feedback, however, we have at least one student who claims that his teacher pair was too authoritative and did not give him equal say in the seminar preparation.

Although the teachers reported problems not having enough time to participate especially in the seminar sessions the overall grades of both students and teachers were rather good. The Web pre-discussion supported the actual seminar presentations, which turned out to be of good quality. Some of the participants even wanted the discussions to be alive for a longer period:

> *"Meeting an in-service teacher on the Web and elsewhere was something very useful for a computer science major and working with professionals gave us new ideas. The Web discussion period could have continued after the actual seminar presentations." (student/1997)*

We recommend bringing in-service and pre-service teachers together with ICT oriented students in a manner described above. At our department, this collaboration between our students and in-service teachers has lead to another course of similar flavour. Namely, on a follow-up course where our students build an interactive Web learning environment we have a group of local in-service teachers as domain experts. They provide interesting topics for our students and act as advisors during the learning environment design and implementation process. The pupils in their classes can also serve as usability test subjects for these learning environments. In return, the final Web environments are installed permanently on our departmental Web site for their classes to use. Thus, the experiences of the two courses reported above did not diminish our enthusiasm for university and school synergy!

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Socio-Cultural Factors Influencing Face-to-Face and Online Collaborative Knowledge Construction: Preliminary Findings from Survey Data

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Introduction

We present preliminary data from a survey designed to probe issues we thought to be relevant to a successful implementation of Bereiter and Scardamalia's (1996) theory of knowledge building and similar social constructivist approaches to teaching and learning. An important goal of research on knowledge building is to develop the practice of expertlike learning in school-based learning experiences. The survey consists of 30 questions, most of which ask students to indicate their level of agreement with a statement on a six-point Likert scale, also providing a verbal justification for their rating. The survey probes such issues as students epistemological beliefs, attitudes toward school activities (e.g., students' perceptions about the relevance of what they learn to their immediate lives, their attitudes to and experience with working with computers, and metacognitive awareness. Some of the questions probed such issues particularly in the context of science education and language arts education. The survey draws from previously published work, including Schommer (1990) and Linn and Hsi (2000).

The motivation for this work was as follows. Lampert, Rittenhouse, and Crumbaugh (1996) found that the qualities, experiences, and beliefs that students bring with them into the classroom influence their ability to collaborative construct knowledge. Race (Catsambis, 1995), gender (Hsi & Hoadley, 1997), and status (Bianchini, 1997) have all been found to influence participation in classroom discussions, a vital aspect of collaborative knowledge construction. Furthermore, Chan (1999) reported that students' beliefs about knowledge were related to their participation in a Knowledge Forum database. Because participation in face-to-face classroom discussions (Bianchini, 1997) and in online environments, as well as epistemological beliefs (Schommer 1990) are also related to student performance, it is imperative that researcher and teachers are aware of various socio-culutral factors that may influence knowledge building and similar educational practices.

The data set analyzed consists of the responses by 52 students in an experimental 8th grade combined Engligh/Science program. Within this cross-curricular program, students from two separate classrooms jointly investigated various scientific and literary issues embedded in overriding themes through classroom activities and the Knowledge Forum database. The survey was given on the first day of school and again at the end of the single-semester program; only students who completed the survey on both occasions are included in the study. We examined statistical changes over the semester, as well as qualitative changes. These preliminary analyses allowed us to identify common beliefs and experiences inconsistent with knowledge building practices and to redirect the development of the classroom work in early stages of the project.

Preliminary Results and Conclusions

Pedagogical and Epistemological Beliefs

Some of the students' pedagogical beliefs were consistent with knowledge building practices. The vast majority of the students subscribed to an incremental theory of intelligence and most students believed that both teachers and students are responsible for students' education. The majority of the students believed that they were capable of self-instruction, given appropriate resources; on the pre-test, girls were less likely to endorse this statement than boys.

The vast majority of students believed that scientific knowledge is evolving as discoveries are made and new technologies are developed. However, few, if any students asserted that knowledge is socially constructed. While some students realized that information might be incorrect if it is out of date, the majority of students believed that information on the Internet and particularly in textbooks is trustworthy. It is expected that students' beliefs about the nature of knowledge may shift with further knowledge building experiences. There is some evidence to suggest that adult learners who participate in deep, collaborative knowledge building in online forums experience a shift towards more constructivist beliefs (Chan, 1999); however, it is unknown whether this finding can be generalized to younger populations.

Pedagogical Practices

Many of the learning strategies used by the students were inconsistent with knowledge building practices. The majority of the children reported using "fact-finding" strategies, stating that these methods were easier and allowed them to perform well on tests. Students disliked working on problems with no known solutions and this tendency increased over the semester. Students claimed that these problems were too challenging or a waste of time. Although the majority of students asserted that they revised their work, other measures of students revision do not support this finding. At the beginning of the semester most students claimed that they relied on external sources, such as teachers and tests, to evaluate their comprehension; however, by the end of the semester the majority of the students reported using metacognitive assessments to evaluate their understanding. As Scardamlia, Bereiter, and Lamon (1994) assert, students are adaptive and will use strategies that maximize performance while minimizing effort. While memorizing facts, rote problem solving, and avoiding progressive problem solving may pay off for students in traditional classrooms, students in collaborative knowledge construction environments must be encouraged to develop new learning strategies.

Students' self-reports of collaborative learning experiences were relatively low at the beginning of the semester, and did not increase by the end of the term. While applications such as Knowledge Forum can provide a platform for collaboration; teachers and students must understand the importance of collaboration in knowledge construction. Furthermore, assignments and evaluations need to be constructed that encourage interdependency and collaboration between students.

Computers Access, Experience and Attitudes

In general, students had positive attitudes toward the use of computers, had substantial experience with various computer applications, and the majority had regular access to computers and the Internet outside of school. However, our findings suggest gender differences in computer attitudes and experiences. These results are not surprising considering previous research findings in this area (see Volman, 1997). It has been suggested that online discourses are more democratic in nature (Hsi & Hoadley, 1997); however, students with less experience with technology may initially participate less in online discourses than other students. Simply introducing new hardware and software in to the classroom is inadequate in addressing gender differences in computing and further steps must be taken to ensure equity.

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How To, and Why?
What You Should Know About Course

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Abstract: Well over a hundred course and learning management systems are available on the market today. So the time and energy an institution might invest in researching
considerable. Unfortunately, many institutions seek out systems that are technically robust rather than
ten has less to
do with *learning* than *management*. The problem is that end-users, instructors and students, may be disinclined to use the system; all of the system's compelling administrative features will prove meaningless to them if the user interface makes learning cumbersome for students or if the system itself is so complicated that instructors develop strategies for avoidance. Because the success (or failure) of any learning management system is largely dependent upon the effective use instructors and students make of it, institutions would do well to consider—prior to system hunting, in fact—*how* they plan to train instructors and students to use the system and *why* they think such a system will benefit them in teaching and learning.

Introduction

This paper examines and illustrates pre-planning strategies for online learning programs that utilize course and learning management systems (CMSs and LMSs) and critiques the advantages and disadvantages of such systems according to certain basic criteria for effective, successful teaching and learning. It argues that teaching and learning concerns need to be at the forefront of system adoption decisions and system installations, especially in light of the cost—the educational cost of hampered teaching and learning, of course, but also the literal expense of the systems themselves. The Gartner Group suggests that institutions serving 10,000 users should expect to pay approximately $110,000 to install course and/or learning management systems and an additional $110,000 to use the systems (Aldrich, 2000).

Before the How and the Why

Well in advance of adopting an online course or learning management system, institutional administrators or program directors should take the time to assess faculty receptiveness to and facility with web-enhanced or online learning programs. This is a crucial preliminary step that is often missed--as is the step to assess students, though primarily for the kind of computer access they might have rather than their computer interest or competence levels. While a number of institutions perform market research to discern whether or not there is a genuine, fee-paying audience for the online education they might dispense, they engage in a good deal of guess work where faculty are concerned. Unfortunately, this "strategy" is far from atypical; offering the sun and the moon but proffering lumps of coal is the stuff of short-lived businesses and failed institutional programming everywhere. Internet-connected computers in every faculty member's office are merely a start, a good start, but hardly a means to an end. Most instructors and university professors are simply not ready to "set aside their roles as teachers and instead become designers of learning experiences, processes, and environments" (Dunderstadt, 1999, p.7). And in order to get ready, most of them will need some very good reasons. Already overburdened with heavy course loads, faculty are not exactly thrilled about expending hundreds of hours discovering how a new course or learning management system works; many remain reluctant to use a time-consuming or cumbersome technology and require proof of its educational value.

A proactive approach can go a long way in avoiding the "cart before the horse" syndrome, which emphasizes the purchase and installation of learning management systems "without providing sufficient funding for the staff learning required to win a reasonable return on the huge investments being made" (McKenzie, 2001). While assessing a school's need for course management software, one should also consider student requirements. Schools need to focus their efforts on uses of these systems that will be curriculum-rich, and not simply glitzy--what some call "powerpointlessness" (McKenzie, 2001).

How, Part I: A Simple Plan

The key to planning simply is planning introspectively. When people work with what they have and know, there aren't as many variables. Of course, a person must have what he thinks he has, or she must know what she thinks she knows in order to develop a plan that is sincere and sensible. An introspective individual does not think "I have a computer, so I'll start teaching online." She wonders, instead, about her knowledge of the necessary technologies, about how much time it will take to become an adept user of these technologies, about her own comfort level with change and experimentation, especially where live human subjects (students) are involved. An introspective individual considers his basic capacity and fitness. He asks, "Am I up to the

In order to facilitate a basic capacity and fitness, colleges and universities need to have a training facility of sorts, a support system in place for their teaching faculty as they learn their way around this new approach to teaching. Some effective strategies are as follows:

1. Establish a plan for professional development. Administrators and professors should draw up a new set of guidelines for professional development that include the new course or learning management system. Junior faculty should receive credit towards tenure for their work with the system, while more senior faculty should also be in a position to derive credit towards promotion for their participation.
2. Organize study groups. Instructors should meet frequently to discuss their triumphs with and concerns about the new system. Such study groups are ideal for problem solving and for brainstorming. Many instructors come out of these meetings with a new enthusiasm for the educational benefits of learning management tools.
3. Establish curriculum development teams. Instructors in the same academic area can cooperate to develop their own standards-based study units to incorporate into the online course. "Even though the focus of these activities might be student learning and curriculum, participants are 'learning by doing' - another basic tenet of adult learning" (McKenzie, 2001).
4. Recruit technology coaches. Newcomers to course management systems can derive an enormous benefit from working with a more seasoned partner. Schools should identify faculty who have developed a high degree of facility with the system, and ask them to make themselves available to help their colleagues gain a degree of comfort and confidence with the system as well. In the absence of such faculty, e-learning services companies might be contacted to assist with the training.

The best approach to faculty training involves blending the above strategies to help convince faculty that the system works, and that help is there if they need it. Many teaching faculty prefer to learn on their own, and are far less threatened by advice from their peers than they might be by a high-tech workshop filled with "techno-savvy" kids.

Why, Part I: Remembering the Basics of Teaching and Learning

Once the initial planning is completed, once an institution has discerned the general "will and skill" of its faculty to adopt and use new teaching and learning technologies and once it has established a support-system plan, administrators and program directors should understand that they are not likely to get their money's worth

-unfriendly." Effective tools should be able to reproduce and/or facilitate the teaching and learning experience of the typical college course. Thus it is vital to keep in mind the criteria of effective teaching and learning. Below is a chart detailing the course (CM) and learning management (LM) system features that can supplement, extend, and emulate the activities of teaching and learning.

Activities	Effective Teaching	Effective Learning	Optimizing CM/LM System Features
Reading/ Research	Instructors need to recognize and recommend adequate, if not excellent, course literature and resources.	Students need to be directed to adequate course literature and resources.	Systems with hypermedia-enabled library, database, annotation, categorization, and search features aid reading and research. Systems that display hypermedia clearly and make content easy to save and print are particularly effective.
Discussion	Instructors need to initiate and moderate class discussions.	Students need to discuss what they have learned with other students as well as their instructors.	Systems with asynchronous discussion forums, real-time AV and/or text chat, shared whiteboards, listservs, built-in email or email interfaces enhance, extend and capture discussion.
Lecture	Instructors need to disseminate their expertise on course subject matter in a timely, efficient manner.	Students need to access or avail themselves to expertise on course subject matter in a timely, efficient manner.	Systems accommodating hypermedia and streamed media can dispense video/audio lectures asynchronously or in real-time. Also web documents allow for immediate dissemination of and access to lecture notes and transcripts.
Assignments	Instructors need to announce, distribute, and acquire a variety of course assignments—to and from individuals and groups.	Students need to know about, access and submit course assignments.	Systems with hypermedia-enabled pages allow for immediate dissemination of and access to assignments; systems that simplify announcing assignments with features such as calendars, bulletin boards, and email alerts are particularly useful—as are systems that simplify or automate the assignment submission and review process. Also advantageous are systems that facilitate and track group work or group-produced assignments.
Examinations	Instructors need to assess student knowledge and abilities; they need to announce, distribute, and acquire course examinations—to and from individuals and groups.	Students need to know about, access and submit course examinations.	Systems with hypermedia-enabled test, survey, and test bank features allow for a wide range of test types; one that allow for restrictions (such as time limits) and programmable actions (such as randomized testing, automated grading, and alternate coursework based on score) can optimize the use of exams in teaching and learning.
Labs/ Practicums	Instructors need to supervise or gauge student skills or techniques in certain contexts at specific times.	Students need to practice and demonstrate skills or techniques they have learned in certain contexts at specific times.	Systems that offer real-time functions, such as AV or text chat, and interactive simulations, such as VRML and Shockwave media, can enhance or extend a traditional course features that are generally face-to-face or physical activities requiring and interactivity. Some developments in VR (virtual reality) programming look especially promising.
Relevance/ Timeliness	Instructors need to demonstrate the significance or relevance of concepts and theories.	Students need real-world examples; they need to appreciate the relevance of concepts and theories.	Systems that support a means of listing, displaying, linking to, or categorizing (by chronology, subject, author, etc.) relevant and timely events and news in a variety of media formats underscores the importance of course concepts and theories.
Consultation	Instructors need to meet with students privately to discuss individual concerns.	Students need the opportunity to meet with instructors privately to discuss their concerns.	Systems with an email interface or built-in email system, AV or text chat, or discussion forum allow for public, private, and group consultation.

Activities	Effective Teaching	Effective Learning	Optimizing CM/LM System Features
Feedback/ Grading	Instructors need to acquire feedback on their teaching from students as well as disseminate feedback on assignments, examinations, labs, and courses to the appropriate parties.	Students need prompt, clear feedback on assignments, examinations, labs, and courses.	Systems that include tests systems that automatically grade quizzes or organize survey data are particularly helpful, as are tools that include online grade books that store, calculate, and display grades for instructors and students. File transfer systems, email interfaces or built-in email systems also enhance the ease by which content can be assessed and returned.
Record/ Review	Instructors need to keep careful records of their work and their students' work.	Students need the opportunity to/facility for recording, studying and reviewing course content.	Tools that keep and display careful records and can graphically represent, extrapolate, export, archive, and/or recycle contents are advantageous. Also advantageous is the ease with which web content can be excerpted, downloaded, copied, and printed.

Note: The teaching and learning activities in this chart are loosely based on Neil Rudenstein's (1996) observations about the Web's potential in his special address at the Harvard Conference on the Internet and Society; also, a special thanks to Gail Darden (2001) at Eduprise, Inc. for her assistance in developing the "Optimizing CM/LM System Featur this table.

Why, Part II: Analyzing the Systems and Selling the Analysis

Online learning tends to be more self-directed than classroom learning, thus any system adopted must be easily adaptable to the style of the individual user, capable of producing "fast results." Neither instructors nor students want to be faced with hours of pointless searching in order to figure out how to use a new tool or how to find their documents. In light of the expense involved in setting up an institution with a new course or learning management system, a thorough examination of what that product offers is definitely in order. Keeping in mind the criteria of effective teaching and learning, and how these criteria are represented by available learning systems, one must perform a thorough exploration of tool features in order to satisfy the basic needs of instructors and students.

Course Tools	Collaboration Tools	Assessment Tools	Student/Management Tools
Content hub Announcements Index/Homepage Calendar Syllabus generator Built-in HTML editor Auto-linking (text) Auto-embedding (media) Context-sensitive help Content search Content upload	Discussion Forum --better optimized by search, compile, time/date stamp, attachment, archive, moderator, and anonymous post features. Email --built-in or email interface systems Real-time chat --better optimized by archive, multiple room, private messaging, AV, browsers, and whiteboard features.	Multiple question types Hypermedia support Automated grading Automated and pre-programmable feedback Test bank creation Randomized testing Surveying and statistical extrapolation Offline testing Regarding, grade changes Restrictions (timed, password protected, multiple attempts, availability) Online grade book	Grade viewing Student websites Content bookmarking Enrollment functions, including batch and individual uploads Student tracking Webpage tracking Read and unread message or submission alerts Annotation capability Change profile Link to offline content or CD-ROM

Note: The CM/LM system categories and features described in this chart are based upon a working document created by Jane Harris (2000) at Eduprise, Inc.

Examining CM/LM system features in light of how those features may augment teaching and learning will go a long way in assisting institutional decisions about which system is best for the institution. Indeed, a course or learning management system is not necessarily useful or cost-effective if what it does best is exchange data with the university system's back-end (such as Datatel, PeopleSoft, etc). Indeed, if it doesn't facilitate the data exchanging that instructors and students engage in on a daily basis, there won't be much to send, in the end, to the back-end. Finally, instructors are not easily sold on a product that puts the work of the university (teaching and learning) at risk in the name of a more efficient administrative data flow. They will, however, buy into a system that streamlines their efforts, maximizing their teaching while augmenting and enhancing student learning.

How, Part II: Revising the Plan

Regardless of the system ultimately adopted by an institution, a new set of instructor competencies will result from its implementation. Except for the case of the absolute beginner, some of these skills will already be present, i.e. the ability to open a program, the ability to work with word processing software, etc. Others will be new and specific to the chosen system--whether one needs to know how to develop online tests depends upon whether the system in place possesses a testing feature, for example.

In many cases, however, instructors will not make use of all the tools available in any one system. Certainly the instructor who does not wish to utilize an online discussion forum has no need to learn how to use one properly. Likewise, the instructor who does not intend to insert links into his online text has no need to be familiar with HTML. Developing a set of training goals or competencies can be complicated by the needs of the instructors, so they are worth careful consideration. Ultimately administrators and program directors will have to decide to what extent the training plans can be customized, and then integrate those goals and competencies into the simple or first-stage plan. In addition to professional development mentors, study groups, curriculum development teams, technology coaches, another useful approach to faculty training involves a sort of "show-and-tell" session, in which new users are introduced to those more familiar to the system. The more seasoned users can then show off their work, and discuss teaching approaches and system features that have proven to be particularly effective for them. Individual instructors can then determine, based on their own pedagogical approach, which features will be the most useful to them, and subsequently avail themselves of the training necessary to gain a level of comfort with these features.

Conclusion

Educational administrators and program directors have a great deal of information to sift through when investigating course and learning management systems. It is, however, in their best interest to take care in the process, and avoid "jumping on" the first or next "great thing" that comes along. Additionally, what might appear to be the best system to the administrator, may have so many bells and whistles that it is too cumbersome for faculty and students to use--what results are creative avoidance strategies--both on the part of the students and the instructors. While many teachers wish there were magic elves who could put their online courses together for them, or even a lowly graduate assistant who would be willing to spend a few hours a week typing material, all but a lucky few will be spared; most will end up doing this work themselves. It therefore behooves administrators and directors to keep in mind the level of "user-friendliness" in any course management system being considered. In addition, administrators should be aware that many instructors will balk at using online course materials if they do not stand to gain any recognition or reward for the time taken to learn how to work with the system and to prepare their materials for online dissemination.

Moreover, administrators should be talking to teaching faculty well before any system comes under consideration. Faculty want to have a say in which system is ultimately chosen, and may well balk at using one that, though glitzy and shiny, is impossible to use and is pedagogically unsound. Teaching faculty must also have ample opportunities to learn how to use the system. At the University of South Carolina, for example, we have found that many faculty hesitate to attend large, campus-wide Blackboard workshops, preferring instead to attend smaller, intra-departmental training sessions that are tailored to their specific instructional preferences.

In these smaller settings, faculty are able to work with faculty who teach in areas closer to their own, and whose ideas they can more easily adopt and adapt to suit their own needs.

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The Digital Backpack: Issues in the Development and Implementation of a Digital Portfolio

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Abstract: Despite the fact that moving information around in the networked economy is generally accepted as being easy, it is still surprisingly difficult to move an individual's structured knowledge across time and place in ways that are useful with the context of the educational institution. Using a developmental portfolio to assist students in demonstrating evidence of their learning over time – from course to course, semester to semester, and on into their teaching career – makes pedagogical sense. However, this rarely takes place because of the challenge of negotiating compatibility of media formats or software applications, conflicts and redundancies in curriculum and instructional strategies of faculty. With the creation of the Digital Backpack, lessons and other student-related artifacts can be ported to a classroom setting. Student teachers who become employed have at their disposal, a set of tools that allows them to be a better teacher.

The Digital Backpack: Issues in the Development and Implementation of a Digital Portfolio

One of the roots of the word "portfolio" is "port," the same Latin root that gives us "portable." But the professional development portfolios of pre-service teachers, which at their best are the tools students use to structure and refine knowledge during the course of their education, have become anything but "portable." In fact, they seldom are carried away from the institution that requires students to produce them.

It has been estimated that if you collected all the portfolios produced in one year from all the teachers who are certified by colleges and universities in the area of St. Louis, Missouri, in the United States – or about 750 people, the pile would reach the height of the Gateway Arch, a 630-foot monument. At the University of Missouri--St. Louis (UM-St. Louis), these documents need to be assessed by faculty, and this means physically moving them to a room where faculty do the assessments. The idea of "portability" ceases to have much to do with an individual's evidence of knowledge and has everything to do with carting these documents from place to place.

Despite the fact that moving information around in the "networked economy" is generally accepted as being easy, it is still surprisingly difficult to move evidence of an individual's knowledge across time and place in ways that are useful within the context of an educational institution. Using a developmental portfolio to assist students in structuring evidence of their learning over time – from course to course, semester to semester, and on into their teaching career – makes pedagogical sense. However, this rarely takes place because of the challenge of negotiating compatibility of media formats or software applications, conflicts and redundancies in curriculum and instructional strategies of faculty.

The State of Missouri requires students to create and submit portfolios for certification. UM-St. Louis requires portfolios from every student in order to complete certification. The student portfolios contain artifacts – papers, lesson plans, videos, photographs, recordings, etc. -- for the 10 teaching areas: (1) Subject Matter, (2) Human Development and Learning, (3) Individualization and Diversity, (4) Curriculum/Performance Standards, (5) Instructional Strategies (6) Motivation and Management, (7) Communication Skills, (8) Assessment, (9) Reflective Practitioner, and (10) Relationships. Students are expected to provide evidence that demonstrates the extent to which they have met each of the standards. The materials presented in the portfolio are produced in the education classes and arts and sciences classes taken by students during their course of study. Students are expected to save the materials for presentation in the portfolio. Each of the standards has three levels of competence: (1) developing, (2) passing, and (3) exceeds expectations.

The process at UM-St. Louis is that three faculty assess the portfolios according to ten state mandated criteria. A number score is given each criterion and comments are made. This creates three pieces of paper. The scores from these are averaged and the comments noted. Each student is notified of the average scores they received for each criterion and a summary of the faculty comments is attached. The work that goes into entering scores and copying comments is currently in serious need of automation. While some states may have more sophisticated systems for scoring, the fact remains that digital portfolios and digitized scoring could provide a more efficient and improved method for working with portfolios.

Many of the current digital portfolio applications by universities focus on a visual presentation of the portfolio as opposed to a presentation of the portfolio's content. Energy is spent on making attractive web pages to contain the artifacts or links to the artifacts. These presentations focus on the software used to design the web page, and the visual presentation itself. Too often, they are nothing more than a, "how to make the web page portfolio." The implementation of the Digital Portfolio or Digital Backpack at UM--St. Louis is a driven by the need to present the content of the evidence of the student's learning.

The Technology and Learning Center at the College of Education at UM--St. Louis has been experimenting with several object oriented document management applications and courseware applications since November 1999. Figure 1 contains a snapshot of our prototype portfolio structure based on Missouri standards.

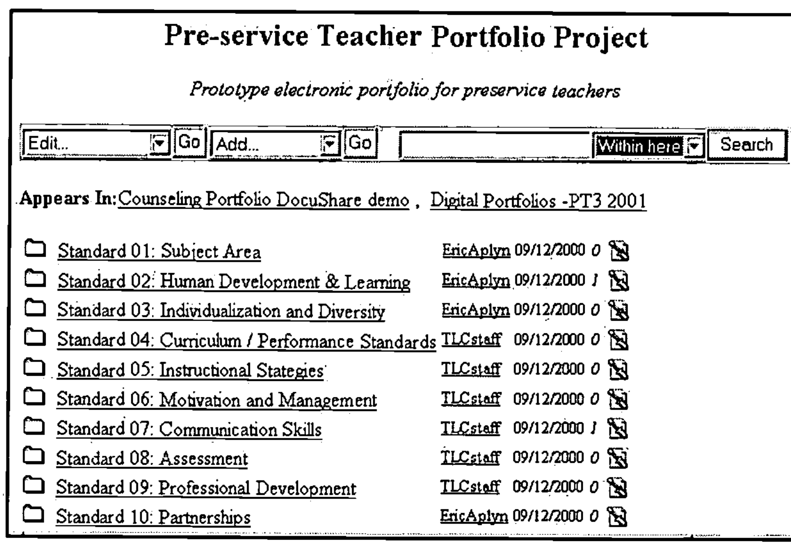

Figure 1: Prototype portfolio structure

The current design of the Digital Backpack at the University calls for use of Xerox Corporation's DocuShare product. Using only a web browser, users can save, access, organize and manage documents and attach information to documents (e.g. reflections, observations). The system is easy to use and resembles familiar file management environments, like Windows Explorer and Mac Finder. The staff at the Technology and Learning Center at UM--St. Louis believes that DocuShare is the best platform for the digital portfolio design because it is fully customizable, has a relatively open architecture on which we can easily build and is entirely native to the Web. The basic functionality of DocuShare allows users to upload and download files, organize them into collections, and search -- all through a browser.

The next stage of development of the software will include a portfolio structure creator tool that enables the university to designate the portfolio structure for any group of users. Included will be the ability to generate the new portfolio structure for each user automatically, create user accounts automatically from the university's databases, and allow pre-service teachers to select, seal (make "read only") and submit a portfolio to a review group.

While placing artifacts in the Digital Backpack is relatively easy, a need exists to have students place all artifacts produced while studying to be a teacher in the Digital Backpack. Students complete many assignments in a digital format that can be easily included. However, many faculty make assignments without reference to digitization and without reference to placement in the student's portfolio. Thus, the situation that currently exists is a "mad dash" by students to complete their portfolios in the last year, as opposed to an orderly accumulation of digital artifacts. By working with the sixty-five full-time faculty and more than one hundred part-time faculty, the Technology and Learning Center is proposing to help faculty members integrate technology into their classes more fully, thereby creating a process whereby students have a wealth of artifacts to choose among for their final portfolio presentation for certification.

An additional setting. Student teachers who become employed have at their disposal, a set of tools that allows them instantly to be a better advantage of the Digital Backpack is its portability to the classroom once student teachers have found a job. They can use materials with which they have familiarity. This heightens the potential for their being more comfortable in that first often difficult year of teaching. As the teach, these teachers can add to their portfolios. The Digital Backpack thus allows for continuity from their university learning experience to their professional teaching experience.

The potential for use of the Digital Backpack is being implemented and explored at UM--St. Louis. The overarching principle of a backpack is that it contains the evidence necessary for demonstrating competence, evaluating work, teaching and sharing information. It has the potential to be a powerful tool that integrates the activities of the student, the university faculty and the school. With an easy-to-use document management system, the Digital Backpack also has the potential to assist in making a long-term connection between the student and the university.

MAMBO - Experiences from developing, implementing, and evaluating a multimedia-enhanced distant education learning system

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Abstract: During the course of the MAMBO-Project at the Bauhaus University in Weimar, Germany, a multimedia-enhanced distant education course in the field of water and environment has been developed. This included the creation of multimedia elements, restructuring of existing content, development and implementation of a XML-based content management system prototype for cross-media publishing and development of an internet technology based learning environment. The resulting course has been evaluated by an independent team of psychologists.

Introduction

Between January 1998 and June 2000, it has been the authors' job to implement one conventional paper based courses for distant vocational training in the field of water and environment offered in Weimar into a multimedia-enhanced environment for research purposes, and to perform an evaluation on the final product.

The aim of our work was to show if and how the use of multimedia elements in such an environment could add quality to the learning process. Furthermore, we wanted to find out how the production of suitable course material could be achieved and imbedded in an average German university environment.

Fields of work

The project work can be separated into the three parts of implementation:

1. Structuring and formatting of text: The paper-based material, originally being composed in different releases of MS Word, and containing text, 200 figures, and 80 equations, had to be reorganised. Handling and publication of such large amounts of non-reusable content has been described in previous work [Hofmann99], where we explain the reasons for developing a for our purposes "ideal" workflow using SGML/XML and a CMS.

2. Creation of multimedia elements: We redrew all 200 figures to get the best results for printouts as for viewing on the screen [Shneiderman98, p. 336-342]. We built different parts of a sewage plant in 3D Studio Max. Out of those files we created roughly 30 animations, 20 VRML-files, 20 figures, icons, and a video film of 18 minutes length. As an add-on, we created a software for process simulation of a waste water treatment plant.

3. Integration of old and new: The conventional material and the new multimedia material was integrated in one interface. We decided to use a web browser as front-end, to be independent from the hardware platform and the operating system. In the test case the students had to be enabled to work at their local computer at home with an Apache web server and Netscape Communicator. This allows them to access the content from a CD-ROM in several manners (such as the original sequential paper based version, a different, hypermeshed multimedia version, or a screen or print version of a PDF-file), but also to use several administrative functions like a history, notes, or search.

Multimedia Production

The production of each sort of multimedia element is different in itself, but might also be different for other environments with other constraints. The common factor for all elements is the complex process of their production involving different groups of experts. A standardised workflow has to be developed. The modelling of strongly computer-related objects like for newly created 3D-objects can not be created and presented on the traditional way (paper based). A benefit of 3D-objects is the re-using of different elements out of one model (pictures, animation VRML). This requires modularisation and standardisation, as those elements are based on different models of computing [Regenbrecht00, p. 19].

Therefore, the general phases in the workflow of this example can be separated in building, animation, and export. Different groups of experts have to work together.

Getting deeper into the example, in order to create an animation, the author (or teacher) stands for the didactical goal and by what content to achieve that goal. In a next step, detailed information has to be developed by somebody allowing a modeller to create a 3D-model fitting the needs of the teacher, the animation, the VRML to be exported, and the graphical display of all. In a parallel process, the story has to be given to a writer, who translates it into text which can be read out loud by a speaker and be recorded. This recording is used as a basis on which to create an animation by either the modeller or someone else, then the text is spoken again by a professional speaker. After doing some sound editing, the sound file and the animation pass to someone who packs them together and compressing picture and sound as needed. Controlling mechanisms between the single steps have to ensure the quality of the final product.

Consequences

Experiences from our work have shown, that even though different processes have been laid out at the beginning and followed rather closely by most members, a limit of practicability is reached rather soon. In a distributed environment like ours, it would be very desirable to have a distributed framework taking care of the connections between different files, description of content in metadata, and securing transactions with the ability to roll back to an earlier state. It would further be desirable to have such a framework implemented in a manner, which allows non experts to adapt its functionality to their needs without having to rewrite the whole thing. On the other hand we are aware of the dangers resulting from such an ease of use in changing such mechanisms.

On another level, teachers and authors have to get acquainted with the new possibilities and chances, but also the pitfalls coming along with new media. By what we know from the field of psychology and didactic, there is still research being done on how to best use multimedia for learning [http://www.vgk.de/research.html]. Experiences gained from that will be adapted by teachers and authors in the future, to create and use teaching material better suited for both their own and their students need. This again asks for tools to allow the authors to concentrate on their work of providing and structuring information instead of becoming computer experts.

Benefit

The results from the evaluation of our course material show that the application of developed structuring rules to existing text material leads to a text hierarchy which the students found to be easier to navigate in [Schubert01, Appendix A]. Newly created multimedia elements were accepted as an important source of knowledge (illustrative, informative) and therefore very helpful, especially in the beginning of studies. Students did not want to do without them, nominated them explicitly as an added value of MAMBO and recommended additional animations.

On the course production side, the workflow of creating new course material has been adapted as a result of our work. The higher quality and easier reusability of figures due to following documented and standardised creation processes are noted as benefits from this adaptation. Currently, all existing material is transformed and restructured to allow for automated processing and easy platform independent publishing.

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The Learning Software Awards Competition

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The University of Minnesota has sponsored a second competition to recognize the design of innovative educational software. The competition was open to professional and not-for-profit educational software designers in such areas as higher education, K-12 education and commercial training. Winners of the second competition were announced in late April. Finals judges were Dr. John Bransford of Vanderbilt University, Dr. Brent Wilson of the University of Denver, and Dr. Peg Robyler of the University of West Georgia. Over a hundred other individuals have served as preliminary judges.

One of the competition's goals is to establish a bank of exemplary educational software that can be examined by designers and students of educational software design. We propose to present the results of the competition at the conference and show the winners.

The presentation will present some of the exemplary work in the field; discuss how technology can successfully be used in the classroom; and why it is worthwhile to take the time and take the risk. Observations of the judging and competition process will be presented as well as future plans for the competition as an annually recurring event. Video of the award ceremony and judges interviews will be available. Winners of the competition will be demonstrated and observations from the process and the pool of winners will be presented.

Media and Cognition: An Imaginary Journey

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There are three broad steps or evolutions in current educational theory as it relates to computers and cognition. These three descriptions of computers in education and cognition include: that computers and technology act as a delivery mechanisms which transmit information without regard to or changing the content. The second understanding is one which recognizes technology as a generative mechanism, one which acts as a 'tool', as one uses a pencil, just faster. And finally, there is an understanding that technology and computers can exist as media in and of themselves, a place for creation, shaping our thoughts and the nature of the results of our exploration.

Let us build on our own learning, through our own imaginations, as a means to investigate the idea of media and cognition.

Imagine your own educational experience. Picture in your mind's eye the best teacher you had throughout your educational experience. Was that teacher solely concerned with the information delivered? Did that teacher vary substantially in method with other teachers you have experienced? Now picture the worst teacher you have had; probably that teacher focused or spent inordinate amounts of time and effort in getting the facts straight and covering the content.

This is a presentation on the concepts concerning media and its use in thought; cognition and media.. It is an exploration of our use of new media and technology as a means to thought, and by that nature, involves other means beyond the verbal presentation of a paper; it involves visual referrals to supporting quotations and directed imaginations to the participants own history of cognitive development. Viewers in the poster session will be asked to answer a series of questions about their own thought patterns and educational history; these responses will build the poster presentation and the data for the paper.

TRIANGLE: A Multi-Media test-bed for examining incidental learning, motivation and the Tamagotchi-Effect within a Game-Show like Computer Based Learning Module

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Abstract: At first sight, "TRIANGLE" appears to be just another piece of learning software but it is much more than this, it is an experimental test-bed for examining motivational factors in computer based training. Such a multi-media application derives its power of attraction from the quality of the interface design and the multi-medial content. Used as a trial on a defined target group of K12-students this learning module returns results on three basic effects; motivation, incidental learning and what we term a "Tamagotchi-Effect" within a Game-Show-Setting. Depending on how much an avatar has learned, it can answer questions for the player in the Game-Show. The avatar serves as a personal "Tamagotchi". Mathematics was chosen because it is rarely the favorite subject of K12-students at the age of 14-16, therefore it is ideal for testing motivational factors.

1. Introduction

A large variety of institutions are currently supporting Web Based Training (WBT) and Computer Supported Learning (CSL) as the future solution for gaining knowledge and becoming "fit" for the growing requirements of jobs in any field (cf. Rozell & Gardner, 2000). Even governments themselves and the European Union seem to see the future of education systems in promoting computer based training as an alternative to the common learning techniques used today (cf. Holzinger, 2000a, [W01]).

Coming up with a vast amount of ideas and concepts, most programmers of educational software appear not to have tested their products beyond interface usability aspects. With "TRIANGLE" [W02] we bring a specialized learning module, implementing some ideas and motivational techniques of the state of the art multimedia development. While appearing, at first sight, to be just another piece of educational software, the purpose is to provide a test-bed for examining some new principles and ideas.

The module was originally based on the work for the masters thesis of two students of Graz University of Technology, where they developed and implemented a Game-Show-like web based training environment named "VRFriends". Details and both theses are available on [W03]. The basic Idea of "VRFriends" is to learn by playing a quiz show. A virtual partner reacts on the players input, for example with anger, if all the answers are wrong, or happiness if the player wins (cf. Holzinger & Maurer, 1999). When analyzing the pros and cons of this concept, we detected the necessity of testing this learning module within its own target group (K12-students).

2. Concept of "TRIANGLE"

The concept of "TRIANGLE" is to provide a motivating computer game, where players need to gain knowledge in order to win. But more than that, even if the player is not willing to learn, nevertheless he may do so by playing the Game-Show and remembering the answers to given questions. In order to test the efficiency of the methods of incidental learning and to measure degrees of motivation, there are some demands on the learning module:

Linearity and time limits: Test-persons must be forced to play the whole module without having too great scope in controlling the game flow, also, there must be a time limit for the whole game.

Diversity: To identify oneself with the avatars in the game, the player must have the option to choose among a diversity of characters.

Attractiveness: Multi-medial attractiveness is of extremely high importance. The game "must rock", has to "be cool" in order to motivate. This is the most difficult part, because it also sets focus on hardware requirements (cf. Holzinger, 2000d), which would not commonly be the purpose of learning software (see fig.1).

Measurability: The module itself has to provide values of some kind, which can be measured and - more important - compared among different test-persons.

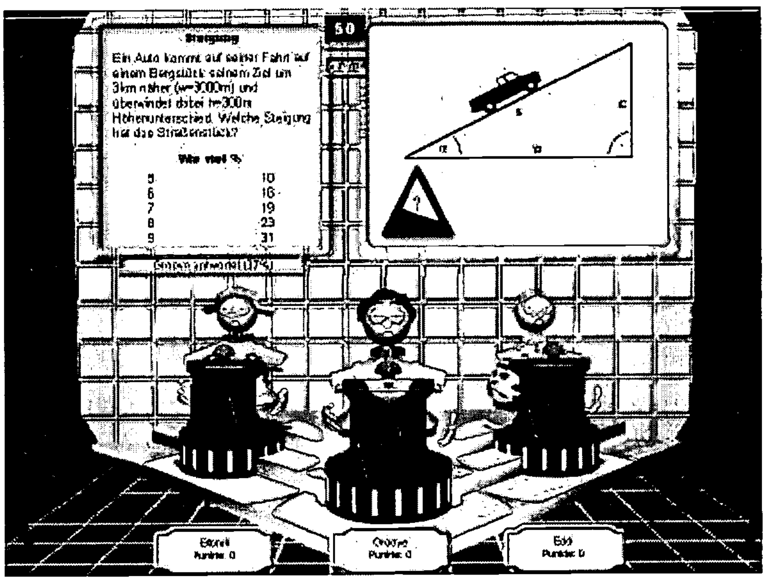

Fig.1 The "Game-Show"

3. Technological Background

3.1. Hardware Aspects and Software Considerations

When sending questionnaires to the schools which offered to be test partner in this project, we realized that the different hardware status is a great problem in creating a homogeneous testing environment. So we decided to limit the groups of test-persons (K12-students) to 10 and let them "play" on notebooks with headsets, in order to minimize disturbing influences and to have equal conditions for every group in any school.

While "VR-Friends" was strictly web based, we wanted "TRIANGLE" to be a state of the art multimedia, which raised the requirements for a web based module to a very high bandwidth. As the motivational aspects had precedence over public availability, and the amount of time invested in programming should not exceed the cost of testing and research of retrieved data, we decided to use a standard multimedia authoring tool. Our choice was the "Director 8" from Macromedia (cf. Endres-Niggemeyer, 2000). Additionally this software is made for publishing in internet [W05]. The current version can easily be converted to an internet application, by making use of the "Shockwave" plug-in, which comes with most common internet browsers.

3.2. Open Architecture

Another requirement which we kept from "VR Friends" is an open architecture, which allows anybody to modify contents and examples of the learning module. In the current version this is realized by using a very simple hypertext format for the learning material and Game-Show questions, including multi-medial content organized in a strict directory and name system.

4. Theoretical Background

A big problem in successful learning is keeping the motivation for continued learning. This problem is most crucial if the material to be learnt is difficult to understand or even worse, the learners do not have much personal interest in the material but have to learn it for some "external" reason. In learning as such we have on the one hand intentional learning - used in traditional computer assisted learning systems - on the other we have incidental learning (cf. Holzinger & Maurer, 1999).

4.1. Why incidental learning is important

In traditional classroom learning as well as in traditional computer assisted learning sessions intentional learning dominates. But not all learning is intentional, a fact often overlooked. Game-Shows are an ideal example. Also the concept of avatars and agents (Wang, 1997; Lieberman, 1998). Many people are of the opinion that unless learning is planned, setting out to learn some specific, one really hasn't learned anything. Worse, many people believe that unless learning opportunities are offered by some institution, the learning is either of lower quality or, possibly, not learning at all. According to Lankard (1995) incidental learning serendipitously increases particular knowledge, skills, or understanding. Incidental learning, then, includes such things as learning from mistakes, learning by doing, learning through networking, learning from a series of interpersonal experiments. It is clearly obvious that incidental learning is particularly powerful for children. And certainly nobody would deny that children up to the age of six are learning quite a lot - their mother tongue for instance. But at the age of six incidental learning looses its importance and is replaced by a "sit down, listen and repeat" approach (Anderson, 1985). Standard research experiments in these fields include examples such as Anderson and Bower (1972), where one group of the testing persons was informed that afterwards there would be a memory test, and the other group was not. The intentional group recalled only 48,9 % of sentences while the incidental group recalled with 56,1 %, significantly more. Interviews later on showed that the intentional learners performed less well because many of them were busy employing poor memorization strategies, like saying the sentence over and over again to themselves. Many students are hampered in intentional learning situations by their mistaken ideas about memory and memorization strategies.

4.2. Motivation

According to Brehm & Self (1989) intensity of motivation is reflected by changes in the sympathetic nervous system. Increasing motivation is dependent on increasing arousal, which - as a psychological concept - refers to the degree of alertness, awareness, vigilance, or wakefulness (Robbins, 1997). It varies from very low values (coma or sleep) to very high values (panic or extreme anxiety), however the relationship between arousal and intensity of motivation is not linear. This relationship is called the Yerkes-Dodson-Law, first described by Yerkes and Dodson (1908), which points out that there is an optimal level of arousal for the most effective learning behaviour (Holzinger, 2000b). The chance of the VR-Friends concept is to keep arousal of the students as often as possible in optimal areas to get best learning performance. Berlyne (1965) pointed out, that one of the most important sources of arousal are stimulation, meaningfulness, and for VR-Friends particularly relevant, the novelty of situations, and the surprises that come with them. A further interesting cognitive factor is described by Brehm & Self (1989): Motivational arousal may be a function of the extent to which the learner assumes personal responsibility for the outcomes of behaviour. That is directly connected with something we call the "Tamagotchi-Effect":

4.3. Tamagotchi-Effect

Since Tamagotchis [W04] became a worldwide success in 1997, experts have been wondering why these Tamagotchis have been successful in such an unexpected way. It would be very interesting if these virtual beings could be used for other, possibly, more useful things. As a result an idea emerged to develop a completely new learning software that could considerably improve the quality of learning with computers by using such effects. This approach was called "VR-Friends" and should represent some sort of virtual learning-companion based on the Internet. VR-Friends differ in three ways from original Tamagotchis. They are kept happy if their owners answer questions correctly, they are implemented in software, not in hardware and they live on the web.

5. Implementation

5.1. Incidental Learning

One of the main theses to be tested with "TRIANGLE" is the efficiency of incidental learning. The primary knowledge imparted in the game is mathematical (the content is specialized on the triangle, hence the name). But an equal amount of additional knowledge is involved. In the training phase these two areas of knowledge are not kept separate, although internally there is a strict distinction between mathematical knowledge and additional facts, meaning that the avatar also gains only mathematical knowledge, if the player only retrieves pages with primary content.

5.2. The Tamagotchi Effect

The virtual companion is implemented as a sequence of pre-rendered video files. In the training phase, the avatar rests on the lower right side of the screen, reading in a book, looking around, talking to the player and reacting to screen changes (see Fig.1). This is implemented by an event driven system. At every event occurrence a video sequence is added to a animation queue. For greater diversity there are up to three different video sequences for the same event. This avoids repetitions and makes the avatar more "alive". In the Game-Show the chosen avatar is one of three candidates playing. Depending on the correctness of the answer it is delighted or sad.

But the most important fact about the Tamagotchi is the ability to learn with the player and to help in the Game-Show. This is implemented in a very simple, but effective manner. A routine calculates the time required for reading the whole page, based on the number of words, after about 70% of this time passed without a change to another page, the avatar "learns" this part of the material. Depending on how much the avatar has learned, it can answer questions for the player in the Game-Show. So it is up to the player, the avatar itself is his "Tamagotchi".

5.3. Motivational Factors

A multi-media application like "TRIANGLE" derives its power of attraction from the quality of the interface design and the multi-medial content. On the other hand, the interface itself has to be quite functional, as it serves as a replacement for common learning environments. While learning, the player deals with a text area ("the book"), a multimedia content window ("the blackboard") and some navigational elements. The virtual companion also has a very prominent place on the screen and is always present and in motion. The training phase could bore some students, so the avatar (the learning partner) comes up with witty comments, creating a moment of motivation to continue learning in order to see all the funny comments. The primary motivational element is the Game-Show. Here the player can show what he has learned and win points by answering correct questions. So the training appears to be only preparation for the Game-Show, while really being the main purpose of the whole module. In addition to the multi-medial components of the interface, animated jingles introduce the player to the phases of the game. Music is not a carrying element throughout the program, nevertheless it fills the game show with ambience.

5.4. Open Architecture

An open architecture for the content data structure was a basic requirement. "TRIANGLE" is planned as a prototype of learning software, which provides multi-medial fun and edutainment capabilities while being open to everyone who likes to impart any kind of knowledge to students. Therefore a very simple hypertext format was developed. There are two types of hypertext: content and examples, both in plain text format and divided in sections initiated by defined tags. The examples contain the question title, the question, the correct answer and the maximum points. Content consists of a head, any numbered tags and the information itself. In the text hyperlinks can be set by formatting a word in a certain structure. The target of a hyperlink is simply the filename of another text file, similar to HTML. In addition multimedia content can be provided by tags pointing at bitmaps or video files in the corresponding directories, and also the witty comments of the avatar are defined in the content hypertext files. Considering this simple data structure one can see that it would be easy to provide a simple content editor for anyone who likes to adapt the module for his learning material.

6. Experimental Setting

6.1. Target Group

The target group for testing our module were K12-students. There were a couple of reasons for this choice. The students were aged between 14 and 16 and they already had some experience in using computers. The mathematics curriculum is independent of the school type, which made it possible to test the module without the necessity of producing various versions with different contents. Mathematics was chosen because it is rarely the favorite subject of students at this age, therefore it is ideal for testing motivational factors (cf. Boaler, 2000).

6.2. Classroom settings

Groups of ten students were placed in a classroom each equipped with a notebook computer. The first questionnaire collected data about motivation, mood, readiness etc. Then the students played the learning module in a time limited (20 minutes) training process, in which the students were allowed two attempts to win the Game-Show with a maximum of points. During the game the module collected data about the user behavior. A further test of motivation showed the students' enjoyment when playing the game (and learning). Finally a questionnaire collected general data.

6.3. Data Provided by Module

The module itself collected a variety of data, some for reasons of user interface testing, others required for motivation tests. The program saved the data in an external file, which was easily transferred to a statistical program (SPSS). The collected data contained: the chosen avatar, the number of correctly answered questions (divided into mathematical and additional knowledge), the intensity of content study (by measuring time in relation to the amount of text on a page), the number of hyperlinks followed, pictures watched etc. Most of this data were used to control questionnaire results.

7. Results

The first questionnaire measured the motivation according to the AMS-Scale (Gjesme & Nygaard, 1970). The first 15 items determining the performance of motivation (expectation and success). The remaining items measuring the unsuccessfulness and fear. Thus, the first questionnaire showed the level of motivation before starting "TRIANGLE". Our program delivered the values during the game by storing all links used in log-files. The second questionnaire set, after playing with "TRIANGLE", delivered a standard of comparison to the first test. Finally, a special test showed the adjustment in attitude to mathematics in school.

7.1. Thesis 1: Incidental Learning

The results of the case study showed that additional factual knowledge provided by hyperlinks was also memorized. Supported by carefully selected multimedia elements to serve as "anchor points" the learner builds a network of facts - a mind map of the knowledge contained in hypertext. Since there was very little probability that the students were acquainted with the material before their participation the correctly answered questions serve as prove for the success of incidental learning.

7.2. Thesis 2: Tamagotchi Effect

Although the students enjoyed the interaction with the virtual partner in the program, no positive effect was measured in the case study. There were no significant differences in the motivation and success of the two groups using different versions of "TRIANGLE". The overall motivation was very high and the avatar or it's absence did not influence on the groups enjoyment. The original concept of the "VR-friends" could not be carried out. Due to the low level artificial intelligence, time and technical limitations the personal interaction was weaker as planned. By further experimentation more versions should be used.

7.3. Thesis 3: Motivation

The case study showed a high level of basic motivation among the students using "TRIANGLE". Whether, due to real interest in the program or the novelty of something new is difficult to judge: most students enjoyed the game show. Several students reacted emotionally to success and failure, showing that they were really "in the game". These motivational factors can be used to intensity previously learned material. Multimedia elements received a higher level of acceptance than the classical education methods. An advantage of this multi medial software was proved by the correlation between the number of correct answers and the media elements participated in.

8. Links

[W01] http://europa.eu.int/comm/education/elearning/index.html (eLearning Initiative of the EU, last visited th)
[W0 28 March 2001
- - - last visited 28 March 2001)
[W04] http://www.urban.ne.jp/home/jun/tama (- - ge, Jun Matsuda, last visited 24 Oct. 2000)
[W05] http://www.macromedia.com/software/director (Director 8, last visited 25th Oct. 2000)

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Multimedia Learning Systems based on IEEE Learning Object Metadata (LOM)

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Abstract: One of the hottest topics in recent information systems and computer science is metadata. Learning Object Metadata (LOM) seems to be a very powerful mechanism to represent metadata, because of the great variety of LOM Objects. This is one of the reason why the LOM Standard is cited in a lot of projects in the field of eLearning Systems. We came to the conclusion that this multi media learning (MML) related technology could enhance conventional learning systems. Some applications have many possibilities to interpret and use the information of the Learning Object Metadata base schema. One of the disadvantages of the very complex metadata-structure is the fact, that it is going to be difficult or confusing to determine the relevant elements for a satisfying result. Therefore a Learning System based on the LOM standard is expected to provide an intuitive user interface that supports the user in getting good results. This article describes why metadata is needed, discusses the development from Dublin Core, Gateway to Educational Materials (GEM) and Warwick-Framework to the IEEE LOM and presents four examples of successful implemented systems.

1. Introduction

1.1. What is metadata?

Metadata is commonly described as being "Data about data", which provides a means by which the multimedia's semantics can be described in a structured fashion for use by various applications. More technically Metadata is standardized information to describe digital information resources (cf. Dorner, 2000). Metadata created only for use by a single application goes against Searchability, Extensibility, Reusability and Scalability. Required is a standard that everyone conforms to for the exchange and use of media. But even this may not be enough, especially for interoperability issues e.g. spoken language independency.

1.2. Why is educational metadata needed?

Traditional search techniques are user-directed, manual and often time-consuming tasks. The reason for creating metadata, from the perspective of the provider of learning material, is to improve the possibilities of document retrieval (especially the search precision) as well as to support control and management of collections. But there is still another problem remaining: Digital documents with their abundance of different formats and control measures might not always be usable directly by everyone. The format might be unreadable, the content can be encrypted, even prohibited or only permitted after payment. The document might be large, difficult or time consuming to access etc. Especially if multimedia documents are used in education like audio and video, metadata is extremely helpful in managing the multimedia learning content. A solution for all those cases could be metadata which supports the users decision process. Such metadata, necessary to describe educational material homogenous, could be e.g. language, title, catalogue numbers, date, format etc, and in the case of audio and video a time-based documentation of the audio/video image content on a layered basis depending on the documentation focus.

As these multimedia objects typically get larger and larger, a manual metadata documentation becomes very expensive and is not practical anymore. In these cases content management systems (CMS) can support automatic extraction of metadata with audio/video analysis processes that e.g. separate clips into scenes or extract relevant key-frames (cf. Kleinberger, Schrepfer, Holzinger, Müller 2000).

1.3. Why are standards needed?

Metadata is information about an object and as the number of objects increases, the lack of information or metadata about objects has produced a critical and fundamental constraint on our ability to discover, manage and use objects. Only standards might address this problem by defining a structure for interoperable descriptions of learning objects. According to Wantz & Miller (1998) there are four remarkable efforts concerning education via the Web:

1.4. Dublin Core

Emerging from the field of digital cataloguing the Dublin Core defines a small, core set of metadata attributes for describing features of generic Web resources [W01, W02]. This core set of metadata is given in the following XML-notation which can be a possible physical representation of the Dublin Core metadata attributes:

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
      xmlns:dc = "http://purl.org/dc/elements/1.1/">
 <rdf:Description about="http://purl.org/dc/about/index.htm">
  <dc:title>Dublin Core Metadata Initiative - About the Organization and Process</dc:title>
  <dc:description>A description of the Dublin Core Metadata Initiative process.</dc:description>
  <dc:date>1999-04-06</dc:date>
  <dc:format>text/html</dc:format>
  <dc:language>en</dc:language>
  <dc:contributor>The Dublin Core Metadata Initiative</dc:contributor>
 </rdf:Description>
</rdf:RDF>
```

Forsberg & Dannstedt (2000) encountered problems when applying Dublin Core due to the fact that these problems are a consequence of trying to describe information resources without taking into account the context in which the learners create and consume information.

1.5. Gateway to Educational Materials (GEM)

The GEM-Project, as a project of U.S. Department of Education and the Educational Resources Information Center on Information Technology (ERIC/IT), has extended the Dublin Core with metadata to support the description of lessons, curriculum units and special educational resources [W03]. The Dublin Core Element Set (DC) became the base referent for GEM elements. The following GEM metadata example from Sutton (1998) shows the integration of scheme and type information in HTML 4.0 meta tags:

```
<META NAME="DC.subject.levelOne.1" SCHEME="GEM" CONTENT="Science">
<META NAME="DC.subject.levelTwo.1" SCHEME="GEM" CONTENT="Biological sciences">
<META NAME="DC.subject.levelTwo.1" SCHEME=/GEM" CONTENT="Life sciences">
<META NAME="DC.subject.levelTwo.1" SCHEME="GEM" CONTENT="Technology">
```

1.6. Warwick-Framework

Based on the Warwick Workshop 1996 in the UK, the so called Warwick-Framework provides an architecture for the interchange of distinct metadata packages and allows to combine good extensibility to provide elaborated schemes to certain communities with a simple interoperable Dublin Core description of form and content of the objects. Feature overkill is avoided. It provides the possibility to describe either on an item or on a collection level. The Dublin Core could be a good incentive to authors and publishers to deliver a minimum of metadata with their documents [W04], (cf. Lagoze et.al, 1996).

1.7. IEEE Learning Object Metadata (LOM)

The IEEE Learning Technology Standards Committee (LTSC, [W05]) working group IEEE P1484.12 (Learning Object Metadata Working Group, Chair: Wayne Hodgins) has developed a standard conceptual model.

The IEEE conceptual model for meta-data definitions is a hierarchy (see fig.1). At the top of this hierarchy is the so called "root" element. This root element contains many sub-elements. If a sub-element itself contains additional sub-elements it is called a "branch." Sub-elements that do not contain any sub-elements are called "leaves." This entire hierarchical model is called the "tree structure" of a document [W06].

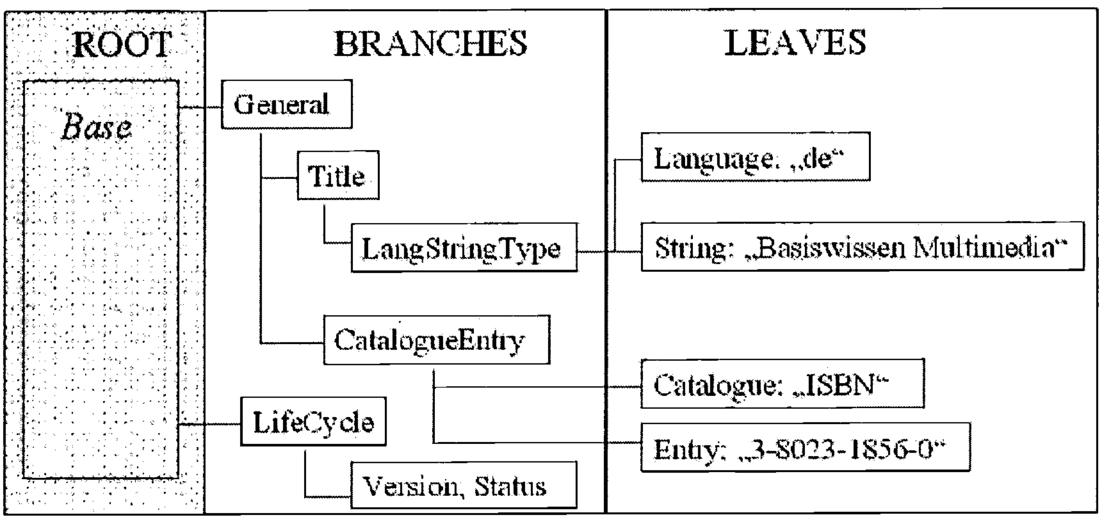

Fig.1: The IEEE LOM Hierarchy

2. LOM – Scope, purpose and working draft

2.1. Scope

This proposed standard will specify the syntax and semantics of Learning Object Metadata, defined as attributes required to fully/adequately describe a Learning Object. Learning Objects are defined here as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning. Examples of technology supported learning include computer-based training (CBT), web-based training (WBT), or intelligent computer-aided instruction systems in Medicine (cf. Holzinger et.al., 2000). Examples of Learning Objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning.

The Learning Object Metadata standards will focus on the minimal set of attributes needed to allow these Learning Objects to be managed, located, and evaluated. The standards will accommodate the ability for locally extending the basic fields and entity types, and the fields can have a status of obligatory (must be present) or optional (may be absent). Relevant attributes of Learning Objects to be described include type of object, author, owner, terms of distribution, and format. Where applicable, Learning Object Metadata may also include pedagogical attributes such as: teaching or interaction style, grade level, mastery level, and prerequisites.

It is possible for any given Learning Object to have more than one set of Learning Object Metadata. The proposed standard will support security, privacy, commerce, and evaluation, but only to the extent that metadata fields will be provided for specifying descriptive tokens related to these areas; the standard will not concern itself with how these features are implemented. The working group is expecting that these standards will conform to, integrate with, or reference existing open standards and existing work in related areas. For example core attributes of Learning Objects will be coordinated with or may simply defer to the efforts to standardize content objects in general [W07].

2.2. Purposes

According to the WG the main purposes of the LOM are to enable [W06]:
learners/teachers to search, evaluate, acquire, and utilize Learning Objects,
the sharing and exchange of Learning Objects across any technology supported learning system,
the development of learning objects in units that can be combined and decomposed in meaningful ways,
computer agents to automatically and dynamically compose personalized lessons for an individual learner,
education, training and learning organizations, both government, public and private, to express educational content and performance standards in a standardized format that is independent of the content itself,
a strong and growing economy for Learning Objects that supports and sustains all forms of distribution; non-profit, not-for-profit and for profit,
the documentation and recognition of the completion of existing or new learning & performance objectives associated with Learning Objects.
and least but not last to compliment the direct work on standards that are focused on enabling multiple Learning Objects to work together within a open distributed learning environment.

To provide researchers with standards that support the collection and sharing of comparable data concerning the applicability and effectiveness of Learning Objects. To define a standard that is simple yet extensible to multiple domains and jurisdictions so as to be most easily and broadly adopted and applied. To support necessary security and authentication for the distribution and use of Learning Objects.

3. Examples of LOM-based Systems

3.1. ABITS - An Agent Based Intelligent Tutoring System for Distance Learning

ABITS (An Agent Based Intelligent Tutoring System for Distance Learning) is an Intelligent Tutoring Framework highly re-usable and suitable to several knowledge domains, and has been realized in the context of the InTraSys ESPRIT project. It is able to support a Web-based Course Delivery Platform with a set of "intelligent" functions providing both student modeling and automatic curriculum generation. Such functions found their effectiveness on a set of rules for knowledge indexing based on Metadata and Conceptual Graphs following the IEEE Learning Object Metadata (LOM) standard. Moreover, in order to ensure the maximal flexibility, ABITS is organized as a Multi Agent System (MAS) composed by pools of three different kind of agents (evaluation, pedagogical and affective agents). Each agent is able to solve in autonomous way a specific task and they work together in order to improve the WBT learning effectiveness adapting the didactic materials to user skills and preferences [W08]

3.2. GESTALT (Getting Educational Systems Talking Across Leading-Edge Technologies)

For GESTALT (Getting Educational Systems Talking Across Leading-Edge Technologies), the emphasis is on delivery of learning within a managed process as part of the core business of the educational or training organization. This entails tight-knit integration between the learning delivery and the central management of the institution, with reliable flow-through of data on student tracking etc. The GESTALT project is then coming at this problem from a systems perspective, the goal being to achieve organization-wide integration of existing and future systems within the institution and linking the promotion of on-line learning opportunities with the CORBA-based brokerage service. The broker would service queries from potential learners across a wide range of delivering organizations and a central value-added function of the broker is that it quality assures these offerings and the institutions behind them. As can be seen from the above descriptions, these two projects have a very different view

of the role of on-line learning, but nevertheless they have co-operated (along with IMS and others) on the definition of the IEEE Learning Object Metadata. It is hoped that this will strengthen the LOM specification, enabling it to meet a wide set of requirements across user communities.
Other areas of development within GESTALT have included a European-focused implementation of the IEEE Public & Private Information (PAPI) specification from the Learner Model Working Group and the definition of a Unit Object Model for describing student progress between the Learning Environment and the Administration MIS. Aligning European R&D activity with the wider standards formation work has had clear benefits in terms of developing a common language for describing systems, components and functionality and generally encouraging the cross-fertilization of ideas around the globe [W09].

3.3. ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe)

The ARIADNE Project has been active both within the IEEE LTSC and in the formation of the Learning Technology Working Group under CEN/ISSS. The project Manager, Eddy Forte, is also the chair of the PROMETHEUS forum. The European Commission (DG III, DG XIII) and CEN have been instrumental in the formation of PROMETHEUS, a forum for exchanging ideas and driving consensus amongst actors in this area within Europe. In the international arena, ARIADNE has been a major contributor to the IEEE LOM work. The actual project has developed a range of tools for the delivery and support of on-line learning which are made available free-of-charge to the ARIADNE user community. Many both within and external to the project have authored content which is described using metadata and made available to tutors via the ARIADNE Knowledge Pool Sites. The ARIADNE distribution model seems based on co-operation between, and free access for, the academic community who will develop their own content and tools which will be freely exchanged. As such, the system model is very flexible as tutors simply select the tools they wish to use [W10].

3.4. The L3 project

The L3 project (L3 stands for Life Long Learning, cf. [W11]) is a project founded by the German government with the goal to create a technical and organizational infrastructure for a lifelong further education. The solution approach emphasizes two different points: On the one hand the creation of an educational infrastructure which uses new media efficiently and can be used by all interested people, independently of there education or social position. On the other hand the development of organizational structured and economic business models with which the developed infrastructure can be operated at a medium term.

The central component of the educational infrastructure is a multimedia repository (cf. Kleinberger, Holzinger 2001) which manages online educational content, especially multimedia content like audio and video. The educational multimedia content consists of learning objects which can be structured hierarchically in courses and lessons. The actual relationship between the learning objects is defined in a course structure which is represented in XML. Metadata for the learning objects is represented in an XML notation of the LOM definition 2.2 with appropriate document type definitions. Media objects are references out of the LOM metadata objects to physical media objects stored also in the multimedia repository.

Because the multimedia repository is designed in layered building blocks with different services for its functions, it can easily be embedded in educational environments like the lifelong learning environment build up in decentralized service centers and learning centers

4. Conclusion

There are some standardization initiatives for metadata in teaching and learning objects. Learning Object Metadata (LOM) seems to be the most powerful and most extensive mechanism to represent metadata, because of the great variety of the LOM Objects. There are some implementations which are using LOM already, but we weren't able to find an implemented System based on the LOM standard which contains an intuitive user interface for the definition and search for metadata. The other side of the very complex metadata-structure is the fact, that it is going to be difficult or confusing to determine the relevant elements for a satisfying result. Of course the decision to remove some of the Objects would be a difficult one, because of the danger to loose the functionality and flexibility of the current model. Exactly this seems to be the biggest advantage of LOM due to it's hierarchical and extensible approach.

5. Links

[W01] http://purl.oclc.org/dc (Dublin Core Metadata Initiative, last visited 26th March 2001)
[W02] http://purl.org/DC/index.htm.rdf (Dublin Core Metadata for [W1])
[W03] http://geminfo.org (Gateway to Educational Materials: GEM, last visited 24th Oct. 2000)
[W04] http://www.lub.lu.se/tk/warwick.html (Warwick framework and Dublin core set provide a comprehensive infrastructure for network resource description, last visited 24th Oct. 2000)
[W05] http://ltsc.ieee.org (IEEE Learning Technology Standards Committee (LTSC), Chair: James R. Schoening, last visited 23th Oct. 2000)
[W06] http://ltsc.ieee.org/wg12/index.html (WG IEEE P1484.12/D4.0, Chair: Wayne Hodkins, last visited 23 Oct.2000)
[W07] http://ltsc.ieee.org/doc/wg12/LOM_WD4.htm5 (February 2000, Draft Standard for LOM, last visited 23th Oct 2000)
[W08] http://virtcampus.cl-ki.uni-osnabrueck.de/its-2000/paper/capuano/ws2-paper-3.htm (ABITS: An Agent Based Intelligent Tutoring System for Distance Learning, Nicola Capuano, Marco Marsella, Saverio Salerno, ITS 2000 Workshop)
[W09] http://www.fdgroup.co.uk/gestalt/metadata.html (Getting Educational Systems Talking Across Leading-Edge Technologies, GESTALT, last visited 10.7.00
[W10] http://ariadne.unil.ch/ (last visited 24th Oct 2000)
[W11] http://www.l-3.de L3: Lifelong Learning – Education as a basic need, Leitprojekt des Bundesministeriums für Bildung und Forschung zum Themenfeld „Nutzung des weltweit verfügbaren Wissens für Aus- und Weiterbildungsprozesse".

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Application of Mobile agents in Web-based Learning environment

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Abstract: Web-base learning environments are strongly driven by information revolution and the Internet, but they have a number of common deficiencies, such as slow access, no adaptivity to individual student, limitation by bandwidth, and so on. This paper outlines the benefits of mobile agents technology, and describes its application in web-based learning environment to improve learning process. Mobile agents technology is being used in the implementation of the TILE adaptation mechanism, which the TILE project aims to provide an integrated system for the management, authoring, delivery and monitoring of education at a distance.

1. Introduction

Intelligent Agents are one of the "hot" topics in Information Systems Research and Development at the moment. The last ten years have seen a marked interest in agent-oriented technology and a distinct trend has evolved to the research and development work on intelligent agents. This trend relates to the diversification in the types of agents being investigated and most popular types include user interface agents, information agents, multi agent system, mobile agent and so on.

The educational systems, especially the web-based learning environments, are becoming mainstream applications on the Internet. But these environments face some common deficiencies, which need to be resolved. Intelligent agents, and in particular, mobile agents, have huge potential to address those deficiencies. A number of research projects have been initiated to apply agent technology in web-based learning environments. But most of these research projects have used intelligent interface agents, which are usually static. In this paper, we shall demonstrate how mobile agents can address the problems that limit the potential web-base learning environment development.

2. Challenges for web-base learning environments

The information revolution has induced the boom of knowledge economy. This strong trend is supported by the updating technologically skilled workforce, which is achieved by lifelong learning, education in the workplace and distance education. Those are the prime factors driving the web-base education.

Institutions with long-standing involvement in distance education, such as the Open University in United Kingdom, are incorporating web-based elements in their instruction. Although Web-based course materials have advantages over conventional textbooks and lecture notes, they have a number of common deficiencies, such as access to course materials is slow; courseware does not adapt to individual students; the real time interaction between student and system is hard to achieve because of the connection unreliability and bandwidth limitations.

A number of attempts have been made to attack some of these problems, but solution to one problem often impedes solutions of the remaining problems. For example, InterBook (Brusilovsky et al., 1996) supports adaptivity and authoring, but all adaptation and page generation takes place at the central server, risking access delays. QuestWriter (Bogley et al., 1996) supports authoring, and has built-in client-side and servers side interactivity, but does not adapt presentations to individual students. ADE (Shaw et al., 1999) uses an animated pedagogical agent, who guides and assesses students, to develop an agent-assisted learning environment. The Adele agent basically belongs to an intelligent interface agent, which still concentrates on providing helps to students.

In general sense, a web-based learning environment should interact with the students, adapt to the needs of individual students, support interaction with teachers and other students, and be user-friendly to the authors. The emerging mobile agents technology is not only capable to facilitate these benefits but also attempts to address the problems mentioned above.

3. Motivation for using mobile agents

Although it is possible to propose an alternative, based on an existing technology, to almost every mobile agent-based function (Chess et al., 1995), in certain cases mobile agents have significant advantages over conventional approaches at the design, implementation and execution stages. The motivation for using mobile agents stems from following anticipated benefits:

- *Efficiency and reduction of network traffic:* Mobile agents consume fewer network resources since they move the computation to the data rather than the data to the computation. Also mobile agents can package up a conversation and ship it to a destination host, where the interactions can take place locally, so network traffic is reduced (figure 1).
- *Asynchronous autonomous interaction:* Tasks can be encoded into mobile agents and then dispatched. The mobile agent can operate asynchronously and independent of the sending program.
- *Interaction with real-time entities:* Real-time entities require immediate responses to changes in their environment. Controlling these entities from across a potentially large network will incur significant latencies. Mobile agents offer an alternative to save network latency.
- *Local processing of data:* Dealing with vast volumes of data when the data is stored at remote locations, the processing of data over the network is inefficient. Mobile agents allow the processing to be performed locally, instead of transmitting the data over a network.

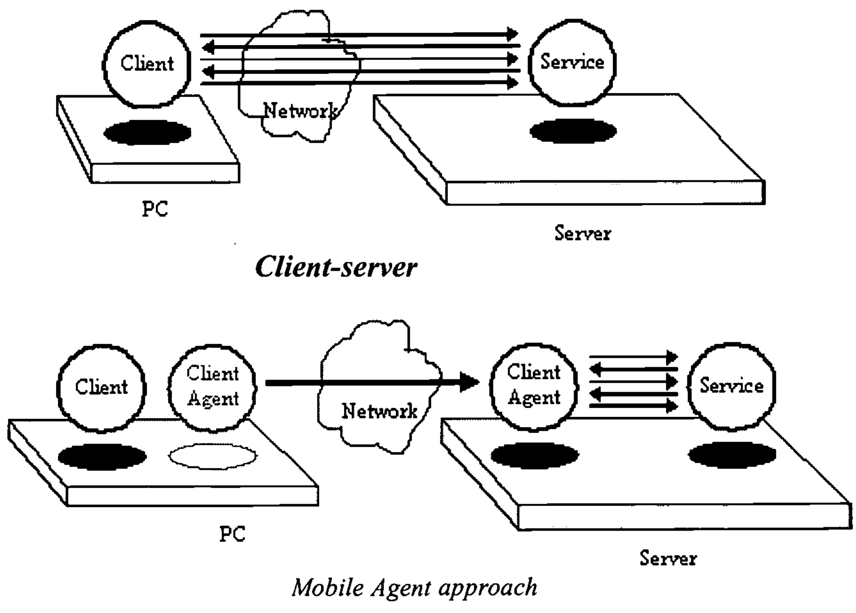

Figure 1. Client-server paradigm vs. Mobile Agent approach.

- *Support for heterogeneous environments:* Both the computers and networks on which a mobile agent system is built are heterogeneous in character. As mobile agent systems are generally computer and network independent, they support transparent operation.
- *Convenient development paradigm:* The design and construction of distributed systems can be made easier by the use of mobile agents. Mobile agents are inherently distributed in nature and hence are natural candidates for such systems.

4. Application of mobile agents technology in web-base learning environment

After examining the benefits of mobile agents, and considering the limitations of web-based learning environments, it becomes clear how mobile agents technology addresses those limitations very naturally. We discuss below how mobile agents can improve web-based learning environment.

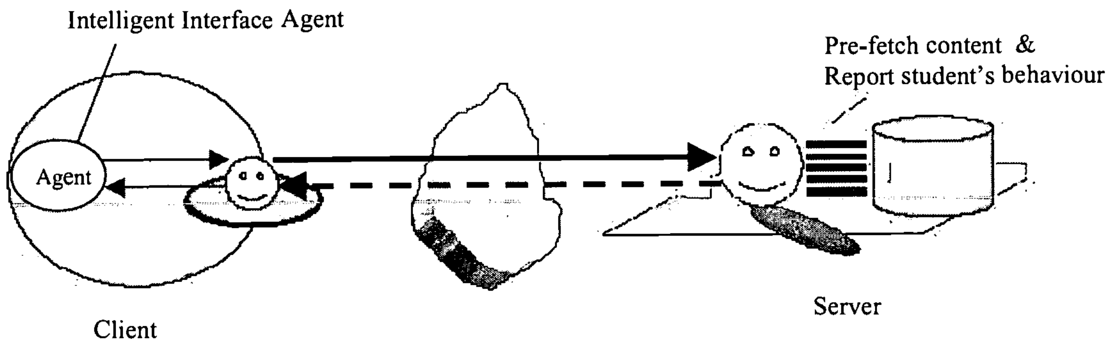

Figure 2. Scenario of mobile agent working

- In a web-base learning environment, as shown in figure 2, mobile agents can be used to pre-fetch the domain content that will be requested shortly by the student, and report student's performance to the central server. This pre-fetch process is based on real-time analysis of the student's behavior, and calculation of the probability of a request. Each student behavior, as they work through the web-based learning system, can be monitored and recorded by an intelligent interface agent, which runs on the student computer. Depending on the state of the network, an immediate request or a reservation can be fulfilled by the mobile agent. In this way, end-to-end quality of the service can be improved for the delivery of distributed multimedia material, such as that represented by distance education. This agents technology avoids unnecessary networking delays, cope the bandwidth limitation and adapt the representations to students, based on the student performance.

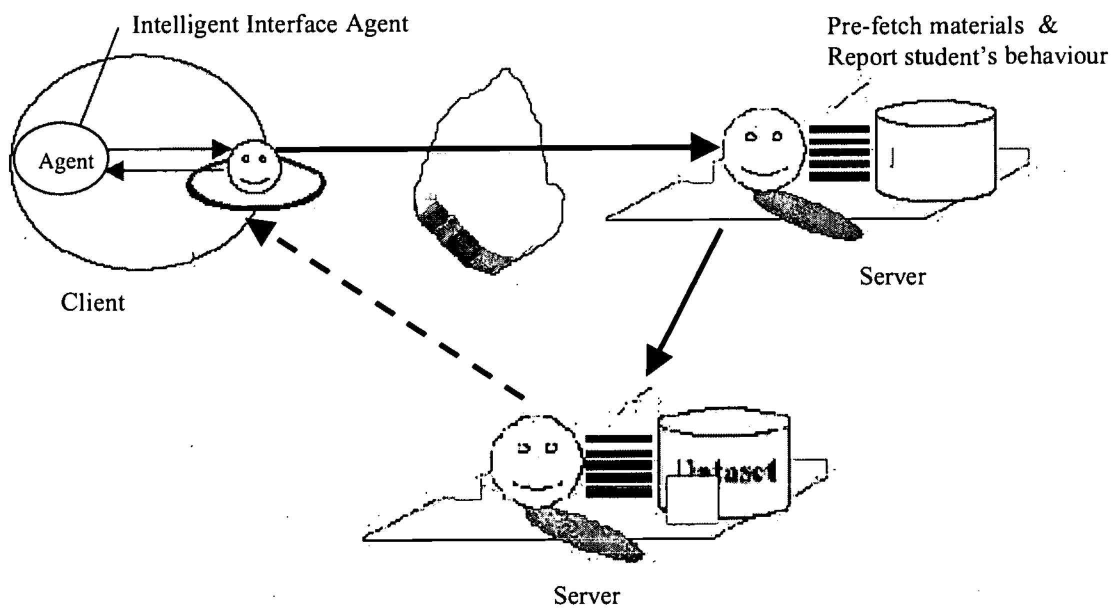

Figure 3. Scenario of mobile agent moving around distributes systems

- In terms of mobile users, portable-computing devices such as laptops, palmtops, and electronic books will access web-based learning environments. These devices have unreliable, low-bandwidth, high-latency telephone or wireless network connections. Mobile agents will be essential tool for allowing such access.

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- Mobile agents offer application developers a new programming paradigm with higher-level abstraction and unified "process" and "object". In terms of scalability of system and easy authoring, these features of mobile agents offer a flexible and effective philosophy on learning environment development, design, and scalability.
- In the future, web-based learning environments can share resources through different systems, as shown in figure 3. Both the computers and networks on which web-based systems are built are also heterogeneous in character. As mobile agent systems are generally computer and network independent, they support distributed systems and resources sharing.
- On another note, web-based learning environments are ideal test beds for mobile agents technology. Till now, electronic commerce has been treated as the only important target for mobile agents technology. Money is involved, so security is a key factor for agent technology. There are three types of security: agent-agent security, host-agent security, and agent-host security. Existing techniques can be successfully applied to protect agents from malicious agents, and hosts from malicious agents, but it is currently very hard to protect the agents from malicious hosts due to the possibility of the host changing the programming code of agent for some vested interests. This factor is one of main obstacle affecting mobile agents applications in the real world. However, in education sector, the agent-host security is not as important as in electronic commerce. This makes the web-based learning environments as the most suitable test bed for mobile agents technology.

Mobile agents technology is being applied in the TILE project. Following section gives brief introduction of TILE before describing the application of mobile agents.

6. Application of mobile agents for student adaptivity in TILE

The Technology Integrated Learning Environment project (TILE) aims to provide an integrated system for the management, authoring, delivery and monitoring of education at a distance. Its architecture gives a modular framework for the inclusion of a range of tools to achieve the project's goals. TILE can be compared to a computer aided software engineering (CASE) tool but for the development of on-line education. It supports the planning of syllabi and courseware, the tracking of development by staff, the reuse of course-ware modules and (if necessary) any auditing of royalties. Finally and perhaps most importantly it provides a means by which the educational web sites are built. One of the main aims of the TILE is to provide adaptive learning environment to the students. The adaptation in the system requires consideration of following criteria (Kinshuk et al., 1999):
(a) adaptation with respect to current domain competence level of the learner;
(b) suitability with respect to domain content; and
(c) adaptation with respect to the context in which the information is being presented.

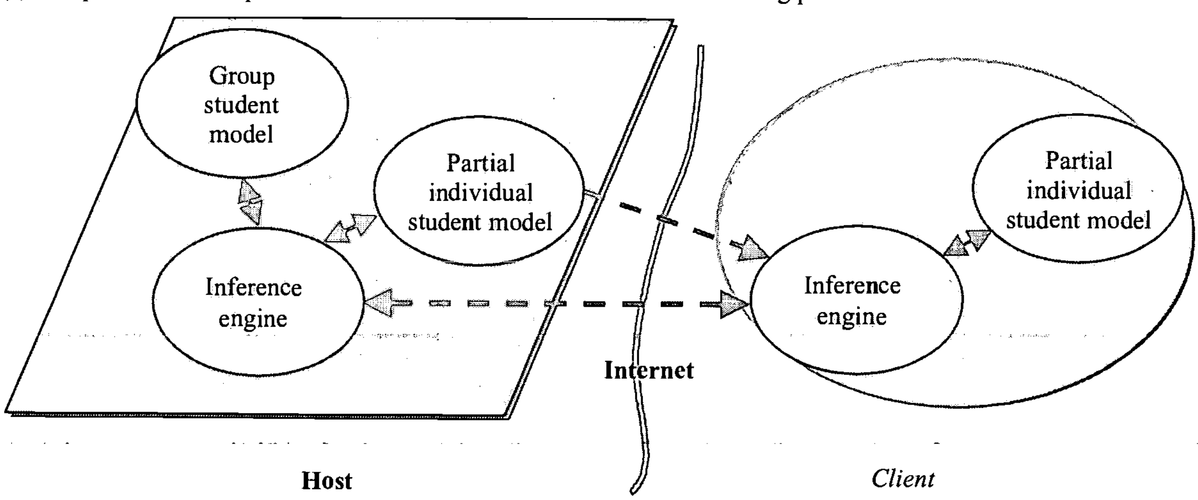

Figure 4. Adaptation mechanism in TILE environment

The fulfillment of these criteria requires the development of student model that captures the interactions of student with the system to extract information about student's competence level for various domain concepts and tasks represented in the system. TILE environment benefits from the collaborative learning on the web by having two separate student models:

1. *Individual student model*, which serves an individual student and contains the detailed information about particular student's domain competence level, preferences, interaction information and other relevant details; and
2. *Group student model*, which generalises various attributes over a number of students and attempts to classify students in various categories (for various attributes).

This two-step modelling enables the system to provide adaptation at different granularity, and also refines default assumption of the system towards new students.

The learning process in the TILE environment also benefits from the client-server approach, which has been extended to the adaptation process. Consequently, the student model is divided into host and client bases. The host base contains the group student model, and partial individual student model, whereas client base contains only individual student model. This approach serves a number of purposes. First of all, it allows the system to be much more flexible, particularly in the web-based environment, where connectivity between host and client is not always guaranteed, and the quality of the connection often suffers from traffic congestion. The client side student model facilitates adaptivity even in offline mode, whereas host side student model allows adaptivity based on new information available from the domain experts and better adaptation procedures resulting from group student model. Figure 4 shows the schemata of the adaptation mechanism in the TILE environment.

Mobile agents technology is being used in the implementation of the TILE adaptation mechanism. Figure 5 describes the implementation of mobile agents technology in the adaptation mechanism.

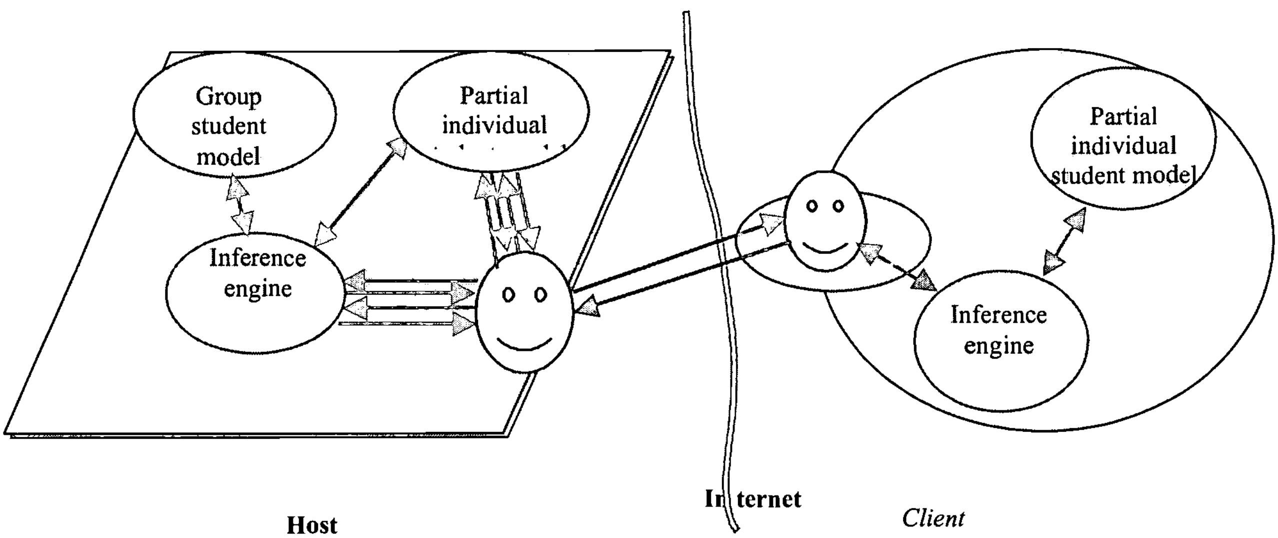

Figure 5. Implementation of mobile agents technology in adaptation mechanism.

As seen in figure 5, a mobile agent interacts with client side inference engine to pick up data, which relies on individual student model at client side. Then mobile agent moves to the host (or server) side. At host side, mobile agent performs all the processes needed, such as updating the partial individual student model based on summary of client side student model (based on the data brought by mobile agent), interacting with group student model to determine if that student model also needs to be updated. After mobile agent finishes all actions at host side, it gathers all the information it needs, and returns to the client side. Then it updates the client side individual student model. This mobile agent approach works even in the intermittent connectivity between client and host because mobile agent can be dispatched when the connection is available and then the agent works autonomously without requiring continuous connection.

7. Conclusion

There is a strong case in favour of the use of mobile agents in many Internet applications. Moreover, there is a clear evolutionary path that will take us from current technology to widespread use of mobile agents within the next few years. Once few technical challenges are met and few pioneering web-based applications start using mobile agents technology, we believe, the use of mobile agents will expand rapidly. TILE project is one such step in that direction.

A number if research issues are still to be resolved. For example, besides building mobile agent, we also have to provide environment for mobile agent. Although some mobile agent systems, such as Bee-gent, come with wrappers, they are still quite limited. But we hope, mobile agents technology will open a new interesting research area in the web-base education, where traditional approaches are proving fruitless due to severe limitations imposed by the existing technology.

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A Framework for Creating Counterexamples in Discovery Learning Environment

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Abstract: A framework for designing intelligient assistance in discovery learning environment is proposed. The process of discovery learning is analyzed and the required functions for intelligient assistance are discussed. A flexible simulator which fits any types of discovery learning is necessary. The problem solvers which perform fundamental tasks of discovery are also needed: Hypothesis generator and experiment designer. We especially focus on the other important function: Evaluator of the effectiveness of counterexamples. Counterexamples have much clue for learning, but a learner often feels difficulty in utilizing them. We, therefore, propose the method of evaluating counterexamples from two educational viewpoints: (1) Does it suggest the occurrence of error clearly? (Visibility), and (2) Does it suggest the cause of error? (Suggestiveness). Some case studies are presented to illustrate these functions. Then, the whole framework is described.

Keywords: discovery learning, microworld, intelligent assistance, counterexample

1. Introduction

Microworld has been getting important as an educational tool to support learning by doing. It provides computer simulation of restricted environment, in which a learner can manipulate the existing objects directly and see the result of her/his action intuitively. A learner explores the world and tries to discover the knowledge and laws in the learning domain. Such a situation is educationally quite good because it promotes a learner's initiative, motivation and interest. Here, discovery learning becomes a central issue.

Discovery learning, however, is not so easy. It needs several skills in 'discovery task,' e.g., how to generate a hypothesis, how to design an experiment to test it. A learner without these skills often comes into an impasse or objectless action, so appropriate assistance is necessary.

One way is to provide some auxiliary tools which makes cognitive process of discovery explicit. For example, in generating hypothesis or in designing experiments, it is quite difficult to find out what are the essential elements of the domain. So, to provide a list of basic variables will be helpful. Hypothesis Editor and Monitoring Tool [Joolingen 1999] are the typical examples.

Another way is to provide more 'intelligent' assistance. It gives a learner some advice concerning the contents of the discovery task, e.g., to suggest a reasonable hypothesis based on the data in hand, to judge the reasonability of the experiment to test the hypothesis. Electric Studio [Shoda 1999] is an example, of which domain is the diagnosis of electric circuit.

For designing the intelligent assistance (which is of our main interest), it needs the problem solvers in discovery task. Especially, hypothesis generator and experiment designer are the essential: The former generates all reasonable hypotheses based on the data in hand, and the latter generates all reasonable experiments to test the hypotheses. They are often depend on the learning domain.

Few discovery learning environments, however, have been developed with such intelligent assistance. It is because there occurs two difficulties in designing such an environment. The one is domain dependency of the problem solvers, but it could be alleviated by modularizing them to interact with other components through abstracted data. SimQuest, the authoring system for discovery learning environment, has the libraries of such components [Joolingen 1997].

The other difficulty is more serious. That is, 'too kind' adviser deprives a learner of her/his initiative, which is the essential merit of discovery learning. (It may teaches her/him what to do next.) Explanations from the adviser must be minimun not to demotivate her/him. In discovery learning environment, it is preferable that the phenomena in microworld themselves make a learner be aware of what to learn.

Such an 'educational' phenomenon often appears as counterexample, which is the phenomenon a learner didn't predict. It impresses on her/him the necessity of learning by suggesting the error in her/his action. Thus, the 'learning from mistakes' is promoted [Perkinson 2000].

A Counterexample, however, must be carefully used in discovery learning. A learner often ignores the anomalous data as the error in measurement, or excludes it out of range of the hypothesis [Chinn 1993]. Even when she/he accepts the counterexample, without any help, she/he cannot reach the correct hypothesis and comes into impasse [Fukuoka 1994, Nakajima 1997].

Therefore, when using counterexamles in microworld, it is necessary to evaluate their educational effectiveness and to decide whether they are shown to a learner or not. (Inappropriate counterexamples confuse a learner.) We have studied this kind of 'management' by using Error-Based Simulation (EBS), which simulates a learner's erroneous equation of motion in mechanics [Hirashima 1998, Horiguchi 1998, 1999, 2000]. As a counterexample, EBS must be evaluated from the following viewpoints: (1) Does objects' erroneous motion in EBS make a learner be aware of the occurrence of error? (Visibility), and (2) Does objects' erroneous motion in EBS suggest the cause of error? (Suggestiveness) We have designed such mechanism and developed the EBS management system, of which usefulness has verified through experiments.

In this paper, we propose a framework for designing discovery learning environment with intelligent assistance, especially focusing on the counterexample management. It is done by generalizing our methodology in EBS research project. First, two types of discovery learning is described. Secondly, the required functions for intelligent assistance is discussed. Thirdly, two viewpoints for managing counterexamples are introduced and how to evaluate their effectiveness is also discussed. Some examples are presented for illustration. Lastly, the whole framework is described.

2. Requirements for Intelligent Assistance in Discovery Learning

2.1 Two types of discovery learning

In discovery learning environment, a learner often encounters counterexamples. Figure 1a. illustrates a typical case (type-A). After observing a few phenomena in microworld, a learner constructs a 'theory' which is assumed to rule the world and to explain the phenomena. Then, she/he makes an experiment to test her/his theory, which yields a new instance of phenomenon. If her/his theory is wrong, the new instance contradicts it, to become a trigger of reconsidering the thoery, i.e., counterexample.

In this case, it is assumed that a learner predicts the world of phenomenon ruled by her/his wrong theory, which is compared with the one ruled by 'correct' theory. Most of simulation-based learning environments provide one simulator only which simulates the latter world, because the former already exists in a learner's head.

In some cases, however, the world ruled by a learner's wrong theory needs to be simulated explicitly. For example, when a learner attempts to make an object in microworld move as she/he plans, she/he writes some kind of command sequence, i.e., program. If the program includes some 'bugs,' the object moves in contradiction to her/his prediction. In this case, the world ruled by a learner's wrong theory (eq. program) must be simulated because she/he doesn't predict it, while the correct (planned) world is in her/his head. This is illustrated in Figure 1b (type-B). 'Turtle' world [Papert 1980] is a typical case of this.

Another example of this type is EBS-simulator [Hirashima 1998], which simulates a learner's erroneous equation of motion in mechanics. It is assumed that a learner can correctly predict the motion of objects, but fails to construct correct equation. The world ruled by her/his erroneous equation is simulated and compared with the correctly predicted world.

The difference between these two types of discovery learning mainly comes from the difficulty in formulating a theory. For example, when a learner supposes a proportional relation between two observed variables, it may not be so difficult to formulate it by using linear function. Yet, when she/he predicts an object moves circularly by centripetal force, it will be more difficult to formulate the equation of circular motion. Thus, in the case of complicated formulation, a learner often fails to write her/his theory (eq. prediction) down as the formula. Such a formulation includes several processes and knowledge, so some bugs can easily steal in.

It must be noted that the boundary between these two types often becomes ambiguous. (Suppose that a simple program to control 'Turtle' gradually gets complicated.) It is difficult to know which type of discovery learning is ongoing only from the observation of a learner's action. Therefore, it is necessary to design the flexible simulator which can simulate both correct and erroneous formula of theory. One example is Logo interpreter for 'Turtle' world. EBS-simulator for mechanical world is another example. Both of them allow a learner's formula (Logo program or equation of motion) with some range of semantic (not syntax) error.

2.2 Functions for intelligent assistance

The cause of errors in type-A discovery learning is supposed that a learner dosen't have sufficient data

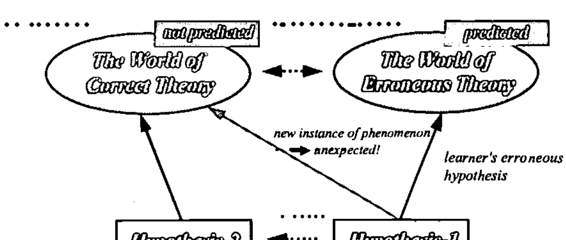

Figure 1a. Discovery Learning (Type-A)

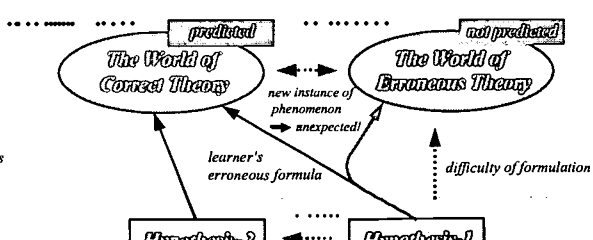

Figure 1b. Discovery Learning (Type-B)

(instance of phenomenon) to make the correct theory, or that she/he mistakes the important data in hand. Therefore, the assistance needed is to suggest the additional experiment which yields counterexample to her/his theory, or to teach how to construct the adequate hypothesis to explain all data in hand.

The cause of errors in type-B discovery learning is, as described above, the difficulty of formulation of theory. The assistance which guides a learner to construct a formula will be helpful.

For providing intelligent assistance in a discovery learning environment, therefore, the following functions are necessary:

Function-1: A problem solver for 'discovery task'

The function which generates all reasonable hypotheses from the given data. It judges the reasonability of a learner's hypothesis based on the data in her/his hand.

It also generates all reasonable actions (i.e. experiments) to verify the given hypothesis, and judges the reasonability of a learner's action based on her/his hypothesis.

In other words, the function as a problem solver for 'discovery task.' (It knows all the 'correct' theory and principle in microworld.)

Function-2: A problem solver for 'formulation task'

The function which generates all formulas of theory in microworld. It knows all the principle which rules the objects' behavior in microworld, and builds them up to the formula.

It also diagnoses a learner's formulation process, and checks the misconceptions within.

In other words, the function as a problem solver for 'formulation task.'

In addition to the functions above, a discovery learning environment needs another important function. A flexible simulator plays an essential role here. When a learner's action/formula yields counterexample, the difference between its result and her/his prediction is very important. It must be clear and meaningful. Even when the action is 'theoretically' reasonable, or even when the formula makes an object's unpredictable motion, if its result isn't clearly different from a learner's prediction, it is not 'practically' (eq. 'educationally') effective. Therefore, the following function is necessary:

Function-3: An evaluator of counterexample's effectiveness

The function which evaluates the effectiveness of the difference between the result of a learner's action/formula and her/his prediction. It is performed as follows: The flexible simulator simulates a learner's wrong hypothesis/formula. It also simulates the correct theory/formula. Then, the both results are compared and the difference is educationally evaluated.

2.3 Two viewpoints to evaluate counterexamples

Apparently, it is necessary to prepare some kind of criteria with which the difference of two results is evaluated. 'Visibility' is the key issue in considering this. Because all a learner can observe in microworld is the objects' behaviors (i.e. phenomena), her/his erroneous idea must be visualized in them. There are two viewpoints:

Viewpoint-1: Awareness of the occurrence of error

In this viewpoint, it is made sure that two simulated results are clearly different. It is measured by comparing the specific (often physical) variables of these phenomena in microworld by using the criteria, which defines what kind of difference of the variables is 'visible' to a learner.

This suggests a learner's hypothesis/formula contains some erroneous idea, to motivate her/him for reconsidering.

Viewpoint-2: Awareness of the cause of error

In this viewpoint, it is made sure that the difference of two simulated results points out the cause of error, besides its occurrence. It suggests a learner how to correct her/his erroneous idea. The criteria is necessary, which defines what kind of difference of the variable in microworld suggests what kind of error in problem-solving.

The former viewpoint is concerned only with the phenomena themselves in microworld. Some observable (often physical) variables are selected and checked whether they have clearly visible difference between the two results. The ability of human perception should be carefully considered to define the 'visibility.' (It may be useful to provide some kind of 'visual tool' which aids a learner to observe the variables.)

This viewpoint is comparatively simple, but often useful to give a learner good motivation for reconsidering.

The latter viewpoint is more complicated. It is concerned not only with the phenomena themselves but also with the problem-solving process. The difference between the two results must be 'suggestive' of the cause of a learner's error. (Here, to be 'visible' is a necessary condition.) Some kind of rules are necessary, which link the phenomena in microworld to the misconceptions in problem-solving. The criteria should be defined based on the task analysis of the domain.

The phenomena which are 'visible' but not 'suggestive,' sometimes mislead a learner because it doesn't reflect her/his problem-solving process. This viewpoint becomes necessary in such cases.

We call both 'visibility' and 'suggestiveness' in above two viewpoints 'visibility' sensu lato. In defining the criteria for Function-3, 'visibility' plays an important role. It is much concerned with the problem-solving process of Function-1 and Function-2, so these three functions (and the flexible simulator) must cooperate with each other.

In the next chapter, we present some examples which illustrate how the criteria are defined and how the effectiveness of counterexamples are evaluated. Then, we propose a general framework of designing the discovery learning environment with intelligent assistance discussed above.

3. Examples: designing the evaluator of counterexamples' effectiveness

In this chapter, we describe how to provide intelligent assistance when a learner encounters counterexamples. It is illustrated by using a series of case studies in managing Error-Based Simulation (EBS) [Hirashima 1997, Horiguchi 1999, Horiguchi 2000]. EBS simulates a learner's erroneous equation of motion in mechanics. Objects' unnatural motion in EBS often differs from their correct motion predicted by a learner, which motivates her/him for reconsidering her/his erroneous equation.

The difference, however, is not usually 'visible' to a learner, or sometimes misleads her/him. Therefore, it is necessary to evaluate the effectiveness of EBS as a counterexample. We've designed such mechanism and developed the EBS management system. Thus, what we discuss here is type-B discovery learning, and is mainly concerned with Function-3 described in chapter 2.

3.1 EBS management from viewpoint-1 [Hirashima 1998]

In the earlier stages of our research, EBS was mainly managed from the viewpoint-1. In motion simulation of physical objects, the most specific variable is their velocity and acceleration. So, using these variables, we defined the following criteria for evaluation of the difference.

Criterion for Error-Visualization-1 (CEV-1):
In EBS, an object's velocity must *qualitatively* differ from its correct velocity, i.e., their qualitative values must be different.

Criterion for Error-Visualization-2 (CEV-2):
In EBS, the rate of change of an object's velocity must *qualitatively* differ from the one of its correct velocity, i.e., their qualitative values must be different. The rate of change of velocity usually means acceleration, but sometimes means the derivative by non-time parameter.

These criteria are derived from the fact that human ability of vision is sensitive to rather the qualitative properties of motion than the quantitative ones. CEV-1 is preferred to CEV-2 because the velocity is easier to perceive than its derivative. The reasonability of them were verified through cognitive experiments [Horiguchi 1998].

By using these criteria, the effectiveness of EBS is evaluated as follows: When an erroneous equation is constructed by a learner, it is simulated by EBS-simulator. The correct equation is also simulated, and it is checked whether the difference between the two simulations satisfy CEV-1 and/or CEV-2. The module which performs this process is implemented by using qualitative reasoning techniques, and called EBS-manager [Hirashima 1998].

For example, consider the problem in Figure 2a. When a learner constructs Equation-B, the EBS which simulates the equation is judged 'effective,' because the block's velocity and acceleration in the EBS are qualitatively different from the ones in correct simulation. (It satisfies both CEV-1 and CEV-2.)

When a learner constructs Equation-C, matters are more complicated. The EBS which simulates the equation satisfies neither of CEVs by itself, because the block's velocity and acceleration in it are *not qualitatively but only quantitatively* different from the ones in correct simulation. EBS-manager, in such a case, searches some 'modification' of the EBS which makes qualitative difference. In this case, perturbing the angle of slope Ø works well. When Ø increases, the block's velocity decreases according to Equation-C, while it increases according to the correct equation. This satisfies CEV-2, so such an EBS is generated and used as a counterexample. The snapshots of the EBS management system are shown in Figure 2b.

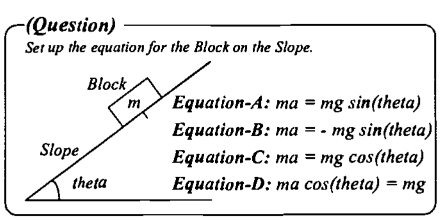

Figure 2a. Example Problem-1

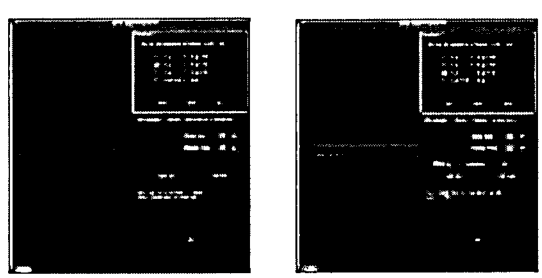

Figure 2b. Error-Based Simulation

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Table 1. Force-Enumerating Rules (FERs) (abstract)

force	Rules for enumerating forces	
friction	**R3: r3-c1** Object-1 and Object-2 are touching together • •	
	r3-c2 coefficient of friction of touching surface μ > 0 • •	
	r3-c3 normal force N acting on touching surface • •	
	r3-c4 Object-1 and Object-2 are moving oppositely along the tangent	
	• •	
	r3-a1 friction Ff1 to Object-1	**Qualitative**
	r3-a2 friction Ff2 to Object-2	**Qualitative**
	r3-a3 Direction(Ff1): opposite to the velocity of Object-1	**Qualitative**
	r3-a4 Direction(Ff2): opposite to the velocity of Object-2	**Qualitative**
	r3-a5 Magnitude: Ff1 = Ff2 = μN	**Quantitative**

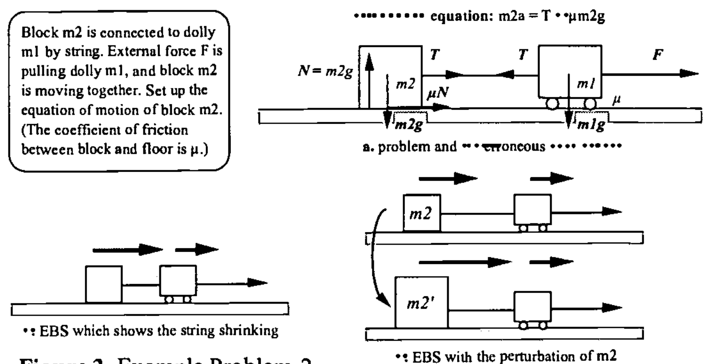


Figure 3. Example Problem-2

Table 2. Error-Identification Rules: EIRs (abstract)

force	appearance	cause of errors	correcting strategy
friction	missing	missing knowledge of friction **(R3)**	re-teach the concept/definition
		overlooking the touching together **(r3-c1)**	re-show the problem and indicate the corresponding part
		overlooking that coefficient of friction μ > 0 **(r3-c2)**	re-show the problem and indicate the corresponding part
		missing normal force **(r3-c3)**	proceed to the correcting strategy of normal force
		belief that normal force doesn't work **(r3-c4)**	indicate that friction is missing
	extra	missing that coefficient of friction μ = 0 **(r3-c2)**	re-show the problem and indicate the corresponding part
		extra of normal force **(r3-c3)**	proceed to the correcting strategy of normal force
		belief that normal force works **(r3-c4)**	indicate that friction is extra
		extra of the force which causes friction **(r3-c4)**	proceed to the correcting strategy of that force
	error	error of normal force **(r3-c3)**	proceed to the correcting strategy of normal force
		error of the force which causes friction **(r3-c4)**	proceed to the correcting strategy of that force
		error of direction/magnitude **(r3-a3/4/5)**	indicate that direction/magnitude is erroneous

Table 3. Criteria for Cause-of-Error Visualization: CCEVs for single object (abstract)

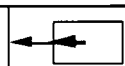
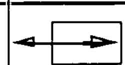
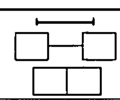
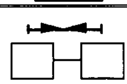
motion		difference	suggesting errors
correct motion		•	• • •
motion **(c)**		velocity: same acceleration: opposite	missing of the force same as moving direction • • extra of the force opposite to moving direction • • smaller of the force same as moving direction • • larger of the force opposite to moving direction • •

Table 4. Criteria for Cause-of-Error Visualization: CCEVs for two objects (abstract)

motion		unnaturalness	suggesting errors
correct motion		constant distance	• •
motion **(e)**		closing string shrinks	extra/larger of the tension • • extra/larger of the propagating force • •

3.2 EBS management from viewpoint-2 [Horiguchi 2000]

The merit of viewpoint-1 is its simplicity. It does not depend on the problem-solving process but only on the resulting phenomena, so it is comparatively easy to design the evaluator of counterexamples' effectiveness.

The counterexamples evaluated from viewpoint-1, however, don't always provide a learner useful information to correct her/his error, and sometimes mislead her/him. This comes from the lack of consideration of the problem-solving process. Therefore, our recent researches are paying more attention to the viewpoint-2 for managing EBS.

Apparently, the problem solver which can construct the correct equation is necessary. (It means the Function-2 in chapter 2.) We developed it by modelling the formulation process of equation in mechanics. The model focuses mainly on the process in which a learner enumerates the forces acting on the objects, so it consists of a set of production rules, called Force-Enumerating Rules (FERs). They describe the conditions for the forces to act. Part of them are shown in Table 1.

The correct solution inferred by the problem solver is compared with the one by a learner (inputted through the interface which allows her/him to construct equations and diagrams), and the differences are checked. Some rules are necessary which link the error-appearance on her/his solution to its cause. By considering a learner's error as the error about FERs, the rules are formulated as shown in Table 2. They are called Error-Identification Rules (EIRs), which link the erroneous part of a learner's solution to its cause and instruction strategy.

The identified cause of error must be visualized and suggested by EBS. The last set of rules we need is the one which describes what kind of motion in EBS suggests what kind of misconception in problem solving. The fundamental idea is quite simple. When a human observes an object moving, she/he feels its 'motive force' working. We apply this fact to the difference of motion. For example, assume that a learner observes a block moving to the left with deceleration when she/he predicted it moves to the left with acceleration. She/he will feel that the force which acts to the left is missing, or that the force which acts to the right is extra. The same thinking is possible about the relative motion of two objects. The rules are formulated as shown in Table 3 and 4. They are called Criteria for Cause-of-Error Visualization (CCEVs), which link the motion in EBS to the cause of error suggested.

For example, consider the problem in Figure 3. When a learner constructs the equation in Figure 3a (the direction of friction μN is erroneous), the 'unmodified' EBS becomes as shown in Figure 3b, in which the string shrinks. According to the CCEV in Table 4, however, this motion suggests the error about tension, which is not the cause of error in this case. EBS-manager, therefore, searches the 'modification' which makes EBS suggest the real cause of error. It finds the perturbation of the mass of block m2 works well. When the mass m2 increases, the block's velocity increases according to the erroneous equation, while it decreases according to the correct equation. This satisfies the CCEV in Table 3, and such an EBS correctly suggests the error about friction μN (Figure 3c).

4. Framework for Discovery Learning Environment and Concluding Remarks

The functions which are required for intelligent assistance in discovery learning environment were discussed. They are: the problem solver for discovery task, the problem solver for formulation task, the flexible simulator, and the evaluator of the simulations' effectiveness. (The last needs some criteria for evaluation.)

The more 'intelligently' each function is designed, the more highly it depends on the learning domain. So, it is preferred modularizing them as independent components to designing them according to some common template. This modular model allows the system designer to utilize the existing tools and simulators of each domain. The intelligent adviser will adjust these modules and user interface (which should be also modularized). The one key issue is to abstract the variables each module uses for efficient interaction, and the other is to enrich the component libraries.

We are now developing the authoring system for intelligent discovery learning environment of such an architecture.

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A Computer Tool for Writing Japanese as a Foreign Language

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Abstract: Because few materials teach how to write in Japanese as a Foreign Language (JFL), students must write as much as possible, and learn largely by trial and error. But the complexity of the Japanese writing system, and the awkwardness of the method traditionally used to type Japanese, combine to make writing JFL truly daunting. This paper proposes a new method to write JFL. A computer program combines information from several bilingual dictionaries and creates a concise display showing the JFL student all they need to select quickly and easily from menus of Japanese homonyms and synonyms. Informal experiments suggest that this program helps JFL students to write accurately and with three times the speed of previous methods.

Background

Students of Japanese as a Foreign Language (JFL) are perhaps most challenged when they *write* Japanese. One reason is a lack of materials teaching writing. This is surprising: A stroll through any large bookstore in Japan finds dozens of texts and CDs; a web search finds hundreds of sites, all teaching JFL. But these materials concentrate on listening, speaking, and reading. Very little material addresses writing. Most students must learn to write by trial and error, so they need to write as much as possible.

A second reason JFL students are challenged when writing is that the Japanese themselves have difficulty simply *typing* Japanese. Again, this is surprising to Europeans, because European languages are relatively easily input. One need only spell a European word (on a keyboard) to type it:

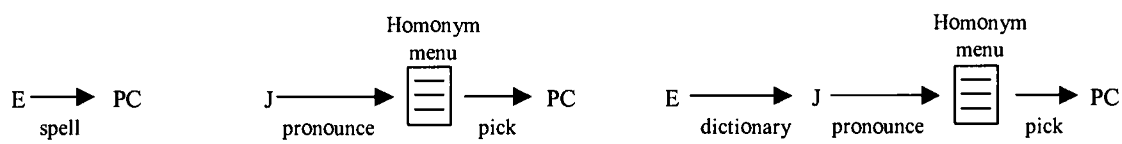


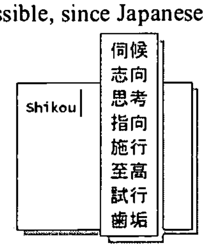
Figure 1: Typing English (left), Japanese (middle) and JFL (right)

In (Fig. 1) E denotes a European word; for concreteness, let's say an English word. Such a word can be entered into a Personal Computer (PC) by typing its spelling, and the typing is straightforward because all the needed characters are displayed on PC keyboards.

In contrast, to write in Japanese, one must be able to input some 6000 different characters. How can Japanese enter this wide range of characters using only the 100 or so keys on a keyboard? Indirectly: Japanese type the *pronunciation* of a word, and then the computer looks up the typed pronunciation in a dictionary, and displays the written characters. For example, typing `shikou` produces the characters 思考, meaning *thought*.

The problem: *homonyms*. The pronunciation `shikou` is actually shared among several unrelated words. When a Japanese types `shikou`, the computer in fact finds multiple writings in its dictionary, and displays them in a menu. So a Japanese typist inputs a few letters, then examines the resulting menu, and picks the desired word (Fig. 1 Middle). This process seems laborious to Europeans. "Blind typing" is impossible, since Japanese must constantly attend to the computer screen.

For a student of JFL, unfamiliar with Japanese vocabulary, typing is even more complex (Fig. 1 Right). Of course, a computerized dictionary can accelerate the added first step, mapping English to equivalent Japanese words. But the third step, choosing among homonyms, can be especially difficult when the student can't recognize some of the menu entries. A typical homonym menu can bewilder



Even if a JFL student recalls the pronunciation of a desired word, she may have difficulty choosing its written form. (These homonyms have totally unrelated meanings; there is no reason to suppose the student should know them all.)

Previous Work

Of the various software that search dictionaries for Japanese homonyms, perhaps the most commonly used is **MS-IME 97** (Microsoft 1997), which Microsoft distributes with recent versions of Windows and Office. This program includes *definitions* of some of the homonyms, as an aid to choosing the sought word. But these are of little help to JFL students, because (1) only a small fraction of the homonyms have definitions, and (2) the definitions themselves are written in Japanese and so are not easily understood by JFL students.

Bi-lingual dictionary software (MindDate 2001, Basis 2000) **and web sites** (Altavista 2001, Breen 2001, Rudick 2001) translate single words and noun groups between English and Japanese. While more convenient than paper dictionaries, these are all quite awkward to use while writing. Typically, a student need first look up an English word, finding several Japanese entries in an English-to-Japanese (E2J) dictionary. For example, *thought* has 92 entries in WWWJDICT (Breen 2001). Then, in order to choose the most appropriate of these entries, the student must look up each entry in a J2E dictionary to confirm their (English) meaning. Some of those 92 entries turn out to be only tangentially related: one translates back into English as false science; science out of line with the world of *thought*." Such blind-alley dictionary searching can be tedious.

Text editors designed for JFL writing (Rosenthal 1999, NJStar 2000) include similar bilingual dictionary software, but are no more convenient than standalone and web dictionaries. Students need a new alternative, one that collects information from various dictionaries and presents it in an easily understood form.

A Tool for Writing JFL

This paper proposes a computer tool called *Writing JFL*, a tool that combines the data from multiple bilingual dictionaries and then concisely displays all the information a JFL learner needs to correctly type Japanese. For example, when a student knows the Japanese pronunciation, but not necessarily the writing of a word, she can type the pronunciation and then, as usual, choose from a list of homonyms sharing that pronunciation. What is unusual is that the **homonyms are presented along with their (English) definitions**, taken from a J2E dictionary (Fig. 2 Left):

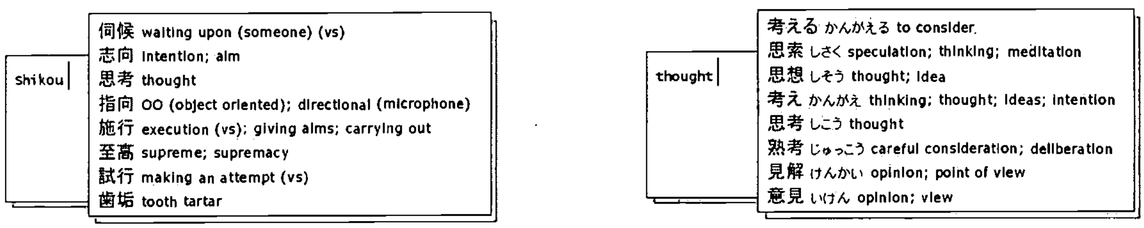


Figure 2: Screens in WritingJFL. Left: Written forms for typed Japanese reading. Right: Translations of typed English word.

Selecting from this menu is easy even for JFL students. [The (vs) notation indicates a specific verbal usage, giving further clues to the words' nuances and grammar.]

As another example, when a student can't recall even the Japanese pronunciation, she can type an English word, and see a menu of (nearly) equivalent Japanese words (Fig 2. Right). Each Japanese word is presented with its Japanese pronunciation and English definition. For the JFL student, this display tells them everything they need to choose between these near synonyms. It is a natural display. Yet no prior software created such a display. The key point is that this display is generated by first looking up the given English word in an E2J dictionary, and then looking up each of the resulting Japanese entries in a J2E dictionary, to confirm its English meaning. This program simply automates the manual strategy JFL students have long used with computer and even paper dictionaries. But it results in a radical change in the way JFL texts are input (Fig. 3):

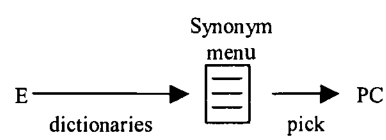


Figure 3: Writing JFL.

We implemented this program, using EDICT (Breen 2000) as our J2E dictionary, and GENE95 (Kurumi 1995) as our E2J dictionary. Informal trials with three adult JFL students suggest that this program allows students to write accurate Japanese **three times faster** than with prior methods. When compared with previous tools for JFL writing, this system was preferred unanimously.

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Multipoint Desktop Videoconferencing for Teacher Training: A Singapore Experience

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Abstract: Rapid technological development in the last decade makes it easier than ever to use technologies as collaborative learning tools. Computer video conferencing as a computer-supported collaborative learning (CSCL) technology brings learners closer to real-world environments and it provides increasing opportunities for learners to share experiences across time and space. This paper reports on how multipoint desktop video conferencing (MDVC) is used in preservice teacher education programs in Singapore. Our summative research findings reveal that student teachers reacted positively to the scaffolding provided by peers and supervisors via video conferencing. MDVC apparently opened up a new avenue for collegial learning, and student teachers do not have to rely only on the expertise found in their own schools.

Introduction

During the evolution of computer-supported collaborative learning technologies, researchers have increasingly embraced Vygotsky's sociocultural theory (Vygotsky, 1986) in evaluating and understanding electronic learning environments (Bonk & Cunningham, 1998). Vygotsky's sociocultural theory postulates that individual mental functioning is inherently situated in social interactional, cultural, institutional and historical contexts, and learning occurs through social interactions with peers, mentors and experts. Researchers holding sociocultural views have begun to concentrate their investigations on the role of social interactions and dialogues, scaffold instructions and collaboration in computer conferencing environments (Iseke-Barnes, 1996). Focuses are shifting from discussions on tool features and procedures to the theoretical rationale or justification for using technologies, and to studies on how technologies can augment and redefine the academic learning environment (Koschmann, Myers, Feltovich & Barrows, 1994).

Reflective practice is a widely accepted concept in teacher education. It is generally agreed that active and critical examination of one's thoughts and teaching will help one to make sense of the complexities of teaching and improve one's teaching. Reflection as defined by Dewey (1933) is "turning a subject over in the mind and giving it serious and consecutive consideration," and it enables us "to act in a deliberate and intentional fashion". Schon (1983) developed Dewey's concept of reflection by emphasizing the context and time in which reflection takes place. According to him, reflection may be "reflection on action" and "reflection in action". "Refection on action" refers to the thinking about the lesson before as well as after the lesson. "Reflection in action" refers to the thinking that occurs during the act of teaching. The assumption is that by thinking about our actions and reactions as we are teaching we can improve our teaching. Loughran (1997) developed a conceptual framework that may help preservice teachers reframe their experiences. Reflection may take place in three stages, (1) during the act of planning the lesson (anticipatory reflection), (2) during the actual teaching of the lesson (contemporaneous reflection) and (3) after the lesson (retrospective reflection).

Reflection is an essential component for bringing understanding to the complex nature of classrooms (Zeichner & Liston, 1996). As suggested by various researchers (Richardson, 1989; Schon, 1983; Zeichner & Liston, 1987), reflection should not take place in isolation, rather teachers should constantly strive to make sense of their practice and the student learning with other teachers. This paper reports on how multipoint desktop video conferencing (MDVC) is used to facilitate reflective practice of student teachers during their teaching practice. Learning theorists claim that when learning is situated in meaningful contexts requiring collaborative processing, learners tend to remember the information better (Brown, 1989; Cognition and Technology Group at Vanderbilt, 1991). We hope to find unique opportunities in MDVC for student teachers to share ideas, experiences and teaching resources in real time with an audience wider than the schools where they teach.

Launching of the Teaching Practice Discourse and Computer Communications Technology Project

The Teaching Practice Discourse and Computer Communications Technology Project of National Institute of Education, Singapore, is a project funded by the Ministry of Education of Singapore, and it was launched in May 1999. The project builds on a previous research effort that investigates the discourses between student teachers and their university supervisors (Sharpe, et al., 1994). The early research found that there was a preponderance of low-level factual discourse in student teacher-supervisor conferences, and that conferences were relatively short. It concluded that ways and means needed to be found to increase both the quantity and quality of student teachers and supervisor discourse.

The appearance of multipoint desktop video conferencing (MDVC) technology brings hope that this new communication technology may help to break down barriers of time and space that prevent the quantity and quality of professional sharing. Desktop video conferencing allows users at different locations to see and hear each other using ordinary desktop computers fitted with cameras, microphones, speakers and necessary hardware and software. Desktop video conferencing may be point-to-point, meaning persons talking to each other from two separate desktop computers, and it may be multi-point, that is several persons conference from several desktop computers. For the purpose of our project, we needed a system that could link student teachers across schools and the choice had to be multi-point.

Fortunately, by the time our project was initiated, all the Singapore schools had been provided with Asynchronous Digital Subscriber Line (ADSL) gateway access into SingaporeONE, an ATM network suitable for Wideband Internet applications. SingaporeONE offers low cost user access into a system already designed to distribute video-on-demand (VOD) multimedia services and with sufficient bandwidth capable of hosting a multi-channel MDVC server. The project takes advantage of the existing infrastructure in the schools and uses CU-SeeMe for video conferencing.

The First Phase of the Project (May 1999 – May 2000)

During the first phase of the project, we concentrated on exploring the feasibility of using MDVC for student teachers to have real time discussion. Student teachers doing teaching practice in different schools used MDVC to conference with their peers in other schools and their university supervisors (Sharp, et. al., 2000). Conferences were carried out on a weekly basis among student teachers and their university supervisors. Each conference group consisted of up to five student teachers from different schools and one supervisor. The participants shared ideas and experiences on aspects of their teaching with their peers and their university supervisors in real time.

Three cohorts of 59 student teachers used MDVC during the first phase. Summative evaluations showed that MDVC benefited the users in a number of ways. First, it provided an avenue for student teachers to share ideas, problems and solutions. It enabled them to discuss any matters relating to their teaching practice at the time needed and to receive immediate feedback from peers and supervisors. This is particularly important when student teachers experience varying degrees of isolation from their university supervisors and peers. MDVC also provided a channel for student teachers to obtain peer support and encouragement so that there was a reduction in stress for some of them. More importantly, MDVC broke down communication barriers between student teachers and supervisors. As a result, they felt more comfortable to share ideas and discuss problems with their supervisors.

Student teachers reacted positively to scaffolding provided by peers and supervisors via MDVC. It appears that MDVC opens up a new avenue for collegial learning, and student teachers do not have to rely only on the expertise found in their own schools. Peer and mentor support helps to reduce student teachers' frustration and isolation. It stimulates more interchanges among peer learners and between learners and supervisors. There was a definite feeling amongst all the participating student teachers that they knew each other and the university supervisor much better than they would otherwise. As a student teacher put it, "I look forward to MDVC sessions because I know I will get encouragement and support from fellow trainees and the lecturer chairing the session". It appeared that MDVC actually enhanced trust, perhaps, by a process of decontextualizing conferencing by providing an alternative social frame (Goffman, 1974).

The Second Phase of the Project (July 2000 - present)

During the second phase of the project, we explored the possibilities of using video streaming in MDVC. During the seven-week teaching practice (3 July to 25 August 2000), 28 student teachers were each allocated one of the three teaching competencies for video taping: (1) lesson introduction, (2) questioning and explaining, and (3) small group teaching. A checklist covering a number of teaching behaviors associated with each competency was provided to help student teachers in planning and was explained in detail by one of the researchers. Of the four weeks MDVC, three were used to cover each of the three competencies and one was used for overall reflection.

All the schools involved were provided with a digital video camera, tripod and digital video capture card. Six of these cameras were able to record digital video to tape whilst simultaneously capturing digital still photographs to a memory card, while the other two captured directly to a memory card in MPEG1 format. Both allowed uploading of digital video to a PC and subsequent transfer to the university by the File Transfer Protocol (FTP) method in either MPEG1 or AVI digital video format. Both the school technical assistants and student teachers were trained in how to use the cameras and tripods, the capture cards and FTP. They were also shown where to position the camera in the classroom.

Each student teacher arranged with a fellow trainee or their school's technical assistant to make one three-minute digital video clip of their classroom teaching using the digital video camera. They were allowed to re-shoot the video if they were unhappy with it. The video clips were then transferred electronically by the school technical assistants to the university using the File Transfer Protocol (FTP). At the university, the video clips were edited and placed in a password-protected area of the project WebPage. Video streaming was chosen over conventional file downloading mainly for the reason of confidentiality. Using video streaming meant that no permanent file would be left on the school computers and no video streams may be copied. The school technical assistants were instructed to delete the clips from their own hard disks once they had been transferred to the university.

The student teachers were instructed to view the video clips prior to the scheduled MDVC conference the following day. At one of the conferences, however, the supervisor chairing the session found that four out of five student teachers had not watched the clips for various reasons. The student teachers were then instructed to leave the conference and to return in 20 minutes after viewing the video clips. This unexpected situation turned out to be helpful for us in understanding the feasibility for such a use of technology. All the student teachers reported easy downloading and convenience of viewing the video clips. It took only around one minute to download one three-minute video clip. They responded extremely positively towards such a new experience and welcomed the opportunities provided in sharing of their peers' teaching using the learning environment of MDVC and the Web.

As we were able to stream videos successfully both before and during the MDVC sessions, most student teachers watched video clips of participants in their own group, and some managed to watch clips from other groups (Figure 1). In addition, we tried to incorporate in the Whiteboard in the MDVC sessions. The student teachers were asked to take at least one still video photograph per week of aspects of their school, including their pupils' work and one of the MDVC conferences was devoted to the sharing of these photographs, using the application sharing feature of the CU-SeeMe.

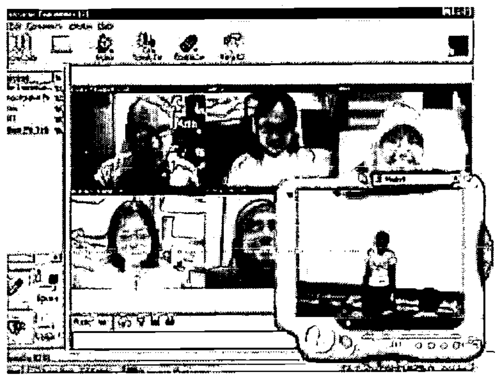

Figure 1 Viewing video clips during an MDVC session

Despite the technical problems encountered initially, the feedback collected so far was generally positive. The student teachers appreciated the opportunities of sharing ideas with their peers. Typical comments were “Eager to hear from what other trainees have to comment on my teaching”. “Informative, reflective, corrective”. “Received positive comments that build up my confidence”. “Peers normally give very non-threatening and constructive feedback. It’s very comforting”. However, a few student teachers felt that there was not enough critical comments, for example: “full of praise, good but doesn’t help me improve on my bad points as some comments are withheld”. All indicated that it was a good learning experience and most would probably agree with the student who commented that it was a “good learning experience; helps in better and more critical analysis development”.

Viewing their own teaching clips obviously facilitated the student teachers to reflect. As one student teacher put it, “it was definitely beneficial as I was able to evaluate and reflect on how I could improve myself”. Another one said it was “helpful in pinpointing my own mistakes”. Still another one could actually see how I teach and learn the mistakes that I made”.

From February 2001, we entered the final stage of Phase Two. While continuing to video stream in videoconferences, we incorporated the facility of file sharing of CU-SeeMe (Whiteboard) in our conferences. We shared lesson plans and web pages during the conferences. We intend to conduct in-depth analysis at the completion of this cohort’s teaching practice. Such analysis will help us learn as much as possible about its pedagogic value and the kinds of administrative support required (Winn & Jackson, 1999).

Discussion

Our experience has demonstrated that it is technically feasible to use multipoint desktop video conferencing to facilitate student teachers’ reflective practice and it is possible to combine multipoint desktop video conferencing with digital video streaming. Although we have not experienced one hundred percent reliability, we can predict that such reliability is not too far away.

MDVC helped create a platform for the kind of ‘reflective practicum’ propounded by Schon (1987) and later refined by Darling-Hammond (1994). The student teachers were provided with opportunities to “learn by teaching, learn by doing and learn through collaboration” (Darling-Hammond, 1994). The MDVC enabled our student teachers to take part in a ‘distributive community of practice’ with participants who shared a common concern of learning how to teach. By participating in videoconferences, student teachers were provided with opportunities to participate in reflective conversations with their university supervisors and peers.

Our summative evaluations to date show that MDVC benefits the users in a number of ways. In our student teachers’ opinion, a major advantage of MDVC over face-to-face conferences is that MDVC reduces the “physical barriers” and it makes it easier “to bring up issues because you feel a safety in distance”. It appears that MDVC represents a less formal medium compared to the formally arranged face-to-face supervisor visits. MDVC provides an avenue for student teachers to share ideas, problems and solutions. It enables them to discuss any matters relating to their teaching practice at the time needed and to receive immediate feedback from peers and supervisors. This is particularly important when student teachers experience varying degrees of isolation from their university supervisors and peers. MDVC also provides a channel for them to obtain peer support and encouragement so that there is a reduction in stress for some of them. As a result, they feel more comfortable to share ideas and discuss problems with their supervisors. Timely feedback, questions, and reconceptulizations from both supervisors and peers further fueled these learning activities because of the relevance of the discussions to teaching.

But did the platform and the opportunities that it provided actually result in improvements in discourse and reflectivity? At this stage, we only have feedback from the student participants and our own experiences to go by, although we intend to collect a range of 'harder' evidence during the main study which began in late February 2001. It is clear from the feedback that the student teachers felt that watching themselves and their peers teach and being able to discuss this had been beneficial. As chairpersons, we thought we detected a growing confidence and willingness to join in discussions as the weeks went by. All participants joined in the discussions and there was never a shortage of anecdotes and ideas to share. We felt that the shyness and unwillingness to criticize that some of the participants noted was more a feature of the earlier conferences. In our judgement, it was due in part to the student teachers never before having had to engage in professional discussion of each other's teaching. As a result they lacked the requisite critical and justificatory discourse skills. The video clips and conferences provided them with practice in this important professional skill but, we feel, that we still have a great deal to learn in this respect.

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Developing Virtual Learning Environments: Finnish Information Strategy for Education and Research 2000-2004

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Abstract: This paper presents the Finnish information strategy for education and research 2000-2004 and the principles for its implementation in Finnish educational institutions. The paper concentrates on describing national projects for building virtual learning environments for students from primary schools to higher education. Also the Finnish strategy for teachers' in-service training is presented. The ministry of education requires that all educational institutions devise their own information strategies, depicting their vision for the use of ICT in education and steps taken to implement the vision. This is a key factor for the successful development of ICT use in education and for building virtual learning environments.

Introduction

The first national information strategy in Finland steered the national information society development from 1995 to 1999. In spring 1999 the Finnish Ministry of Education put in place the next information strategy for years 2000-2004, along with an organization for implementing the strategy (Table 1). The basis for this national strategy was an extensive evaluation of the use of ICT in education in Finland. The evaluation covered all levels of education, from kindergartens to elderly people (Sinko & Lehtinen, 1999).

National Information Strategy for Education and Research Steering committee			
Information society skills	Virtual learning environments	Information society structures	Content development
- All citizens - *Training of teaching staff (OPE.FI)* - ICT professionals	- *Virtual school* - *Virtual polytechnic* - *Virtual university* - Research on learning environments	- Networks, equipment, standards and statistics	- Digital learning materials
In-built follow-up and evaluation			

Table 1. The organization for implementing the Finnish information strategy in the field of education and research.

The government has annually earmarked about € 45.5 million for the implementation of this information strategy. Local authorities and municipalities are also investing in the implementation of the strategy because they share the responsibility for funding the educational system.

The nine projects listed in Table 1 have been set up to implement the strategy. The focus in this paper is on four of these projects, namely the training of teaching staff, virtual school, virtual polytechnic and virtual university.

Descriptions of all the projects can be found in the Ministry of Education publications: "Education, Training and Research in Information Society, a National Strategy for 2000-2004" (1999) and "Information Strategy for Education and Research, 2000-2004 Implementation Plan" (2000). This paper is largely based on these publications but information has been updated concerning recent work carried out in the projects.

Training of Teaching Personnel - OPE.FI

From the perspective of equal opportunity, teachers are the key to the implementation of our national strategy for education, since their skills in and attitudes towards using ICT in education influence the possibilities of youngsters and adult learners to become familiar with technology as a part of their studies.

Developing ICT uses in educational institutions requires an accepted, shared vision and understanding of the role and uses of educational technology. One central aim in this subproject is to encourage all institutions, from primary to higher education, to develop their own strategies for using ICT in education. As a part of this process, the curriculum should be evaluated and updated to meet the requirements of the information society. All educational institutions should devise their strategies by the end of 2002. The teacher training departments in universities are required to formulate their information strategies even earlier, by the end of 2001.

The teacher training project has developed a three-step model for providing teachers with the necessary skills, as well as for estimating the need for teachers' in-service courses (content, duration, the number of teachers to be trained). The three-step model has been designed to be independent of the level of education at which the teachers work (Table 2). The model has been developed by a group of experts on teacher training and on the educational use of ICT, and it is based on our experience that the first step towards developing professional skills in the educational use of ICT is to acquire some technical skills. After the teachers feel relatively comfortable with the technology, more emphasis can be put on new notions of learning and teaching.

Skill	Percentage of teachers	Credits
1. Basic skills in ICT uses - common uses of a computer - word processing - Internet browsers and email - uses of audio and video equipment - mobile phones - educational uses of ICT (principles)	100 %	1 credit week (40 hours)
2. Good skills in ICT uses in education - versatile use of email and web, including web-based learning environments - subject linked skills: generic tools and pedagogical applications - knowledge of learning materials available - ability to produce materials for own use - ability to follow technical progress and update skills - awareness of the challenges and possibilities of ICT	50 %	3-5 credit weeks
3. Expert skills - content-specific and professional applications - production of learning materials - institutional information management - ability to assist, support and train colleagues and to develop the school community	10 %	9-11 credit weeks

Table 2. The three-step training model of Finnish teachers (adopted from Koli and Kylämä, 2000)

The aim is that the first step (basic skills) is organized and funded by teachers' employers and the next two steps are funded by the government and organized by the continuing professional education centers at Finnish universities. The training is organized in ICT and web-based learning environments. The emphasis in training is on teacher teams and school communities, not individual teachers. By this we want to encourage cooperation between teachers and a new kind of working culture in schools.

The teachers' in-service training process based on the three-step OPE.FI model should be completed by the end of 2004. In 2001 and 2002 special emphasis will be put on assisting the information strategy processes, and the teacher teams will also develop these strategies as a part of their training.

Virtual School

The virtual school develops new solutions which guarantee flexibility, equality and diversity in education and training in primary, secondary, upper-secondary and vocational schools. The virtual school project is co-coordinated by the National Board of Education. The aim is to develop and provide learning materials and courses of high pedagogical quality. In addition to opportunities for distance education, the virtual school offers materials for use in classroom settings. Distance education courses are being developed especially for upper secondary and vocational schools.

The core of the virtual school is its own user interface, portal. The portal offers study modules, courses and other learning materials, as well as tools for communication, networking and tutoring. The portal is also used to disseminate good practices. The portal is developed as a tool for both students and teachers. One important aspect in the development of portal services has been to assist schools in devising their information strategies. The National Board of Education has also published a book and several articles in educational journals to support the strategy processes. Educational authorities, training providers and schools are developing the educational portal; some services are being developed regionally. The private sector can join in the development work, especially the production of learning materials.

Schools are also supported financially in the acquisition of hardware and software and in the creation of networks. Schools can get funding from the National Board of Education only if they have a strategy for the use of ICT in education. The technical situation in educational institutions is presented in Table 1 (Networking in Finnish schools 1996-1999). According to the preliminary results of a survey made in September 2000, which has not yet been published, the percentage has reached 100 % at all levels.

	Internet connections	Pupils/PC
Junior comprehensive schools	90 %	12-13
Senior comprehensive schools	90 %	11-12
Upper secondary schools	95 %	9-10
Vocational schools, colleges and polytechnics	100 %	5-6

Table 3. Internet connections and number of pupils/PC in Finnish schools (year 1999)

The aim is that by year 2005 every school has an information strategy, every teacher uses the educational portal and new forms of co-operation exist between the private and public sectors.

Virtual Higher Education

In Finland polytechnics and universities provide higher education. Polytechnics offer professional education (degree programs of 3.5 - 4 years). The polytechnics were established in 1991. There are 29 polytechnics and 20 universities in Finland. There are two projects for developing virtual learning environments in higher education: the virtual polytechnic and the virtual university. Even though separate project groups carry out these projects, they share mane features, and are therefore presented together here.

The Finnish virtual university and polytechnic are based on existing educational institutions: students have to be enrolled in one of the regular universities or polytechnics if they aim at a degree. The virtual higher education projects do, however, accommodate the lifelong learning perspective in the form of a virtual open university and polytechnic and continuing professional education.

All Finnish universities have joined in the virtual university consortium and agreed to develop virtual learning environments for their students. Similarly, all polytechnics are participating in the virtual polytechnic project. The Ministry of Education funds a development unit for both projects.

Our aim is that by the end of year 2004 there will be a virtual university and a virtual polytechnic offering high quality education, also internationally. The virtual university and polytechnic are being built on a network in which universities, polytechnics, companies and research institutes are jointly developing virtual learning environments. This co-operation will diversify teaching and strengthen research networks. The emphasis is on the educational use of technology in teaching and learning and a combination of face-to-face teaching and distance learning assignments. The Finnish virtual university and polytechnic are not based purely on distance education. Therefore the emphasis is not only on producing digital learning materials for use in a distance education setting but also on strengthening teachers' capability to plan learning processes which take partly place in a web-based environment.

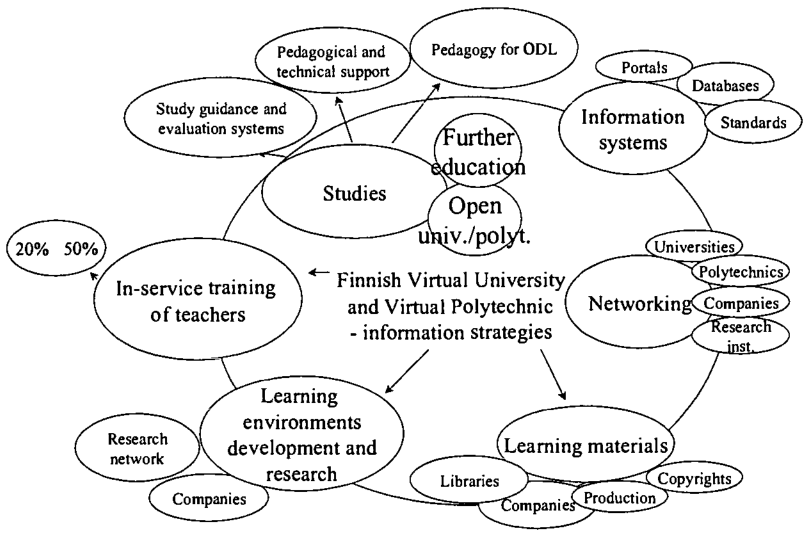

Figure 1. Areas of development in virtual higher education

The funding of the virtual university started in January 2001. The scope of development is presented in Figure 3. The Ministry of Education finances the development of virtual courses, supportive services and course development in each university. It also funds several co-operative projects between universities, including a network for all Finnish open universities and some regional networks between universities. There are also networks in different subject areas: educational sciences, law, psychology, social sciences, literature, cognitive sciences, communication studies, studies in futures research, music, mathematics, chemistry, computer sciences etc. The virtual polytechnic is also planning to set up content development networks in several areas.

There are also a number of projects in support of virtual university development, such as a project for planning, guiding and assessing studies in the virtual university, a national program for training university teachers in educational use of ICT (according to the OPE.FI model) and a network for educational technology units in all universities. The information strategy process in universities and polytechnics is supported and encouraged to contribute to long-term planning and to determining development priorities. Building the virtual university and polytechnic is not only a technical question but above all a pedagogical one. Therefore both projects are strongly networked at all levels to enhance the exchange of good educational practices.

Both the virtual university and the virtual polytechnic arc building an educational portal. Some of the services required can be developed jointly. The virtual polytechnic project aims at having their portal in operation by the end of 2001. By the end of 2002 each student will have studied at least one course on-line and by the end of 2005 at least one student will have graduated with a virtual degree.

Co-operation required

Developing virtual learning environments for educational system as a whole also requires solving some common issues together. The standardization of educational technology and copyright issues are considered the most urgent areas of cooperation between the three virtual learning environments. We have started a standardization process with a view to compatible technologies and tools. The process is open to all parties interested in developing compatible solutions. We also hope that the standardization process will be a good starting point for co-operation and networking between the private and public actors.

Copyright issues are also being addressed with a view to sharing model contracts in projects developing content for virtual learning environments by the end of 2001.

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The Development of On-line Educational Institutes: Malaysian Secondary School Experience

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The development of an open learning environment that can deliver education and training anytime, anywhere, is now not only feasible but also achievable. Using current and emerging information and communication technologies it is now possible to build the fully on-line institute even in schools. This is further booted by the introduction of Multimedia Super Corridor - Smart School flagship in Malaysia. This study will attempt to describe both technological solutions and an organizational culture capable of supporting such an educational institute to embrace change and proliferate in an information age. This study asks questions of, if technology is the key to participating in the Information age, what and how much technology is required and will be investigated. It has been suggested that the appropriate cultural climate; information and knowledge systems in a flexible format; and an Interactive Learning System capable of delivery are three key elements that will constitute the on-line institute.

Retrieval System of On-Line Kanji Dictionary with Learning Functions

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In this paper, the authors have attempted to develop a useful system in retrieving Kanji. It will be terribly difficult for non-Japanese people to master Kanji because Kanji characters are over 2000 and their shapes have much complexity. Especially it will be hard to retrieve Kanji with a conventional dictionary. Even if the user does not know any of Reading, the total number of Strokes, Radical, this system allows people to look up Kanji characters easily by only selecting its simple peculiarity like the number of vertical lines, a number of horizontal lines and four parameters. This system works effectively by just only mouse click when someone encounters an unfamiliar Kanji character. This system consists of the client and the server. The database of this system is updated when the user retrieves a certain Kanji. For that update, this on-line dictionary will become more useful.

Childrens' Attitude toward Internet

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The purpose of this study is to clarify the characteristics of the attitude towards the Internet with the comparison of an attitude toward the old medium. We use the picture-projection technique to measure attitudes toward media, that is, watching a movie, reading a newspaper, reading a comic book, reading a book, watching TV at home, talking with friends and using multimedia and the Internet. Two schools children, one used to the Internet and the other who has not used computers, were used as subjects. .Forty-five short sentences describing a communication situation were prepared, and children were asked to match these sentences to the pictures. The results show significant differences of attitude toward the Internet between two schools children. We find characteristics of the attitude toward the Internet is the possibility and awareness of the expansion of communication, on all-powerful feeling and the feeling of necessity.

A Survey of Current Computer Skill Standards and Implications for Teacher Education

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Abstract: Many national and provincial initiatives are underway to specify the technology skills that students must demonstrate at each grade level. The Government of the Province of Alberta in Canada has mandated the implementation of a new curriculum beginning in September 2000 called the *Information and Communication Technology Program of Studies*. This curriculum is infused within core courses and specifies what students are "expected to know, be able to do, and be like with respect to technology" (Alberta Learning, 2000). Since teachers are required to implement this new curriculum, school jurisdictions are turning to professional development strategies and hiring standards to meet this goal. This paper summarizes the results of a telephone survey administered to all public school jurisdictions in the Province of Alberta with a 100% response rate. We examined the computer skills that school jurisdictions require of newly hired and currently employed teachers and discuss the implications of standards.

Background

Various government authorities have recognized that Information and Communications Technology (ICT) has a major impact on our economy. The Alberta Science and Research Authority (1998) acknowledges that ICT is "the world's strongest, fastest growing economic sector" and the Government of Canada (2000) recognizes that "Canada can benefit by becoming a world leader in the development and use of advanced information and communications technologies." Furthermore, the U.S. Department of Education (2000) has realized that technology is transforming the American economy. As a result, these authorities are pursuing initiatives to incorporate technology into K-12 schools not only to prepare students for this new economy, but also because they see the "potential for technology to transform the teaching and learning experience" (U.S. Department of Education).

One initiative making an impact in the K-12 school system in Alberta is the integration of technology into the classroom. Beginning in September of 2000, Alberta Learning has mandated a new curriculum called the *Information and Communication Technology (ICT) Program of Studies*, which is to be infused within core courses and specifies what students are "expected to know, be able to do, and be like with respect to technology" (Alberta Learning, 2000). Since trained teachers are required to carry out this new curriculum, school administrators are turning to professional development strategies and hiring standards are being revised to meet this goal. This study examines the computer skill requirements of newly hired teachers reports any plans by school jurisdictions to implement changes in policy.

The Study

Purpose

The developments in technology over the past few years have influenced expectations by governments, school jurisdictions, teachers, parents, and students. Schools are being asked to prepare students to use technology in the 21st century. Since teachers are vital to an integration plan, they have been under pressure to learn and incorporate technology skills into their teaching. The purpose of this study is to become familiar with the current status of computer skills required for teachers being hired by school jurisdictions in Alberta, so the Faculty of Education at the University of Alberta can try to improve the match between the needed skills identified by the respondents of this study and the curriculum being offered. Whether school jurisdictions planned to change their computing skill requirements in the immediate future is investigated including what those changes might be.

Method

In January 2000, a letter explaining the purpose of the study was sent to the superintendents of each of the public, separate, and francophone school jurisdictions in Alberta with an attached interview guide. The superintendents were asked to nominate an appropriate person for participation in a 10-minute telephone interview. The designated respondents were then sent a copy of the contact letter along with the interview guide to provide them with an opportunity to review and prepare their responses. From February to April, participants were contacted by telephone to obtain informed consent for their voluntary participation in the structured telephone interview. A 100% response rate was obtained from the 60 representatives, one from each school jurisdiction. They included 17 superintendents, 22 assistant superintendents, 12 technology coordinators, 5 human resources representatives, and 4 other individuals who were nominated by the superintendent.

Limitations

Two limitations were identified during the study. First, participants' interpretation of requirements differed. While some considered only written policy to be a requirement, others had definitions of requirements that consisted of only expectations. To address this issue, the categories, "no, but expected" and "no, but ask in interview" were included in the coding of responses. The second limitation involved the sample of participants. Because participants differed in job position, they are likely to have different perspectives on hiring policy and/or different degrees of familiarity with applicant profiles. Furthermore, participants are likely to have different degrees of experience with technology, which would influence their interpretation of technology preparedness. No correction, however, could be made for this limitation.

Findings

Current Computer Skill Requirements for Newly Hired Teachers

The respondents were asked whether their jurisdiction had mandatory computer skill requirements for newly hired teachers. Seven respondents indicated that they did have such requirements, but three of these said they were minimal. One respondent stated: "Well, it's kind of an odd situation. We do have – we would have requirements. Unfortunately, they don't come with them, and so we have to hire and then train on their own. Many of them don't come with it." The other 53 respondents indicated that their jurisdiction did not require computer skills from their newly hired teachers. Of these respondents, 20 reported that while computer skills were not required, prospective teachers were asked if they had these skills during the interview. One respondent best summarized this: "We do, however, ask questions with regard to their level of competency in dealing with technology, and it is more or less a subjective as opposed to objective list of criteria." Twenty-two respondents indicated that while computer skills were not required, they were expected and were seen as an important asset. One typical respondent in this group said: "I think there is a general level of expectation related to that. For example, we would not place advertisement in any Alberta newspaper for a teaching vacancy that did not include some reference to our need to hire people with these skills." While it is important to note that the vast majority of respondents indicated that computer skills were viewed as very important, a few indicated that other skills and knowledge were more important than computer skills. One such respondent stated: "With an elementary generalist, computer skills is not a requirement and it would not be the decision-maker as to whether we hire or not. There would be many other things that would be more important to us in that hiring decision."

Expected Changes in Computer Skill Requirements for Newly Hired Teachers

We asked the respondents, who indicated their jurisdiction did not require computer skills from prospective teachers, whether their jurisdiction planned on introducing such a requirement. While five respondents said their school jurisdiction planned to implement such requirements, one did not know if they were being pursued and 28 responded that there were no plans to employ requirements. The jurisdictions that planned to introduce requirements were not at a stage where they could describe their proposal, but one respondent summarized the general tone that they were going to "step up the volume, so to speak," in what they would require from new teachers and computer skill requirements." The respondents, who said there were no plans for requirements, raised specific issues about requirements. These issues are well represented by the following quotations: 1) "The only time we would ask for specific skills with regard to technology would be when we're looking for teachers who are going to be teaching in the CTS area – especially in that area," 2) "I think the question that our board is asking is - the resources that we put into technology – are they making a difference for student learning?" and 3) "I still believe strongly that give me a teacher with a good attitude and I can teach them the rest, so no, I would not choose a candidate who has high computer skills over a candidate who demonstrates a very positive attitude."

Nineteen respondents indicated that they would like to implement such standards, but identified some reason why they could not do so. The majority of these respondents indicated they would experience trouble finding applicants with these skills:

> "We'd like to [implement requirements]. It would be pretty darn hard to do so. ... I'll tell you, though, that if we have got an applicant who has got that kind of knowledge – that instructional knowledge in how to use multimedia tools and such – digital cameras, scanners, you name it – they would certainly have a definite edge in employment over anyone else. At this stage, we could not require that, and, you know, demand a certificate, for example, or even coursework in that area, because we certainly wouldn't get the applicants."

Another respondent, however, felt applicants met their expectations: "In general, we are finding that the majority of teachers coming to us now have the skills we need in terms of basic computer use and are comfortable with it." In this case, the respondent indicated that her/his jurisdiction was interested in basic skills such as being able to use e-mail and word processing.

What Kinds of Computer Skills are Required or Expected?

We asked the respondents to identify what kinds of computer skills they required or expected their teachers to have. Fifty-five of the 60 respondents answered this question and each respondent could give multiple answers. Of the 55 respondents, 50 identified "basic skills" as required. Basic skills were generally defined as being able to utilize word processors, spreadsheets, databases, presentation software, and the Internet. Twenty-eight respondents indicated that knowledge of technology integration into the curriculum was also required and five identified subject-specific skills. One respondent described the challenge in specifying skills: "I guess part of the difficulty is you are trying to draw a line in the sand in the middle of a sandstorm because the line is going to keep moving."

The issue of what kind of computer skills teachers should have was one of the areas that created the most divergence in answers. All 28 of the respondents, who included technology integration in their list of skills, also indicated they understood that to do this their teachers would need a command of basic computer skills; however, 22 respondents did not indicate that their teachers needed more than basic computer skills. Many of those who said teachers needed to be able to integrate technology into the curriculum felt very strongly about this point. One respondent said, "we're really looking for people who can build this bridge between technological expertise and helping kids learn better, more effectively, more quickly than previously." Another respondent from a jurisdiction that requires computing skills outlined their teacher performance expectation that

> "the teacher utilizes computer technology successfully to assist in the delivery, enrichment, remediation, and monitoring of student learning. This would include content presentation, delivery and research applications, enrichment and remediation where appropriate, word processing, information management and record keeping, and electronic network usage. The extent to which technology is utilized will vary depending on the age of the students and the availability of hardware and software."

The respondent went on to state that hardware and software were "very available" in that jurisdiction. A different respondent was quite specific that

> "particularly for new people who are entering the field of teaching, I think it is not unrealistic to expect that they have complete familiarity with technology and are able to have a comfort level – certainly how they integrate it into the instructional process, I think is part of the training that they go through in university and in the actual experience that they receive in the schools, but I think they should have a general familiarity with operating systems, programs, etc., and should be comfortable with technology as opposed to afraid of it."

It must be noted that a few respondents were much less positive about the need for teachers to have computer skills. A statement from one respondent summarized this view: "My whole point is that the verdict is still out has technology really improved learning for students? ... We spent all this money and that on the technology, and do we really see better teaching and better learning that's going on? I don't know. I hope so."

Issues and Implications for Policy and Practice

A number of issues emerged from this study that have implications for both policy and practice. These issues will provide a foundation for future discussion about the implementation of standards and inform school administrators about the current state of hiring policy in the province of Alberta.

Preservice Teacher Education

Extent of Preparation

Several respondents suggested that it is not unrealistic to expect that universities should be graduating students who have "complete familiarity with technology and how to integrate it" within the curriculum. While this perception is shared among many of the respondents, there is a difference in opinion as to whether universities are fulfilling this role. The responses vary from the view that "many applicants do not come with requirements so we have to hire and train them" to those who believe "universities have skill requirements for graduates which are going to essentially allow us to put something down on paper saying this is what you need to teach here." Those respondents who were more critical of the extent to which universities prepared teachers to use technology indicated that the "courses being offered were not keying in on curriculum integration." Regardless of the expectation of the extent of technology preparation at universities, respondents often reported that "the more [graduates] have when they come, the less we have to train and the better we feel that they would be," and, furthermore, "it would save [jurisdictions] a fairly large cost in terms of professional development."

A few jurisdictions are taking advantage of student teachers and new teachers who are placed in the school. One respondent said "we have used student teachers on practicum to actually come out and act as peer tutors with some of our teachers to upgrade their technical skills," and another said, "of course, we expect [new teachers] to be [more skilled] and hopefully they are, so they are the ones who can turn around and help the older teachers." Not all respondents, however, were happy with the level of knowledge student teachers had with regard to integration of technology into the curriculum. One respondent summarized this concern, "we had student teachers out here and I talked about integration of technology into the curriculum and they said – they were on their last practicum – and they said 'we don't know anything about that.' I said, 'oh, that's interesting.' So, then I guess my thought is as superintendent is well, now we even have to train those coming out of university."

Hiring Standards

Written Policy vs. "De facto" Requirements

Any discussion of ICT curriculum and requirements for students must eventually lead to dialogue about the implementation of that curriculum with reference to requirements for teachers. Our study found that some school jurisdictions have their requirements for teachers written into public policy, whereas others instead held "de facto" requirements. In the latter case, although policy requirements were not implemented, there may still be implications for teachers who do not meet expectations. One respondent, who said computer skills are not required at this point in time, summarizes the de facto requirement: "What we're trying to do is provide opportunities for the teachers to

t forcing the teachers to do so, but with the understanding that more and more administrators are looking for those skills, so if they don't upgrade then their opportunity for placement or

Whether requirements are written in policy or not, it is important for school administrators to get "a clear sense of [their] own expectations for technology-using educators if [they] are to prepare future teachers for appropriate use of technology in their classrooms" (Gillingham & Topper, 1999). The benefit of using written policy to communicate those expectations would be the consistency of those requirements across a school jurisdiction. Most respondents made note that the hiring process is now site-based as opposed to centralized and the implementation and/or enforcement of requirements for teachers are often at the discretion of the principal. For example, one respondent asked, "Is there a sense of understanding that many of the inservice requirements and the hiring practices have moved to school sites?" Written policy would also communicate those expectations explicitly to universities offering teacher education programs, so that preservice teachers can be better prepared for their placements after graduation.

In contrast, the implementation of policy requirements may have a negative effect on the needs of the teachers learning technology. For example, schools may have different needs and obstacles to meeting requirements. One respondent summarized this point: "We looked at our own unique needs for our teachers ... So, I think any school that has technology, and all do, have different provisions for their teachers to access information and support."

The Need for Standards

There is much debate about whether there should be standards for computer use for students and teachers. In Alberta, where this study was undertaken, the government has mandated the *ICT Program of Studies* for students. Almost universally, respondents acknowledged that this was one of the major reasons (in some cases, it was the only reason mentioned) for their jurisdiction introducing technology skill requirements or expectations for their teachers. No one complained that the ICT Program of Studies had been implemented. Some commented that the government had taken too long implementing these standards or had mismanaged their introduction:

> "I would say the implementation of technology in the classroom would be the single most bungled educational initiative in Alberta if not the world over the last 20 years, and I think it's only now we're figuring out what this is really about. This can work for us and work well with enough resources if we continue to focus on the connection between technology and learning."

Consensus seemed to be that standards for students had been mandated and their schools were complying. However, questions seemed to emerge around issue of teacher standards: Should all teachers have ICT skills? What level of skills was necessary? Should teachers learn how to integrate technology in their teaching? Should older teachers be "grandfathered" and only new teachers be required to meet certain standards? Without a mandated standard for teachers, jurisdictions are answering each of these questions differently.

Technology standards for teachers have been created (ISTE Accreditation and Standards Committee, 1996) and in areas like California (Swofford, 1999) standards have been mandated for new teachers only. It may be that the solution to many of the questions raised above may entail the mandatory implementation of standards in the province for both new and existing teachers.

Conclusion

The eventual success or failure of any computing initiative is shaped by the individual teacher (Collis, 1996). To preserve financial investments in technology infrastructure and to prepare students for the new economy of the 21st century, school administrators must look to teacher training and technology standards. Since administrators and teachers are entering new territory with respect to technology implementation, it became apparent that many respondents were eager to know what other school jurisdictions were doing with respect to professional development and hiring standards. This is evidenced by the 100% response rate that was obtained. Many participants provided additional supportive comments about the pursuit of research in this area. For example, one respondent said, "Well, may I say right off the top that I'm really pleased this is being done, because this is an area t you are taking this initiative." Further research is recommended in this area to begin to address some of the specific themes and questions identified by this study.

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Human-Centred Use and Development of Information Systems

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Abstract: A human-centred approach to the use and development of computerised information systems (IS) is needed to complement the prevalent technocentric way of designing and utilising the applications of IS. The human-centred approach emphasises the need to understand the computer and the human being as an entity the design of which should be based on knowledge of human behaviour both during the development and the use of IS. This paper describes two interrelated studies in which the human-centred idea is concretised by examined the nature of university students' argumentative e-mail discussions, and the IS designers' conceptions of the human being in the context of information systems development.

Introduction

The change towards an information society has been effectively implemented throughout the industrialised world with the aid of information technology (IT) during the past decade. An information society can be defined as a global network built on IT. The nature and qualities of this network are conditioned to a great extent by the information systems (IS) which are developed to connect IT and human beings. An essential task in an information society is to develop technological innovations, applications of information technology, in particular (Webster 1995). Thus, while information systems pervade almost all aspects of human life, they also mediate and condition human action in many ways. In this new situation it is important to clarify how information systems are integrated to human action. The foci of research should, thus, be on both the use and development of information systems.

An essential task of information systems development (ISD) - a process consisting of requirements analysis, logical, physical, and program design, as well as implementation (Friedman & Cornford 1989, p. 178) - is to provide tools for human beings to exploit the technological infrastructure for various purposes. The process of ISD and its outcomes change human action in many ways. However, the focus in ISD has traditionally been on technological questions. Technocentrism and technological determinism are common ways of thinking within research in the field of IS (Jones 1991), and also flourish among IS professionals (Isomäki 1999). The importance of taking human characteristics into account in the development process has not been fully recognised (Kirby et. al 1995). The cognitive quality of information systems, for instance, has seldom been developed (Zucchermaglio 1993). In addition, current ISD lacks appropriate techniques for analysing human activity in certain contexts (Maguire & Graham 1998). It is evident that the properties of future information systems should meet, not only technical requirements, but also various kinds of human cognitive, emotional and social characteristics. In particular, human needs such as work satisfaction, self-efficacy, and need to learn should be paid attention to. For this reason, expertise concerning human characteristics and behaviour is necessary in information systems development.

Recent studies have shown that the use of contemporary information and communication systems has increased and enriched students' interaction (Ruberg et. al 1996), and developed university students' argumentation skills (Marttunen 1997). Thus, these new technologies are well-suited in higher education whose essential goal is to promote students' higher-order thinking skills. However, not enough attention has been paid to the learning of students' argumentation, and communication skills at any levels of education (Laurinen & Marttunen 1998).

This article describes two studies which are included in a larger project (User's Cognitive Resources evoking Technology project, UCRET) concerning human-centred use and development of information systems (see Isomäki et al. in press). The focus in these two studies is on both the use and development of information systems. One study clarifies learning and the nature of students' argumentative discussions in a networked environment Another study clarifies information systems' professionals conception of the human being. The unifying theme of these two studies is the constructivistic approach to human learning and knowledge construction.

Constructivist Theory

According to constructivist theory, learning is regarded as vigorous cognitive activity in which people interpret their observations and knowledge on the basis of their previous knowledge and experiences. *Individual constructivism*, which is to a large extent based on the thoughts of Immanuel Kant and Jean Piaget, regards learning as an individual process and pays attention especially to the description of the cognitive structures and mental models of an individual (Phillips 1997). Individual constructivists also stress the importance of individual students' sensory-motor and conceptual activity during the learning process (Cobb 1994). *Socio-constructivism* (Vygotsky 1982), in contrast, regards learning mainly as a social process which is mediated, in particular, by human language. Socio-constructivism stresses especially the social, interactive and collaborative processes of learning (see Tynjälä 1999). Learning occurs when individuals construct knowledge and understanding by engaging in social discussions and activities concerning shared problems and tasks (Driver et al. 1994).

From the pedagogical point of view it is essential in constructivism is that in the learning process the learner is seen as an *active subject* who constantly defines and shapes his/her learning environment, by finding, for example, new paths in learning materials. An essential idea in constructivism is also that the learner's *previous knowledge* forms the basis for new learning. This means that existing structures of knowledge are elaborated, completed, and re-structured by combining new information with previous knowledge structures (Resnick 1989). Constructivism also stresses the importance of the *situation* in which learning occurs since learning is regarded as contextually bound and culturally mediated in nature (Lave & Wenger 1991). Finally, constructivism stresses the importance of *social interaction* in the learning process. Interaction, for example, in a multimedia or e-mail-environment makes it possible for a group to build new knowledge through the efficient delivery of information, discussion, negotiation, and argumentation.

Jonassen et al. (1993) emphasise that information technology and open learning systems support advanced knowledge acquisition by providing environments and thinking tools that include constructivistic conceptions of learning. Open learning systems, for example, can be characterised as need-driven, learner-initiated and conceptually and intellectually engaging in nature. Technology-based environments such as communication-based environments, simulations, hypermedia environments, and other multimedia-based learning software, engage the learner in tasks that facilitate knowledge construction. An example of such tasks could be an engagement in argumentative discussions in which new knowledge and understanding of issues are constructed by critically examining other students' points of view on the issues handled. Thus, it is important to clarify how modern information and communication technology can be applied in the development of such instructional methods that promote the cognitive skills that are essential in terms of the construction and selection of new knowledge.

In the study concerning IS experts' conceptions of the human being (Isomäki 1999) constructivism is applied in order to understand IS professionals' conception of the human being inherent in information systems development. During the process of ISD professionals are elaborating, supplementing and re-structuring their view of the user of the system (cf. Resnick 1989). This means that IS professionals' conception of the human being forms a basis for their understanding of the users of the system that they are building (Uljens 1991). This kind of knowledge creation occurs in reflective action, which involves constant contemplation of one's knowledge, beliefs and values with respect to the object of thought and action (Schön 1983). As Mathiassen (1998) points out, in modern communities of practice IS professionals co-operate in conformity with reflective action. In this way IS professionals experience and learn the knowledge, beliefs, norms and values that are valid in particular communities of practice (Brown & Duguid 1991; Lave & Wenger 1991). It is essential in reflective action to form an understanding of a design according to the situation at hand, and not to take one's previously formed view for granted (Schön 1983). With respect to the humanisation of IS this means that within the interactive and uncertain situations inherent in the development process the emphasis of investigation should be on IS professionals' reflections concerning the human being. Thus, it is essential to clarify the information systems professionals' conception of the human being.

Towards Humanised Information Systems

The aim of the UCRET project is to produce research knowledge which promotes human-centred information systems development. Traditionally, the human-centred view of ISD is understood as an approach often referred to as the tool perspective. Within the tool perspective attention is predominantly focussed on the computer, and the user of the computer is often forgotten (Nurminen 1986, p. 90). In this paper, a human-centred view in ISD means that the computer and the human being are seen as an entity in which it is essential to know how people behave when they use computers. That is to say, understanding human behaviour is the starting point and focus of reflection during systems development. This is a fundamental characteristic of the humanisation of IS which refers to application development aiming at adjusting information systems to human action.

The human being is the most important facet of an IS, and therefore, knowledge about human behaviour is needed as a basis for developing computerised information systems that esteem humans as thinking, feeling, social and cultural creatures with their own will. *Firstly*, it is necessary to know how people use information systems in order to accomplish tasks characteristic of human behaviour. Relevant questions are, for example, how do people interact with each other, how do they solve problems, and how do they construct knowledge with using computers. *Secondly*, it is important to know how the human being is taken into account within the information systems development processes. Important questions are, for example, how IS designers conceptualize human action, and what kind of conceptual structures of humanity are included in the theoretical models of IS methodologies. Human-centred information systems development can be understood as a cycle in which knowledge of the use of the systems is utilised in ISD, resulting in more humanised information systems which are again used and further examined. By utilising these principles in contemporary ISD it would be also possible to create more human-centred development procedures for information systems development.

The two studies described in this paper support the idea of the humanisation of computerised information systems in different ways. Information about learning of argumentation, and communication skills in computerised environments may be utilised in efforts to take human characteristics into account in ISD. For example, information about how the use of a communication system promotes argumentation and problem-solving skills can be utilised when designing and investigating new communication systems. Information about the argumentative structure of e-mail messages may support the development of such applications that help users to gain well-grounded decisions in situations involving conflicting interests. An example of this kind of application could be an extension to an electronic commerce application that helps the customer and vendor to agree on disagreements about purchases. In addition, applications whose design is based on knowledge of human problem solving or argumentation patterns could facilitate interaction between users and IS designers during the process of information systems development. Moreover, information about IS designers' ways of conceptualising humans as users of information systems may be utilised in analysing the educational needs of information systems specialists. This is significant in regard to innovative applications of modern information technology supporting human action in diverse situations. In order to evolve, the application of modern information technology is increasingly dependent on knowledge of human behaviour. The following sections demonstrate the main research results achieved in the two studies of the UCRET project.

Quality of E-mail and Face-to-Face Argumentation During University Studies

The study examines the quality of university students' (n = 27) argumentative e-mail (n = 11) and face-to-face (n = 16) discussions. The discussions were based on argumentative writings. Free debate and role play were used as working methods in organising the discussions. During free debate the students defended their personal opinions while in the role play, half of the students were given a point of view that they had to support, and the other half were given an opposing standpoint. The data in the study consist of 326 student e-mail messages, and transcribed face-to-face discussions (7 x 1,5 hours).

The results showed that the e-mail students mainly took a neutral position in relation to a fellow student's standpoint while the face-to-face students, in contrast, mostly expressed agreement. The amount of disagreement was about the same in both environments. The e-mail students, however, grounded their disagreement and put forward elaborative agreement more often than the face-to-face students. These results suggest that the e-mail students presented higher quality argumentation than the face-to-face students. One explanation for the face-to-face students' worse performance is that oral face-to-face discussion is a social situation in which particular social rules must be obeyed. These rules include the giving of emotional support to others and the endeavour to maintain group cohesion during the discussions, as happened in this study. The students showed this support especially during role play by making short non-grounded disagreeing comments against those belonging to the group who had the opposing role, and by producing short non-elaborated agreeing comments to those belonging to their own side in the role play. The written e-mail discussion situation does not include as distinct social rules as the face-to-face situation. This gives the e-mail students better opportunities to put forward more carefully grounded and more elaborated opinions than face-to-face students. Furthermore, the results indicated that the proportion of grounded disagreement was higher in role play than in free debate among both the e-mail and face-to-face students. Thus, it can be preliminarily concluded that role play as a working method motivates students to engage in argumentative discussions more successfully than does free debate. The details of the study are presented in Marttunen and Laurinen (in press).

Information Systems Designers' Conception of the Human Being

The aim of the study is to clarify *the Finnish information systems (IS) experts' conception of the human being as a user of computer-based information systems.* The question is explored from a phenomenographical point of view. Within this approach essential features of awareness signify that certain structures of awareness are implied by certain ways of understanding. This means that an individual is simultaneously aware of certain aspects of a situation or a phenomenon, and this awareness of certain aspects logically implies a tacit awareness of other aspects. In addition, certain aspects become focal whereas other aspects recede into the background. The simultaneous nature of the different aspects of awareness are denoted by what- and how-aspects - a special case of the notion of intentionality (Marton & Booth 1997). The thematic interviews of the study were based on the results of a pilot study. The themes of the interviews were focussed on human issues from the different viewpoints of the phases or situations of information systems development (ISD). The subjects of the study comprised 20 information systems experts from seven different enterprises representing the major fields of Finnish information industry.

The results indicate that the IS experts' focus of thought often is on the situational features of ISD and that human issues are omitted. The IS experts tend to conceptualize users through the intentions of the situation in question rather than by connecting characteristics typical of the human being to the user. For example, the human being is conceptualised in terms of business, information technology, job titles and work tasks. Some of the experts reflect on their work in relation to the user but contemplate the human characteristics through themselves. The descriptions connected directly to users centralise around an emotionalist view of the human being: users are seen as emotionally reacting creatures often afraid of computers. In addition, emotionally shaded enthusiasm is regarded as a desired basis of motivation for co-operation and learning. In some cases the conceptions with focus on the users also denote that users are ignorant concerning information systems and that they use information systems in a simple manner. The study suggests, first, that human action or characteristics are not always taken as a design premise in contemporary ISD, and second, that IS experts do not possess holistic knowledge about human behaviour. In this sense the results are in accordance with Swanson's (1988, pp. 43 – 51) definitions of the mechanistic and the utilitarian approaches to information systems development. According to the results of this study, however, the reflective comprehension (Swanson 1988, p. 53) way of thinking is not common among the contemporary IS professionals. The more detailed description of the preliminary results is presented in Isomäki (1999).

Conclusion

The research results of this paper showed that the learning environments based on the use of information and communication technology are effective when the aim is to promote the construction of new knowledge. This is indicated by the results showing that students' argumentation skills developed when an e-mail learning environment was utilised in teaching. The results of another study indicated that IS experts tend to conceptualize users through the contextual features of information systems development rather than by connecting characteristics typical of the human being to the user. For example, the human being is conceptualised in terms of business, information technology, job titles and work tasks. Some of the experts reflect on their work in relation to the user but contemplate the human characteristics through themselves. The descriptions that are connected directly to users centralise around an emotionalist view of the human being. On the basis of the results it seems evident that human action or characteristics are not always taken as a design premise in contemporary ISD. Furthermore, IS experts see humans in terms of their emotional characteristics.

The results described in this paper have shed some light on the topical questions concerning the humanisation of information systems. The results of the project have clarified the role and learning potential of the human being in a computerised environment and the ways in which the human characteristics are seen in regard to the development of information systems. However, another essential aspect of the humanisation of IS concerns the question of how to integrate the research results gained from both the use and development of information systems in order to promote more humanised ways of developing information systems. This question stills awaits future research.

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A prototype for optimizing Web browsing in wireless environment

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This paper describe a prototype that makes it possible to run WWW applications in wireless networks. Web technology in conjunction with today mobile devices (laptops, notebooks, personal digital assistants) and the emerging wireless technologies offer the potential for access to data and applications by mobile workers. Now the limited bandthwith, high latency, high cost and poor reliability of today wireless networks inhibit supporting web applications over this type of networks. TheWirelessWeb prototype reduce the respone time by intercepting the HTTP data stream and performing various optimisations including: file caching, protocol reduction, and elimination of the redundant HTTP header transmision.This paper describe these possible optimisations and some experimental results.

Incorporating Computer Assisted Learning into the Teaching of Cultural Studies: The Virtual Shopping Mall Case Study

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The Virtual Shopping Mall introduces first-year students to the critical study of consumerism and commodity culture via a web-based learning environment that interpellates and motivates student learning through the strategic adoption of the architectures of computer games. Using hybridized learning and game protocols, the Virtual Shopping Mall provides a thematically coherent environment - the mall - to afford situated learning. This paper describes the development of the project, locating it within the research fields relating to game-based and situated learning. It describes each of the four components of the module - Sales Pitch, Just Looking, Quiz Zone and Retail Therapy - and the ludic motivations and critical competencies they are designed to elicit. This paper describes the three-pronged evaluation strategy put in place to test the pedagogic hypotheses of the pilot module and ensure effective redesign as necessary.

Cyber-based Service Learning: Community Projects in Africa

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Abstract: Results from a pilot project on cyber-based service learning in Nigeria are reported. Students worked on three projects with Nigerian organizations through electronic media. US students learned the applied aspects of working within a developing country and the different twists that conceptually similar problems might have in a developing country context. Community organizations received valuable help from students who were more connected to the internet and other materials than was available in Nigeria. Future community engagement projects are planned for Nigeria and Moldova.

Electronically mediated learning has become relatively commonplace at the university level, as asynchronous learning has enabled distance education not only for single courses, but in the establishment of virtual universities. Some of the original enthusiasm has waned, however, as universities became aware that asynchronous learning might not be an effective replacement for interactive learning or hands on applications. It has become evident that in some cases technology needs to be appropriately placed within a larger learning experience, and that teaching pedagogies be expanded to included different modes of learning. What has also become obvious is that technology is not an equalizer: there are significant areas of the globe that cannot benefit from uniform levels of electronically mediated education. Even within more developed countries, we find entire groups of people who are marginalized from technology's 'democratization of information'.

The University of Wisconsin-Parkside has begun a project to introduce cross-cultural, electronically mediated learning experiences that allow students to not only interact with other students on a learning topic, but also to engage in virtual community engagement, where participants can actually participate, electronically, on community projects in other countries using expertise from their home country. A test project has been successfully implemented with Nigerian organizations, and new courses involving womens' organizations in Moldova, and a German University are being offered in upcoming semesters.

The first course, Community Projects in Africa, involved students in the United States in three projects undertaken by Nigerian organizations. Initial communication was initiated through pictures sent over email, and introductions. Traditional media (video and tapes) were provided by the Nigerian organizations to give students an introduction to the Nigerian social context. Projects included an AIDS conflict resolution in central Nigeria, peer health education programs in Oriade, and the negotiation of an environmental contract between local governments and Shell Oil in Port Harcourt. Students communicated directly with community workers on these projects through email and internet connections. The product of the course was a complete project analysis and recommendation done by the students and transmitted to organizations, after a site critique was provided to the students.

To the more electronically sophisticated participant, this may seem like a simple exercise. In reality it was nothing short of miraculous. The organizations worked with only one computer at times, and were working under conditions of variable electricity and unstable political situations. Normally, these would be the marginalized sectors mentioned earlier. However, it is imperative that the electronic connections to these locales be appropriate to the level of technological, social, and economic development of the participating country. Too often, developing countries are left out of this learning opportunity because it is simply too difficult. While the courses might be offered through traditional email participation, compressed video is an ideal format for the exchange, so that participants can 'see' the others in the virtual classroom, even though it may be thousands of miles away. It must be emphasized that the project works within easily available technology- we are not proposing the creation of a virtual reality site- such an endeavour is beyond the scope of the participating institutions.

The results were very encouraging. Students participated in virtual learning, obtaining international experience, while maintaining a local opportunity to practice what they are learning. One of the most pedagogically interesting results was that students stated they had, for the first time, a real understanding of what it means to be a developing country. Even though they understood the concept theoretically, when in practice they experienced the consequences of no electricity, political difficulties, and a marginal phone system they truly understood what it might be like to work productively in the community under these circumstances. The concept of development came through the learning object, rather than through a content oriented lecture. Faculty also benefit through the offering of courses with this multinational contingent in mind, thus providing a motivation to 'internationalize' the course, and also make it more culturally sensitive. There are pedagogical issues at work here, also, since the faculty member must exercise more flexibility in the course (communications are sporadic and non reliable) and be able to encourage independent learning for the students, as well as a sense of community both between the two countries and within the class at home. The experience resulted in a tight knit learning group, which some faculty may need to become accustomed to.

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"To DIE for!" - Declaratice, Interrogative and Experiential Learning of (Geo)Science on the Web

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This project outlines a program including the development, delivery and evaluation over the last four years of online learning programmes to senior science and geoscience undergraduates within a larger Faculty and University Online development project. Lotus Domino was initially used as the software database engine to compile, manage, store and present the course materials. As an example, for one geoscience subject nearly 500 web pages have been compiled and delivered online to the students. Evaluations of this teaching and learning program indicate its overall acceptance and improvement in course delivery to students due to increased flexibility.

Towards Universal Access to Web-based Learning

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Abstract: Universal access to the Web as a learning resource may be facilitated by the use of an adaptive Web based learner support system. This paper describes how modifications to the CAIN system can achieve this aim by matching the cognitive load imposed by Web text pages with the working memory capacities of users.

People who are disabled often experience social isolation, as do many elderly people because their friends die or their family members move away. There is therefore considerable value in the development of software that helps to provide such people with new interests in addition to supporting their access to friends and relatives (Katz & Aspden 1997).

The World Wide Web (Web) appears to offer a vast repository of educationally useful information that would be useful in supporting the development of new interests and further learning for people who are elderly or disabled. However, the Web's disorganized nature reduces its effectiveness as a learning tool and as a tool that enables people to pursue new interests. Therefore, further research is needed to develop the means to transform the available material into coherent information able to support learning or research activities (Eklund & Ziegler 1996; Marshall 1995).

The Computer Aided Information Navigation project (CAIN) (Lamas, Jerrams-Smith, Gouveia & Heathcote 2000) is an example of a Web-based Adaptive Learner Support System. As such, it provides adaptive navigation support in order to increase the Web's value as a learning tool (and one that enables people to pursue new interests). CAIN's approach is reactive as it seeks to provide a way of dealing with the vast amount of useful information currently available on the Web rather than trying to improve the Web's infrastructure.

CAIN provides direct guidance navigation support by enabling the user to follow a context specific ranked sequence of selected Web pages without ever needing to perform any search or follow any link if they do not wish to. This approach does not seek to prevent goal-oriented exploration but rather to provide a reliable path or guideline to help users to retain their focus.

CAIN includes heuristics that use information about the user (stored in a user model) and about each of the Web pages (stored in a Web model). This enables the selection and ranking of the most suitable Web pages for each individual user.

Although CAIN provides adaptivity to suit the needs of different users, it needs to be extended in order to meet the specific needs of a much wider range of users and to enable *universal access*. Our current work therefore entails consideration of the various physical and cognitive attributes of users that affect their learning via the Web. Consequently, CAIN's user modeler will be modified so that the user model will take account of the individual's physical and cognitive attributes. In addition, changes must be made to the way in which the Web is modeled by CAIN.

Cognitive factors which are likely to be influential during learning include working memory capacity and motivation. Of these, working memory capacity appears to be important for learning (Baddeley 1997). In addition, our investigations indicate that it is also likely to be one of the cognitive attributes that can be supported by adaptive learner support systems such as CAIN. We suggest this for the following reasons. First, working memory capacity can be tested in a reliable manner. An existing procedure for testing users'

working memory span is quick, easy to administer, reliable and well-
1980). Very minor extensions to CAIN's user modeler will enable such information to be added to the user model.

ques for rating the suitability of Web resources for use by individuals of differing working memory capacity. Currently, all ratings are added to the Web model of CAIN by experts
e necessary to automate this process as much as possible. We are therefore developing software to carry out automated rating of Web

(Gathercole & Baddeley 1993) suggest that the
ioad on working memory capacity. This is because syntactic analysis loads the central executive component of working memory. An empirical study (King and Just 1991) categorized participants as e
working memory span. It was found that the comprehension performance of low span participants was particularly poor when they were required to read syntactically complex sentences. It is proposed that an
t to examine the interaction between working memory span and the syntactic complexity of Web text pages. Automation of rating the syntactic complexity of a page will be
arser.

use of passive verbs and of negatives, especially the use of double negatives. Finally, we intend to carry out an empirical study which wil
hence learning from pages of differing complexity as measured by Fog indices such as the Gunning Fog index (Gunning & Kallan 1994). The Gunning Fog index rates text complexity on the bas
as the proportion of words of greater than three syllables and the average sentence length. If Fog indices do indeed predict which pages will be more valuable for subjects who have lower working memory capacity,
ly straightforward to write the software to provide a Fog index rating for each page.

comprehensibility of text. These combinations will be tested empirically and compared with working

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A Rich Learning Environment Is Yet To Come: An Action Evaluation on a National eLearning Project for Elementary Education in Taiwan

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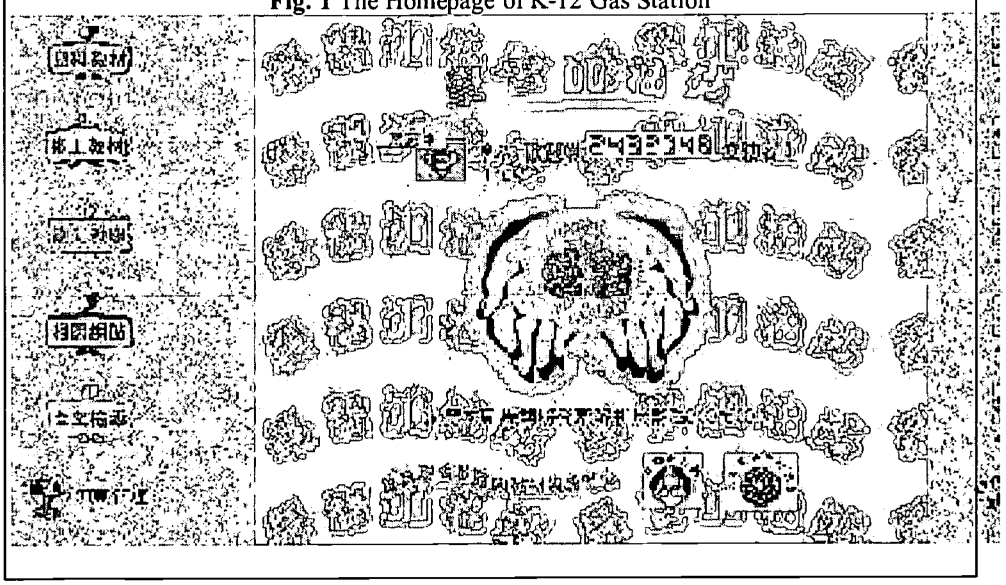
Abstract: Over 250 teachers and principles from eighty elementary and middle schools, representing twenty-five executive districts, selected to serve as Change Agents of a national web project named K-12 Gas Station. Their major tasks are to design, produce, and implement web-based courseware on the ". Besides the expense on the hardware and courseware in the project, there have literally been over twenty thousand seminars/workshops on computer-based education funded each week for in-service teachers at all levels K-12. The actual effectiveness or impact of such diligence is now generally considered suspect. The action evaluation of this project revealed that the whole project should make a sharp turn. The author, a consultant of this national project, has made complete and precise suggestions on the revision of the project. This paper is a condensed report of this research.

The National eLearning Project

Bringing rich learning environment to students in grades K-12 is a high priority for the Ministry of Education in Taiwan. If we are going to bring quality e-learning materials to all students, produce technology literate citizens, and meet the national education goal to be first in the world in academic achievement, we must provide teachers and pupils with rich content for all subject matters in grades K-12. To reach certain apex-level goal, the Ministry of Education has to deal with the major problems of low availability of computer hardware, insufficient courseware and incompetent humanware.

Taiwan educators have invested in the technology of internet-based classrooms. The Ministry of Education at Taiwan has granted 25 million US dollars for courseware and at least one billion US dollars for island-wide wired campus infrastructure at 1997- 2000 fiscal years. Over 250 teachers and principles from eighty elementary and middle schools, representing twenty-five executive districts, selected to serve as Change Agents of the "K-12 Gas Station" (a virtual Learning Resources Center at http://content.edu.tw; Fig. 1). Their major tasks are to design,

Fig. 1 The Homepage of K-12 Gas Station



produce, and implement web-based courseware on the "Learning Resources Center Project" (http://content.edu.tw). The incentives provided to those Change Agents were: (a) grants ranging from $40,000~60,000 for courseware development per year; (b) free-of-charge training workshops; (c) opportunities to lead regional workshops; (d) all-expenses paid trips to present materials/workshops developed at regional and national professional conferences; and (e) stipend for better performer. All Change Agents met every other month during the school year to discuss issues. They share ideas, results, and frustrations via the e-mail and TANET. The project was overseen by a nine-professor steering committee and managed by a leadership team of seven government officers. The overarching goal of this project was to make a quality and quantity learning environment for K-12 schools in Taiwan. Besides the expense on the hardware and courseware in the project, there have literally been over twenty thousand seminars/workshops on computer-based education funded each week for in-service teachers at all levels K-12. The actual effectiveness or impact of such diligence is now generally considered suspect (e.g., Wu et al, 2000).

Action Evaluation of the Project

All participants function as reflective practitioners together, reflecting and examining the goals, values and activities. These interactions are done continuously during the project. The researcherserves as the counselor and engages in the project from the beginning, articulating and negotiating their goals, their values, and their proposed action plans. The action research described in this paper was performed as a counseling project for an eighteen-month research grant funded by the Ministry of Education to the researcher.

Information used to write this paper was collected from the following sources: (a) Review of documents: The researcher reviewed each school's proposal as well as the evaluation result for each. (b) Semi-structured focus-group: These interviews conducted by the researcher at the sites. Each interview lasted approximately two hours. In some cases, follow-up phone calls and e-mail were made to gather additional information. (c) Informal observations of workshop and training programs. The researcher made short, informal observations trainees participating in training activities. (d) peer-evaluation questionnaires: The questionnaire collected island-wide responses of 119 teachers concerning their instructional practices with computers, barriers of computer usage, needs for computer-based resources, educational background, and computer as well as curriculum in-service training. (e) e-mail communication and web-forum, and (f) the self-reflections of the researcher as a member of the steering committee. Besides these, Formal meetings and informal discussions with the MOE staff. These meetings and discussions were held between Feb. 2000 and Dec. 2000 and covered aspects of website planning. After all the site visits were completed, researchers conducted several meetings with MOE staffs to clarify revision as well as implementation issues.

Data from communications and interviews with participants strongly suggested that the whole project should make a sharp turn. Discussion among these change agents covered the important issues of vision, quality of web site, learnability of courseware and capabilities of teachers. The primary results described below are reported in terms of four aspects of the project because the researcherfeels that an exhaustive evaluation report is beyond the scope of this manuscript. The following are some major points emerging from these meta-analyses:

Vague Vision

The vision of the virtual Learning Resources center is far way from the crystal clear visibility. The education administrators, the computing education professionals and teachers as primary users brought different vision and expectations into the change agent team. At the first year, 'just put anything on the web' become the major misconception of the project (http://content.edu.tw). The reason why they treat it that way was that none of the change agent has ever had experience on web before. Unfortunately, the ambiguity lasted for three years. Until today, they still try to figure out the major goal of the project.

Wimp Website

A teacher views their professional responsibility as a process of continual, reflective inquiry and the exchange of ideas with their peers leading to the development of a shared community base. They value various opportunities to share their expertise with other teachers beyond the classroom or the school. Partnerships with community members, collaborations with colleagues, and engagement with and any educational activities do expand teachers' understanding of teaching practice in ways that are sometimes unavailable in school. Therefore, more availability of learning community access should be provided in order to encourage teachers' opportunities in terms of professional development. Nevertheless, the K-12 Gas Station with a WIMP (windows, icon, menu, and pointing device) interface is a 'wimp' system. On the one hand, the de-centralized infrastructure of the web servers is quite manpower demanding. On the other hand, the simplified features and structures (For instance, there is no database server for users to share their work) of web site could not meet the needs of 'sharing' information for virtual communities.

Incompetent Involvement

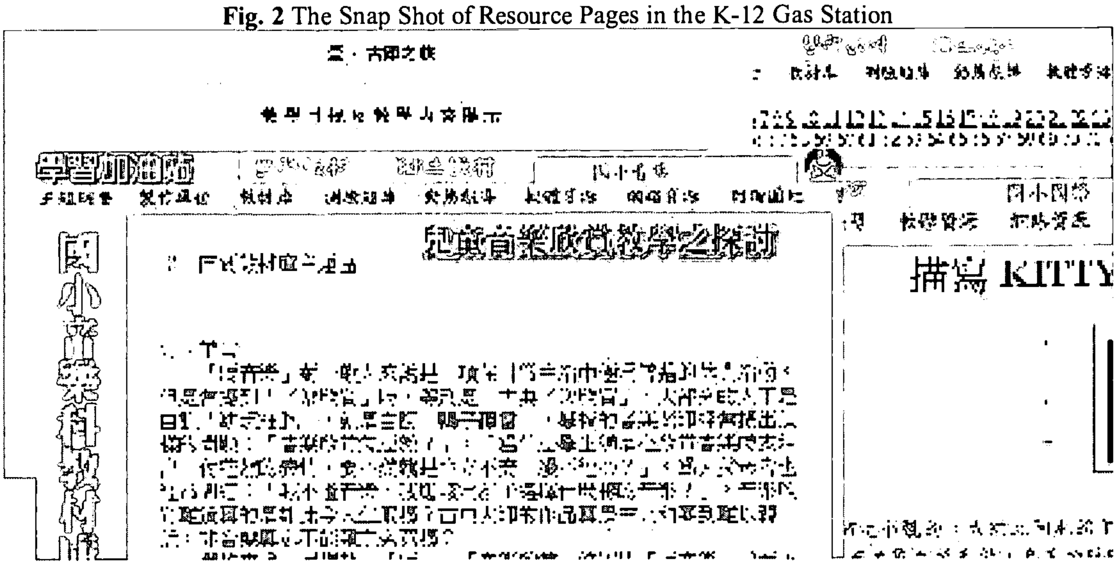
Although it cost a huge amount of budget, however the result terms out not so appealing. Several key persons of the Change Agents stated that they feel incapable about their involvement in the project and that the whole project is "just waste of time and money." Why? Because they never have been designed or produced any web-courseware before this national project taking off. Some change agents considered themselves as digitizer – who specializes in scanning photos and/or digitizes video clips. Some of them even could not find one single subject matter teachers in their schools. Anyone who can make (or locate somebody else do) better image processing works become the superstar of the whole group. Nevertheless, none of them is familiar with or heard the instructional design or systemic development of courseware.

Teachers, as well as administrators, parents, and community professionals, have a vital role to play in educational reform of K-12 in Taiwan. They need the following professional development supports: need a transformation model rather than a transmission model, need pedagogical strategies, need appropriate infrastructure and computer resources and need to model strategies, give guidance and feedback, allow for revision (Krajcik, 2000). However, certain support is absent from teacher training programs and the national project. Only few teachers might integrate the e-materials into their teaching and learning processes. Yet, K-12 teachers have had few opportunities either to increase their domain content background or to have many of the handy learning materials that have been shown to improve student interest and achievement in all area of subjects. Researchers and practitioners proclaimed that, for technology innovation to occur, teachers must feel that they are a part of the reform. However, the major role of teacher should and must be a user of the learning environment, not a one-man team developer.

Rare Resources

The leading characters in any gas station should be the gasoline itself. Consequently, rich learning resources in terms of raw materials, lesson plans, teaching guides, worksheets, activity books, references, and cooperative projects should be provided on the K-12 Gas Station. However, the major characters on the station are scanned pages or reprint pages of textbooks along with their teaching guides as well as published materials available for each teacher (Fig. 2). The real needs for learning resources is under development.

Fig. 2 The Snap Shot of Resource Pages in the K-12 Gas Station



Misjudged Needs

Educational administrators have too often placed computers in each school and teacher's classroom with innocent expectation that technology would and should emerge into classroom activities. However, the truth is teachers always didn't ask for computers nor internet and would not or should not have any specific plans for using those current or future technologies. Fewer than one fifth subjects (20.2%) reported having using computers in their own classroom. Over one third (37.0%) subjects view computers as a "Game station." Approximately one half (47.1%) subjects rank computers as a major factor for short-sight of pupils.

Compact Curricula

One non-technology problem is scheduling. Over one forth (28.6%) subjects proclaimed that the compact curriculum is a crucial barrier for computer uasge. Elementary teachers have many different subjects to cover and so many pupils to teach and guide. It is beyond all reason for most teachers to integrate computer technology into daily school works.

Inconvenient Instrument

The availability of computer is far from satisfaction in Taiwan's classrooms. Among those 119 subjects, 47 persons (39.5%) and 59 teachers (49.6%) complaint that there is no computer nor projector in their classrooms. Moreover, computers and internet often break down. Therefore, the difficult accession to technology becomes a major excuse for teachers not using computers into their teaching practices.

Conclusion

The real voyage of discovery consists not in seeking new landscapes, but in having new eyes. *– by Marcel Proust*

Learning is an active process and should call into play our fully imaginative and creative capabilities so that subject itself becomes a delight to learners of all ages. It is only when we make explicit use of new natures of learning technology that the "new" learning media would add multiple value to human learning of any subject. Many challenges to effective design remain in quality 'rich' learning environments. What recommended by Jonassen's group (1998) should be a good start for the reform of the on-going project. For instance, (a) authentic problem context or project space, (b) authentic tasks and activities, community of learners, (c) cases, examples or simulations that help explain the problem, (d) cognitive and collaborative knowledge-building tools, (e) cognitive apprenticeships, (d) rich information resources, (e) student options/choice and (f) assessment/standards (rubrics).
The researcher has made complete and precise suggestions (Tab. 1) on the revision of the project by the end of this century.

Table 1: Suggestions on the Improvement of the K-12 Gas Station Project

	What has been done (1997~2000)	What else needs to be improved (2001~)
Hardware aspect	Each school has at least one computer classroom equipped with TANET network.	✍✍ To put computers and projection devices into regular (not computer) classrooms. To actually let computers 'walk into' each classroom and become learning accompanies for teachers as well as students and/or parents. ✍✍ To make policy supporting the access of computers. ✍✍ To adopt virtual server idea for replacing local 'real' server at each local center.
Courseware aspect	To select and train Lead Teachers as Change Agent, who design and produce "below-average quality" courseware.	✍✍ To re-build a Website focusing on community-support features, such as, resources and information sharing mechanisms, challenge activity platforms, database servers and etc. ✍✍ To demand instructional design and development in courseware production. ✍✍ To stop the change agent project. ✍✍ To start an eCourseware Contest and use a quality-oriented criteria.

Humanware aspect	To provide basic training on windows application software.	✍✍ To provide with goal-oriented and quality request training program for in-service teachers ✍✍ To focus on technology-learning activity integration training.
Learning community aspect	To form Change Agent schools	✍✍ A teacher could participate in a learning community is vital for his/ or her professional development. The K-12 Gas Station should start a variety of real-world interest groups or clubs to encourage the individual interaction of continuing enhancement of teaching strategies, exploration of innovative technology use collaboratively and individually, and construction of ownership in the group. The real-world interactive group forms the cornerstone of the learning community via the K-12 Gas Station in the cyber space.

A comprehensive reform of the structure and function of the web-based learning resources center, ways of e-course design and development, and the teacher training programs is underway. This reform has been characterized as "quality oriented, deep, total solution, and serious." It is systemic, requiring that all components of the learning environments be partners in change. It is occurring at the national level, in the county level, in schools, and in individual classrooms. We look forward to the fruitful results of the follow-up reform.

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Design Principles of an Open Agent Architecture for a Web-based Learning Community

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Abstract: A Web-based learning community is far beyond putting learning materials into a Web site. It can be seen as a complex virtual organization with enormous work involved with people, cyber-environment, and facilities. There is an inevitable choice to use various agents to assist or replace human to a certain extent for the work in a virtual learning community. There is a strong need for the development of the designated architecture for integrating and using various agents. This research is focused on developing an open agent architecture that can easily integrate developed agents to a learning system and flexibly modify the agents with permission. This paper describes the design ideas of such desired architecture, demonstrates how the architecture system works, and explains three agents in a Web-based learning system, University21.

Introduction

With advances in the Internet and multimedia technologies, development of Web-based learning communities for K12, high education, lifelong learning of citizen has become a hot topic. However, establishing a Web-based learning community is far beyond putting learning materials into a Web site (Donath, 1997, Jones, 1997, Maynatt, 1997). A learning community is in fact a complex virtual organization (Ma, Huang, and Shin, 1999, Ma and Huang, 1999, Ma, Huang, and Kunii, 2000) involved with people, facilities, and cyber-environment. Tremendous work and manpower for maintaining, upgrading, and managing facilities and cyber-environment are required. Teaching/learning activities also require lots of assistance to release human from difficult and/or tedious work so as to achieve teaching/learning efficiency. With rapid developments of software agent technologies, it becomes a good choice to use various software agents (Johnson, 1998, Mengelle, etal, 1998) to assist or replace human for work in a virtual learning community. To efficiently conduct teaching, learning and management activities, many agents are required. In a virtual learning community, agents are mainly classified into three categories, personal agents, facility agents, and cyber-environment agents. Personal agents assist people for personal activities. Facility agents automatically provide monitoring, maintenance and upgrading of tools, systems, and resources. Cyber-environment agents are resided in virtual office, virtual private room, virtual courseroom, etc. for supporting teaching/learning related activities. Tab. 1 gives a list of only partial agents on demand in a virtual learning community system. Facing so many agents needed, it is natural to encounter a problem, that is, how to integrate agents to the virtual learning community system. It seems an architecture that allows easily and flexibly integrate developed agents is preferred. This motivates us to design and develop a so-called open agent architecture. Agents developed by different parties can be easily and flexibly integrated to a virtual learning community system via the open agent architecture. This paper is focused on describing the design principles of such desired architecture, demonstrates how the architecture system works, and describes some agents in University21 (Ma, Huang, and Kunii, 2000). Finally, conclusions are drawn and future work is addressed.

Personal Agents	Facility Agents	Cyber-environment Agents
- Personal scheduling agent - Friend-making agent - Mail/news filtering agent - Personality agent - Announcement agent - Meeting scheduling agent - Group forming agent	- System upgrading agent - Tools upgrading agent - Resource monitoring agent - Resource management agent - System maintenance agent - Tools maintenance agent - Security agent	- User administration agent - Curriculum administration agent - Web course maintenance agent - People awareness agent - Teaching/learning assistance agent * Authoring agent * Tutoring/pedagogical agent * Student learning monitoring agent * Assessment agent ......

Table 1: A list of partial agents on demand in a virtual learning system

The Design Principles

The open agent architecture is designed under the following emphases. (1) It should make system developers easy to integrate agents developed by other parties; (2) It should make agent developers flexible to upgrade or modify agents; (3) It should make agents transparent to users for use. It is necessary to point out that to be platform independent, the agent programs are written in Java language. The open agent architecture has the following three characteristics and can work in two modes: the centralized or the distributed

Ease

It means that a virtual leaning system can easily integrate an agent. In a centralized system, the system only needs to download the agent programs and unpack the agent programs, adds the agent name to the agent list, adds the agent IP address to the agent routing table, allocates a certain resource for the agent, and starts the agent server when the agent is requested by a user. In a distributed system, the system only needs a privilege to start/stop the agent server (Schmidt, 1998) and redirect users to a site where the agent programs reside and the agent server runs since agent programs are distributed in the local machine and resources are managed locally too.

Flexibility

It means that an agent can be flexibly added, removed, and modified with permission. In a centralized system, an agent can be flexibly registered or deregistered. Agent programs are uploaded or upgraded by the agent developer with permission. In a distributed system, an agent is only registered or unregistered with the agent name and address where the agent programs are resided. Uploading programs is not necessary. The agent developer can modify or upgrade the agent programs in his/her local site. The open architecture system is only given a privilege to start/stop the agent server in the remote site. When an agent is to be deregistered or upgraded, the system stops the agent server, deletes the agent name from the agent list, and removes the agent IP address from the agent routing table.

Transparency

It means that all registered agents are dynamically shown in the agent list with attached information like agent name, agent ID, server status, and program type. Whether an agent is available or not, whether an agent server is running or not, and whether an agent is being used or not, all those information is available to users. The server starts to run when a user makes a request of using the agent if the server is not running. The client program is automatically downloaded to the user site. If it is a Java applet, it automatically runs on the Web browser in the user side. Otherwise, the user runs Java application program with a simple command like *make run*.

The open agent architecture system is designed under the above emphases with features of ease, flexibility, and transparency. Fig. 1 gives a system architecture that consists of four basic layers: client, agent, platform and external layers.

- In the client layer, TCP protocol is used for client-to-client communications via the agent server. The agent server is running and then waiting for connections from its clients. After the connections are established, communications among the clients are conducted through the TCP protocol.

- In the agent layer, socket connection is used in a centralized system while IIOP (Internet Inter-ORB Protocol) (Schmidt, 1998) which runs atop the TCP transport protocol is used in a distributed system for communications among agents via the messenger.
- In the platform layer, the function modules of the open agent architecture are provided. This layer is further divided into two parts: system components and external system connection components. The system components consist of agent manager, agent data holder, and messenger. The external system connection components provide various proxy servers corresponding protocols that are ready for connection to external devices or systems. The request of using an external device or system is analyzed by the connection adaptor and the inquiry agent is connected to the corresponding proxy server.
- In the external layer, it places devices and/or systems that agents may require to connect, such as HTTP Server, Mail Server, FTP server, the Internet, database, search engine, etc.

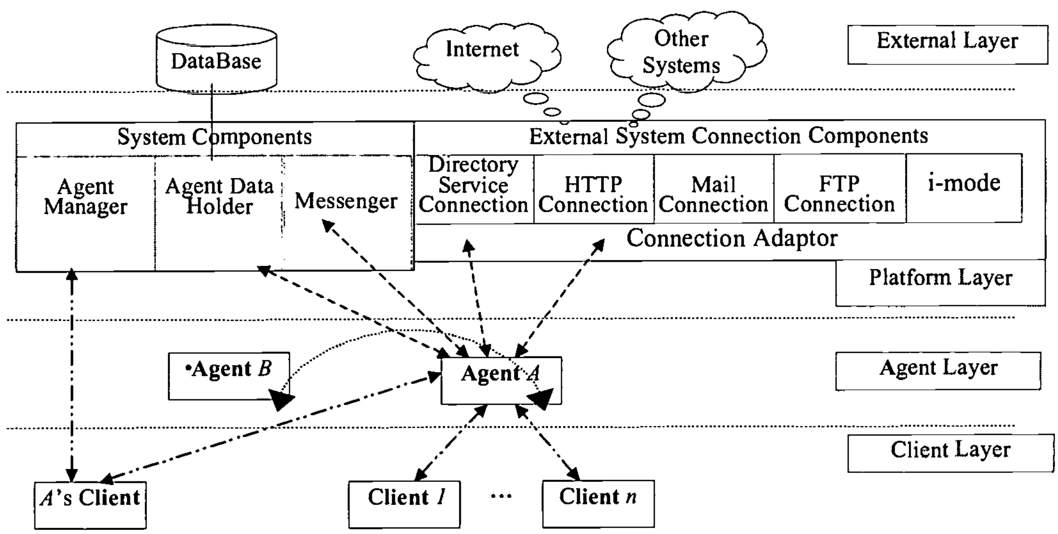

Figure 1: A basic composition of the open agent architecture

The Function Modules

How an agent is functioning in the client layer is relied on the agent (agent server and client programs) rather than the open architecture system. The most core functions of the open architecture system are provided in the platform layer. In this section, we will discuss each function module below.

Agent Manager

Agent management is a function module of operating an agent life cycle on the open agent architecture platform. It mainly provides functions like agent registration, upgrading, deregistration, running an agent server, connection of agent clients to the agent server, and front-end functions to the agent data holder.

To register a developed agent to the open agent architecture platform, an agent developer accesses a web page and clicks *register* button, and then an agent registration page is popped up. The developer inputs necessary agent related information, such as agent name, agent IP address, agent program package name, agent working mode, and server execution command. For working in the centralized mode, the agent program package (*.jar file) is uploaded, unpacked and placed to the host where the agent manager is resided. At the same time, agent related information is sent to the agent data holder by calling method *addAgent()*. For example, an agent name is added to the agent list and agent IP address is added to the agent routing table in the agent data holder. A space allocation request is also sent to the database via the agent data holder. The process of agent registration is shown in Fig. 2.

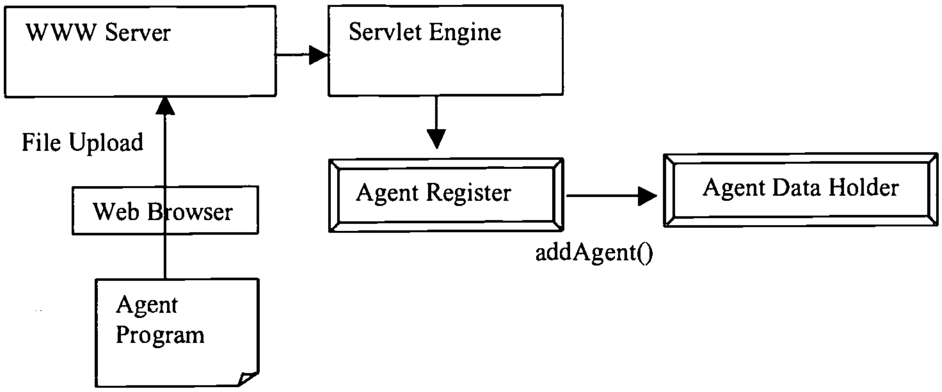

Figure 2: The process of agent registration

For working in the distributed mode, uploading of the agent programs is not necessary since all agent programs are distributed and run on the agent developer's local JVM machine. Only information about the agent, such as agent name, agent IP address, server execution command, etc., is registered. After an agent is registered, it is ready for use. When a user would like to use an agent, the user goes to a specified web page and clicks an agent icon (or an agent name from a list of agents), after that, the agent client program is automatically downloaded to the user's local machine and run on the local JVM (Java virtual machine). The client program requests a connection to the agent server and the agent server receives the request and accepts the connection. The connection between the server and the client is thus established.

Similarly, to deregister or modify an agent from the open agent architecture platform, an agent developer accesses a web page and clicks *deregister* or *modify* button. The developer has to input his/her user ID and password. If the permission is granted, he/she can enter information related to the agent to be deregistered or modified, the agent manager will perform the process of removing the agent, such as, disconnecting all clients, removing agent programs, deleting the agent related information from the agent list and the routing table, and releasing allocated space by calling *deleteAgent()* or *modifyAgent()* from the agent manager.

Agent Data Holder

The agent data holder mainly manages information and data of agents like agent name, agent description, agent type, agent's access path, and etc. The following methods are public to the external modules.

- *Void addAgent()*
- *Void deleteAgent()*
- *Void modifyAgent()*
- *String getAgentName()*
- *String getAgentPath()*
- *Void getAgentInfo()*

Calling those methods is either from the agent register program in the agent manager or from the messenger when an agent requests to communicate with another agent. There is an interface between the agent data holder and the database. Data related to an agent is stored in the database. The agent list table and the agent routing table as shown in Fig. 3 are updated during the agent life cycle operations and client connections.

Agent Routing Table

Agent Name	IP Address
---------------	---------------
---------------	---------------
---------------	---------------

Client Table

Client_ID	IP Address	Port Number	Agent Name
---------------	---------------	---------------	---------------
---------------	---------------	---------------	---------------
---------------	---------------	---------------	---------------

Figure 3: The agent routing table and the client table

Messenger

Messenger is a mediator among agents. It enables the communications between two agents. When receiving a request of connecting to another agent from an agent, the messenger analyzes the request with attached information and retrieves the requested agent information from the agent routing table via the agent data holder by calling *getAgent()* method as shown in Fig. 4. When receiving the retrieving result from the agent data holder, the messenger connects the inquiry agent to the requested agent by calling *connectToAgent()* method if the request agent exists, otherwise it returns a "*not found*" message to the inquiring agent if the requested agent does not exist.

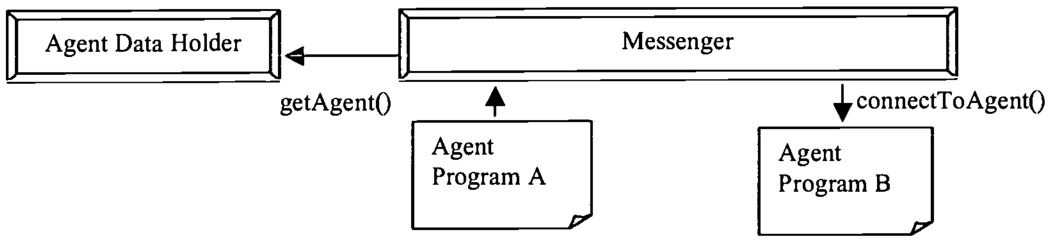

Figure 4: The role of the messenger

Connection Adaptor

In fact, the connection adaptor behaves like a protocol handler that dispatches the request from an agent and decides which type of communication protocol to be used between the inquiry agent and the requested external device or system. After that, the connection adaptor connects the agent to the requested device or system via a proxy server corresponding to the communication protocol to be used.

Agents in University21

University21 (Ma, Huang, and Kunii, 2000) is a virtual university system that is aimed at supporting all teaching, learning and administrating activities via the Internet. It requires many agents to assist teachers, students, and administration staff for the teaching, learning and administration work involved in University21. After developing many agents written in Java by different people or parties, we face a problem of integrating developed agents into University21 system. The open agent architecture as the agent system platform in University21 solves our problem. Currently, three most often used agents, scheduling agent (Ito and Shintani, 1997), friend-making agent, and web-course maintenance agent, are integrated into University21, respectively. The scheduling agent is used for personal scheduling, meeting scheduling, team work scheduling, and tele-lecturing scheduling. A user can request to use the agent from his/her private office, a virtual courseroom, or a virtual collaboration room. Friend making agent plays an important role in a virtual university system since users feel lonely when they are teaching/studying in such virtual environment and the friend making agent can help them find friends to chat, discuss, and even collaborate with. To achieve effective and efficient teaching/learning, friends are indispensable. A user can use the friend making agent from his/her private office. Web-course maintenance agent helps teachers to periodically check and update their teaching materials. With more and more Web-based teaching materials, checking and updating them become difficult and tedious. However, it is an important work. The web-course maintenance agent relieves teachers from such difficult and tedious work. A teacher can use the agent from a virtual couseroom. Both scheduling agent and friend making agent are multi-agent systems and web-course maintenance agent is a single agent system. For the multi-agent systems, communications among agents are conducted via the messenger on the platform layer of the open agent architecture. It is necessary to point out that University21 is currently a centralized system. Integrating three agents to University21 follows a centralized fashion. The programs of three agents are uploaded, unpacked, and resided in University21's server machine as we discussed above. The agent server programs are run in University21 host and the client program is automatically downloaded to and runs on the user's local Java virtual machine when a user requests to use the associated agent by clicking a hyperlink in a web page. The integrated agents are transparent to all users in University21. Users are not aware where agent programs are. What they do just interact with GUI of each agent. They can input their preference, make requests, be consulted with, and get reporting results as well as communicate with an agent through the GUI of the agent.

Conclusions and Future Work

To be platform independent, the open agent architecture is implemented in Java language. For those agents developed in Java language are expected to be easily and flexibly integrated into a virtual learning community system via the open agent architecture platform. As a virtual learning system, University21 has the open agent architecture embedded. Three agents are integrated into University21 via the open agent architecture platform. It proves the our design efforts of the open agent architecture: making the system easy to integrate developed agents, making agent developers flexible to modify their agents, and making agent related information transparent to users. The agent architecture is just like a door of a virtual learning community system that is open to developed agents and allows them to easily and flexibly join and work for human in the teaching/learning community.

It is necessary to emphasize that the open agent architecture is applicable not only in Web-based learning community system but also any Web-based virtual systems such as virtual trading/shopping center system, home agent system, a virtual company, and a virtual city where various agents are used. However, this research is just at its infant stage, there is lot of remain work to be done. We will mainly focus on implementing a distributed open agent architecture, handling agent synchronization problem, and making agent manager intelligent.

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Web-Based Instruction: The Effect of Design Considerations on Learner Perceptions and Achievement

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Abstract: Web-based instruction provides a new medium for the presentation of instructional activities. The medium has the capability of addressing individual preferences and styles of learning through its structure and the use of multiple forms of media. Through careful design and adherence to the objectives of instruction and to learners' needs, web-based instruction can provide a successful environment for a variety of learners. Factors in the web-based environment, such as visualization, as well as individual student characteristics, such as goal orientation, achievement, and perception, must be taken into account, so the design of web-based instruction enhances the educational opportunities of the learners. This study examines learner characteristics that impact engineering students' use of a web-based instructional environment as well as their achievement.

Research Framework

Web-based instruction is a form of hypermedia that is delivered through the World Wide Web [WWW]. Web-based instruction provides a new medium for the presentation of instructional activities that has the capability of addressing individual preferences and styles of learning through its structure and the use of multiple forms of media. Web-based instruction can be developed to closely augment the structure of a learner's memory and place the learner in control of instruction. In the development of web-based instruction, the designer must realize that the instructional media are merely vehicles for the exchange of ideas. There is a need for sound pedagogy and meaningful and stimulating learning experiences that focus on the needs of the learner in order to improve education (Reeves, 1996). The understanding of principles about how individual learners organize and retrieve knowledge and develop personal schema is vital to the design of web-based instruction.

Due to the shift from behavioral to cognitive perspectives, researchers have become increasingly interested in the manner in which learners process information (Ausburn & Ausburn, 1978). Cognitivists define education as not the mere transmission of facts, but the construction of robust mental models (Ormrod, 1995). As a cognitive tool, the WWW can be utilized for knowledge construction instead of reproduction, the design of knowledge, and meaningful learning (Reeves, 1996). Therefore, it is important to determine how individuals learn in order to determine how web-based instruction can reach its potential in educational settings.

The designers of web-based instruction can capitalize on its characteristics as a form of hypermedia instruction to meet the needs of individual learners. First of all, the environment can be designed to take advantage of the structure of the learners' mind. Web-based instruction is a potential learning tool with the capability for extending and augmenting the mind of a learner (Marmolin, 1991). The environment can serve as an information processor, guiding or scaffolding students through cognitive strategies to enhance the organization of their knowledge structures. Web-based instruction has the capability to move the act of learning from hearing and seeing to doing and understanding. Secondly, web-based instruction can capitalize on a learner's motivation for learning, the individual's goal orientation, and their verbal or visual learning preference. By adapting to individual learning styles during the design phase of web-based instruction, individual needs in the learning situation are met.

In order to aid students in the visualization of information, web-based instruction can be designed using multiple forms of media, such as animations, graphics, and text. These multiple forms of media provide the learners with rich and realistic contexts for multichannel learning. The navigational scheme of the environment can be designed so the interface is user-friendly, simple, and the interconnectedness of ideas is clear (Cockburn & Jones, 1996; McLellan, 1992). Learners' goal orientation, whether task goal orientation, relative ability orientation (performance-approach or performance-avoid), or extrinsic goal orientation, affects the learners' focus while exploring the information provided in the environment. These classifications impact the students' performance in the class and their navigational pattern within the environment. Finally, students' perceptions of web-based instruction ultimately impact its value and use.

In web-based instruction, the design should not be transferred just from one medium to another, but the experience should be redefined with the capabilities of the new medium utilized. Instructional designers must capitalize on the new opportunities that the web provides to learners--to access information from remote locations, to interact with the instruction, to access the instruction at their own pace, to visualize the instruction, and to see the complex relationships in the instruction (Alexander, 1995; Owston, 1997). The design of web-based instruction should not focus on the technology but on the goals of the lesson, the needs of the learner, and the nature of the task involved (Rieber, 1994). "The World Wide Web can appropriately be considered the largest and most diverse hypermedia system in existence" (Eveland & Dunwoody, 1998); however, little research has been published regarding the uses and effects of learning from a web-based environment. Therefore, there is a need for more sound research about the impact of the WWW on learning.

Research Questions

In order to validate the design and utilization of a web-based instructional environment such as *ThermoNet*, several research questions were explored. These questions focused on the design features that best enable students of thermodynamics to succeed in a web-based instructional environment. The questions this study attempted to answer were: (1) Which student characteristics affect student achievement to the greatest degree? Characteristics to consider are students' goal orientation, modal learning preference, and access time., (2) Which student characteristics affect the amount of time students engage in *ThermoNet* to the greatest degree? Characteristics to consider are students' goal orientation and modal learning preference. Additionally, how does students' academic achievement affect the amount of time students engage in *ThermoNet*?, (3) How are students' perceptions of *ThermoNet* affected by their characteristics? Characteristics to consider are students' goal orientation, modal learning preference, access time, and achievement., (4) What are the benefits of utilizing the web both as an instructional and a research medium?

Design of Study

Sample

The participants of the study (113) were volunteers taking the course ME 326: Thermodynamics in the School of Engineering at the University of Texas at Austin. The course is an introductory level course based on thermodynamics that is required for all engineering majors who are focusing on mechanical engineering; therefore, students within the course had a wide range of abilities. Typical of engineering courses, there was a male dominance with only 17% of the population consisting of females. The average age of a student enrolled in the course was 21.2 with ages ranging from 18-35. The breakdown of the ethnic background of the students included: 45% Anglo-Saxon, 28% Asian, 12% Hispanic, and 6% African-American. The remaining 9% chose not to disclose their ethnic background.

The amount of computer access and expertise for the sample population was plentiful. Out of the students polled, 82% of the students had computers at home while 18% did not. A large percentage of the students (38%) had also used advanced applications, such as programming and web publishing. The majority of students felt that they were fairly competent in using computers.

Treatment

The web-based instructional site used for the study is entitled *ThermoNet*. The underlying goal of *ThermoNet* was to be the most versatile and interactive source of thermodynamics on the Internet. Since the time of its creation, *ThermoNet* has evolved into a more comprehensive source of information to supplement regular classroom instruction for the course ME 326: Thermodynamics.

Due to the potential benefits of a web-based instructional environment, it was deemed unethical to pursue research with a group of students who had no access or less than desirable access to the treatment condition; therefore, *ThermoNet* was accessible by all of the students involved in the study, and no control group was used. Since *ThermoNet* was conceptualized as a supplement to traditional classroom instruction, groups of students who utilized the web site to varying degrees naturally occurred.

ThermoNet was designed as an instructional web site for many reasons. It was originally envisioned as a site for students to not only find supplementary materials to the textbook, but also to particularly focus on the elements of communication that utilize the unique attributes of the web. Those elements of communication included the use of graphics, interactivity, access to subject matter, and access to real-world applications. The goal of the developers was to create a highly graphic site since thermodynamics is not a naturally graphic topic. The developers used interactivity as a key component of *ThermoNet*. The objective was to present concepts succinctly and then enable the student to interact with the web site to reinforce the concept. Finally, the developers created real-world applications within *ThermoNet*. Through graphics and video clips, more real-world applications could be portrayed in an instructional web site than in a conventional text. In summary, the developers attempted to capitalize on material that could be communicated through the web and was not readily accessible by a student of thermodynamics.

Variables

Independent Variables

There are four independent variables used in the study: (1) goal orientation, (2) verbalizer-visualizer classification, (3) academic achievement, and (4) access time. Students' goal orientation was measured by an adaptation of the Patterns of Adaptive Learning Survey (PALS, Midgley et al., 1997). PALS was designed to measure four separate constructs: task goal orientation, performance-approach goal orientation, performance-avoid goal orientation, and extrinsic goal orientation. The Cronbach's alphas for this scale were reported from .69 to .76 (Midgley et al., 1997) and greater than .70 (Midgley et al., 1998). The students were classified as either a verbalizer or visualizer according to the Verbalizer-Visualizer Questionnaire [VVQ] (Richardson, 1977). The VVQ was found to have adequate internal consistency reliability, .70 and .59 for verbal and visual items respectively (Kirby et al., 1988). Students' knowledge about the concepts of *ThermoNet* was assessed through a posttest. The posttest was the students' final exam that was developed by the professors participating in the study. Students' access time was calculated by subtracting the time students entered *ThermoNet* from the time they exited the site. The server tracked the students' usage for two months--from mid-semester until the end of the semester.

Dependent Variables

There are three dependent variables used in the study: (1) academic achievement, (2) access time, and (3) perception of *ThermoNet*. Both academic achievement and access time were briefly described in the *Independent Variables* section. In order to determine the utility of *ThermoNet* and the impact of a web-based instructional environment on students, a Perception Survey was given to the subjects in the study. The content of the survey covered the following categories: Achievement and Design. The coefficient alphas for the Perception Survey subcategories were .91 for the achievement category and .89 for the design category with an overall alpha of .92.

Qualitative Data

Each student who participated in the study filled out a detailed questionnaire. This questionnaire was solicited in order to gain further information regarding the students' perceptions regarding learning thermodynamics and their perception of the potential usefulness of computer-based learning resources. In order to get further insights into the general use and evaluation of *ThermoNet*, qualitative interviews were administered to individuals in the study. Interviewees were a diverse selection from the sample population. Students were selected for the interviews using purposeful sampling: theory based sampling and maximum variation sampling (Patton, 1990). The purpose of the interview was to probe the reasons behind students' time spent engaged in *ThermoNet*, their preferred learning style, their favorite features of *ThermoNet*, and what aspects of *ThermoNet* they believed could be enhanced in the future.

Procedures and Analysis

Each of the 3 classes of *Thermodynamics* was asked to participate in the study. Prior to conducting the study, the contents and features of *ThermoNet* were demonstrated to students in their discussion groups. Because the web-based instructional environment was a supplement to the students' typical instruction, the subjects accessed the site during their personal study time. The time that students used *ThermoNet* was a unique aspect of the study since the data were gathered from the server. The demographic questionnaire, Perception Survey, VVQ, and adaptation of the PALS were administered during discussion groups that were conducted by the teaching assistants. The academic achievement test was administered during the regular final exam time by the professor of the course.

In order to answer research question one (Which student characteristics affect student achievement to the greatest degree? Characteristics to consider are students' goal orientation, modal learning preference, and access time.), a stepwise regression was calculated to determine if student characteristics and access time predicted the academic achievement. All of the students who participated in the study, whether or not they actually accessed *ThermoNet*, were included in the regression analysis. All of the students were used since insight could be gained from knowing whether or not students of certain characteristics accessed the site or not.

In order to answer research question two, (Which student characteristics affect the amount of time students engage in *ThermoNet* to the greatest degree? Characteristics to consider are students' goal orientation and modal learning preference. Additionally, how does students' academic achievement affect the amount of time students engage in *ThermoNet*?), a stepwise regression and an ANOVA were performed. First, the regression was used to determine if student characteristics predict access time. All of the students who participated in the study, whether or not they actually accessed *ThermoNet*, were used in the regression analysis. Second, an ANOVA test comparing the access time among two achievement groups was conducted. The top and bottom quarter in terms of achievement, was the independent variable.

In order to answer research question three (How are students' perception of *ThermoNet* affected by their characteristics? Characteristics to consider are students' goal orientation, modal learning preference, access time, and achievement.), a stepwise regression was calculated to determine how the student characteristics, access time, and achievement predicted the students' perception of *ThermoNet*.

In order to answer research question four (What are the students' perceptions of the benefits of utilizing the web both as an instructional and a research medium?), questionnaires were administered to all of the students and open-ended interviews were conducted with students of differing achievement levels and with students labeled as visualizers and verbalizers to gain insight into the students' backgrounds and perceptions of *ThermoNet*.

The ultimate goal in analyzing the preceding research questions was to determine the impact of learner characteristics on students' achievement in thermodynamics and their perception of a web-based instructional environment. With this goal in mind as well as the limitations of the study, the quantitative questions were analyzed using the statistical procedures, regression analysis and ANOVA. The results of these statistical analyses were triangulated with the qualitative interview data.

Results and Discussion

The present study gives many insights into the students' characteristics, and how these characteristics impact the students' achievement, their use of *ThermoNet*, and their perceptions of a web-based instructional environment. While some of these results seem counterintuitive, they reveal how specific student characteristics need to be taken into account during the design and development of web-based instruction.

One of the main goals of the study was to determine the effect of students' goal orientation, learning preference, and access time on their achievement. The stepwise regression analysis showed that the best predictors of achievement were performance-avoid goal orientation ($t=-2.976$, $p<.05$) and performance-approach goal orientation ($t=2.293$, $p<.05$). These two variables predicted almost 11% of the variance in the students' final exam grades. Students with a performance-avoid goal orientation were more likely to have a lower achievement level. On the other hand, students with a performance-approach goal orientation were more likely to have a higher achievement level. Students with a performance-approach goal orientation focus on demonstrating and proving competence. They tend to be competitive in a scholastic setting and this competition often leads to the acquisition of a higher achievement level. On the other hand, students with a performance-avoid goal orientation tend to be low achievers. Typically focused on avoiding the display of lack of competence, these students tend to feign more intellectual ability than they actually possess. They often try to avoid challenging tasks and display decreased performance (Elliott & Dweck, 1988; Miller et al, 1993).

The results suggest that the web-based instructional environment had no impact on the students' achievement since time spent engaged in *ThermoNet* was not a predictor of achievement. In order to gain additional information about achievement, students who did log on to *ThermoNet* were divided into two groups according to the amount of time spent on *ThermoNet*. Table 1 reveals the descriptive statistics for the two groups of individuals who used *ThermoNet*. The descriptive statistics revealed that students who used *ThermoNet* less actually had a higher achievement score than students who used *ThermoNet* for more than 90 minutes. Therefore, an analysis of variance for the two groups was conducted which revealed that the difference between the two groups was not statistically significant although the large difference in number of students in each group was a limitation.

Variable	Mean	SD	Minimum	Maximum	N
Group 1 (1<Time< 69)	50.63	13.20	15.5	74.5	42
Group 2 (90<Time<556)	43.15	14.16	7.0	63.5	13

Table 1: Descriptive Statistics of Achievement Scores by Access Time

In order to determine the effect of student characteristics on students' access time, it was necessary to determine which of the variables had a significant relationship with the amount of time spent engaged in *ThermoNet*. None of the variables attained the .05 level of significance needed to be entered into the regression equation. In other words, none of the student characteristics of goal orientation or learner preference predicted access time. However, out of 113 students who had access to *ThermoNet* as a supplement to their instruction, 58 students did not access the web site and only 13 of the students accessed *ThermoNet* over one and one-half hours. This lack of engagement in the instructional medium impacted the results of the study.

Since the variables were not significant predictors of time, an ANOVA was conducted to determine if there was a significant difference between two achievement level groups (low and high) with respect to the time they spent engaged in *ThermoNet*. The analysis of variance showed a significant difference between the achievement groups for the amount of time students spent on *ThermoNet* ($F=4.285$, $p<.05$) with the low achievement group spending more time accessing *ThermoNet* (see Table 2). However, the small number of students in each group was a limitation. This finding supports the prior finding that students who spent more time accessing *ThermoNet* had a lower achievement level.

ANOVA	Sum of Squares	F	Mean Square	F	Sig of F
Main Effects Quarter	6918.376	1	6918.376	4.285	.049*
Residual	38749.934	24	60.4		
Total	45668.309	25	1826.732		

*significant at the .05 level

Table 2: Access time ANOVA's Result

The way students perceive an instructional medium impacts the way they interact with it and how it affects their achievement. In order to determine how students' perceptions of *ThermoNet* impacted their achievement, a stepwise regression analysis was computed. The regression analysis showed that the best predictors of students' perception of *ThermoNet*'s impact on achievement were performance-avoid goal orientation ($t=3.655$, $p<.05$) and extrinsic goal orientation ($t=-2.622$, $p<.05$). These two classifications predicted almost 27% of the variance in the students' perception.

A regression analysis was also conducted to determine the predictors of students' perceptions on the design of *ThermoNet*. The regression analysis showed that the best predictors of students' perception of *ThermoNet*'s impact on achievement was the final exam grade, verbalizer, and performance-avoid goal orientation. These three classifications predicted over 27% of the variance in the design portion of the *ThermoNet* Perception Survey.

The results of the questionnaire indicated that students often have difficulty applying general theory to specific cases and formulating solutions from problem descriptions. They also insinuated having difficulty knowing where to find correct property data for example problems. Students suggested they were lacking a physical "feel" for the subject matter. Overall, the students implied that they were satisfied with the course. They were content with the depth of knowledge, the time spent on specific sections of the course, and the tests covering the information. In order to extend the information gathered through the instruments specified in the study, eleven students voluntarily participated in an interview. Several themes emerged from the analysis of the interviews. These themes included: lack of time, focus of content, preferred mode of learning, and future enhancements.

Many developers believe that when they develop effective instruction, adoption of its use will follow in time; however, this might be a false assumption. The "if you build it, they will come" mentality is not a true statement when working with students who are already pressed for time and are given the option of whether or not to use the instructional medium. Present day students grew up using video games and have a "point-and-click" mentality. This is a trend and designers must tailor their approach to designing instruction to fit the natural background of the students. Therefore, in order to have students access a web-based instructional environment, incentives or requirements must be built into the design. These incentives should be determined during the outset of the development of the site so that the objectives of the web-based instruction can be designed around this idea. Otherwise, if there is no required connection between the web-based environment and what students are expected to learn, there will be little traffic on the site as was evident in this study.

Although the effectiveness of web-based instruction is still unknown for the majority of contexts, the present study attempted to find some research evidence for the support of web-based instruction. The findings of this study provide insight into the type of individuals who use and benefit from web-based instruction and how these characteristics predict their perceptions of a web-based instructional environment. While some of the findings were inconsistent with hypothesized results, the study as a whole gives insight to instructional designers about the capabilities of the WWW for instruction and how web-based instruction should be designed to promote learning.

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An Intelligent Agent for the Promotion of Learner Independence

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Abstract: There is a current trend, in Higher Education, towards a student-centred approach to teaching and learning that will better prepare a student for the role of lifelong learner in the future. This approach sees the teacher becoming a facilitator in the learning process, rather the transmitter of knowledge and the student taking more responsibility for their learning.

In order to promote this type of learner independence we propose a type of intelligent agent that we term an Automated Learning Assistant (ALA). The ALA is a system that attempts to mimic some the teacher's facilitation behaviour by providing support for the student in the tasks associated with learning, rather than providing direct help in a particular knowledge domain. That is, the ALA knows about the process involved in taking a particular course of study but not about its content.

Introduction

The ALA is an automated system that can provide personalised help in the way that a learner approaches their study of a course. The ALA performs tasks and provides help that would otherwise be undertaken by a tutor and as such, we characterise the ALA as a form of Intelligent Agent (IA). Lieberman defines an IA thus:

An intelligent agent is any program that can be considered by the user to be acting as an assistant or helper, rather than as a tool in the manner of a conventional direct-manipulation interface. An agent should as well display some, but perhaps not all, of the characteristics that are associated with human intelligence: learning, inference, adaptability, independence, creativity, etc. (Lieberman,1997).

Unlike the use of IA in Intelligent Tutoring Systems (e.g. Ramirez Urusti, 2000 and Cook, 2000) the purpose here is not to provide help from within the learning domain. Rather, its role is to advise the student on how they should be engaging with a course of study and to prompt them if they appear to be problems.

ALA Functions

Among the functions that an ALA would perform are:

1. Remind the learner of due dates and deadlines (for the submission of assessed work, for example).
2. Remind the learner of work not done or resources not accessed.
3. Help in finding resources for a task and management of those resources.
4. Managing a repository of personal notes and other work.
5. Submission of coursework from the repository.
6. A function that allows learners to contact, others who are working on similar tasks to facilitate cooperative working.

Furthemore, it is the intention that the functionality described should not need to be designed for individual courses but that courses are designed such that a generic ALA could access the online resources of any course and provide assistance to any learner on that course.

Technical Architecture

In order to provide similar functionality across a number of courses, those courses need to be designed utilising an open architecture, such as, proposed by the IMS Project (Graves, 1999). Here, the online resources for a course are described in a standard format that can be easily accessed, programmatically. The purpose of this type of initiative is to make the components of a course more easily re-usable and to bring some standardisation to managed learning environments. However, by extending the information (or metadata) about the course in a similar open way, an intelligent agent could extract appropriate data from the course structure that would be of timely use to the learner. The language of choice in these matters is XML as this provides a vendor independent representation of a data source that can be relatively easily manipulated using standard software tools.

Interface

One of the most important aspects of the ALA system is the user interface. Unless the user can adequately engage with the system and therefore take advantage of its facilities then its utility is severely compromised.

One approach would be to utilise a 'portal' approach with the various sections of the portal mapping onto the functions of the ALA. Here the 'agent' effectively disappears into the interface itself. An alternative would be to attach the agent functionality as a kind of toolbox that is attached to the online course (one can envisage this being drop-down menus or toolbars). Here the agent functionality is explicit and a separate part of the interface.

A second version of the explicit agent would be the use of an avatar or virtual helper. There are good reasons to suppose that such an avatar might be useful, particularly for learners who are not used to the agent functionality. While they might not provide much more in the way of functionality, they can provide a useful 'hand-holding' function for new users, who later might abandon the avatar for a simpler interface (Sumner and Taylor, 1997).

This suggests that a customisable interface might work best, with the user being able to select from a number of options depending on their preference or familiarity with the system.

Data Architecture and Agent Logic

As mentioned before the data representation of the resources would utilise IMS-style structured data that would incorporate references to physical resources but also data regarding the timing of assessment, how resources are related to particular tasks or topics, etc. Additionally, data structures would be designed that would record the activity of the learner, for example, work that had been completed and resources that had been accessed.
These structures would be accessed by the agent logic to provide the agent functionality to the learner.

Conclusion

The aim of this work is to design an intelligent system that will provide real help to the learner in the way they organise themselves for study. It is also the intention to draw on existing or emerging standards (e.g. IMS) in order to make the system compatible with courseware delivery systems and to make it generic in order that the same system could operate on similarly structured courses.

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Application of Virtual Reality to the periodic table for chemistry education

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Abstract: We developed the VR program to be used to learn the periodic table in chemistry education. It is discussed how to develop the VR periodic table and what to learn through that. The VR program is developed using the 3D Webmaster program of Superscape. The students can receive the feedback according their action on the VR world. There are some chemical knowledge such as chemical elements, atomic radius, electron affinity, and ionization energy etc. The students could study interestedly and cooperatively the periodic table.

Introduction

As the computer is popularized in individual and society, it is using a many of area. In particular, there are many materials to learn a science knowledge using multimedia through computer. Many of them are web-based learning materials, which are developed by Java or Flash. Since the technology of the representation, storage, computation and communication in computer make progress, the environment of education is also developed.
Virtual Reality (VR) referred to 'immersive Virtual Reality.' In immersive VR, the user becomes fully immersed in an artificial, three-dimensional world that is completely generated by a computer (Steuer, 1992). It is also possible to define VR in terms of human experience, 'a real or simulated environment in which a perceiver experiences telepresence,' where telepresence can be described as the 'experience of presence in an environment by means of a communication medium.' (Riva, 1999). A key feature of VR is real-time interactivity, in that the computer is able to detect student input and instantaneously modify the virtual world (Seth 1999, Wylmarie, Robert 1999).
It is reported that using the VR simulation in chemistry education can increase student engagement in class, promote understanding of basic chemical principles, and augment laboratory experience (Christine 1996).
In this research, we develop the VR periodic table to grow up the attendance and interest of students in learning chemistry.

VR Periodic Table

The 3D models and objects are presented in the VR periodic table that is developed by 3D-Webmaster of Superscape, therefore the students easily recognize that. There are 4 push buttons on the left-down side in the screen (fig 1). Each of them is the electron affinity, ionization energy, atomic radius and reset. When the students push electron affinity button (fig 2), they can see the periodicity of electron affinity immediately. The knowledge of main elements is also displayed as pushing those elements in periodic table and the discoverer, character, structure are presented on the other frame.

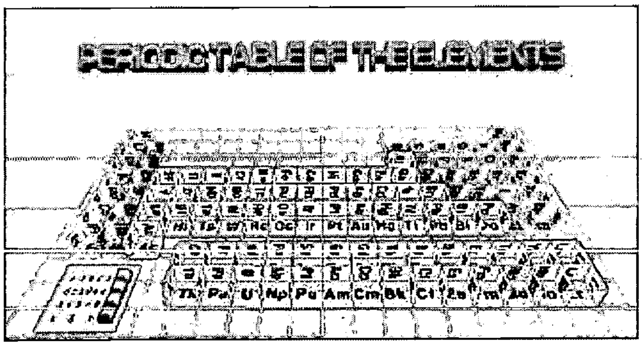

Figure 1. Opening screen

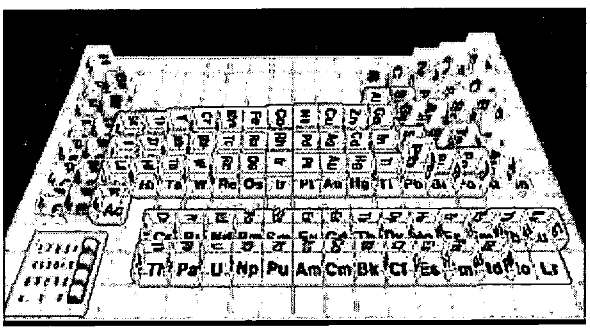

Figure 2. Periodicity of the electron affinity

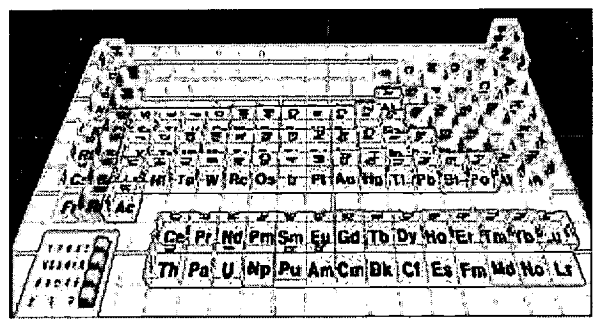

Figure 3. Periodicity of the ionization energy

What To Learn

Students in the level of middle or high school could learn chemical knowledge such as chemical elements, atomic radius, electron affinity, and ionization energy etc. through VR periodic table. Moreover, since the 3D models or objects are used in learning of chemical concepts, the students can feel the interest, and learn independently or cooperatively in learning situation.

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Image Intrpretation Of Digitized Signatures

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Image database of signatures are maintained and the process undertaken in this project is that new signature is being compared with the existing signature. If the signature is mismatched then using a new module called Experts module is being used for the interpretation of signature images. This project provides various menus for image acquiring, where the image is acquired through image sensors like scanners or digital cameras. An acquired image needs preprocessing like maintaining Levels, Color Balance, Brightness and Contrast, Equalize, Threshold, Variations and Cropping for better performance of images. Most vital part of the program is to remove unwanted dots and scratches, which is done throughout a menu known as SPOTING (which is technically known as Rubber Stamping/Cloning). All the images are converted to gray scale mode using Desaturate method before comparison. Comparison is done by pixel by pixel. A separate module for image comparison is provided with two windows. One window is provided for displaying a newly acquired image. In another window the corresponding signature image from the database is displayed. After comparison the expert feeds his analysis and relevant information to provide better results.

Web-Based Instruction; A Paradox and Enigma in Instructional Paradigms and Design Principles

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Abstract: If we look at the delivery of information and learning via web-based instructional systems we find some similarities to traditional learning, however we find more differences than similarities. We find that many web-based instructional systems do indeed make use of stimulants such as movies, sounds, and graphics. We also find that the best web-based instructional sites provide a reference library of sorts, to assist the student in their understanding of the material elements of the particular course. These reference libraries are usually hyper links to other educational or related web sites, which the student can use as a resource to further enhance their understanding of the materials. Some hyperlinks use video and animation to gain and hold the attention of the student, while others are merely "page turner" type of information sites.

But what of the interaction that takes place in the traditional classroom? What becomes of the theoretical arguments that an experienced educator would foster, stimulate, and encourage among the students and/or the educator? What becomes of the personality, fervor, and strength of conviction that normally results as a benefit of these stimuli? What becomes of the vocal intonations, inflections, and the facial expressions exhibited by the student? Are these qualities lost in web-based instruction? Can a chat session accomplish and achieve the finer points of theoretical argument without having the face-to-face stimulants and reactions that are readily apparent in a traditional classroom?

This paper will present the argument that on the basis of initial statistical information that in some cases web-based instruction is not succeeding, and in fact experiences substantially higher attrition rates than traditional class room instruction, with all other variables being equal.

Thesis Objective

The hypothesis of this paper is to present to the reader an argument as to whether existing instructional paradigms and design principles, philosophies, pedagogy, and practices require revision to effectively teach web-based instruction. Due to the length restrictions of this paper the reader is advised that not all paradigm's, philosophies, and practices are included, and those that are evaluated as to their usefulness in web-based instruction are very limited in scope, definition, and explanation. In all probability you will find that this paper will ask more questions than it answers, but in doing so will hopefully stimulate each of us to critically view and analyze the effectiveness of the current and prevailing practices employed in web-based instruction.

Background

As early as 1973 Daniel Bell, and later in 1980, the futurist Alvin Toffler identified several massive changes that our society has undergone: from the agrarian age to the industrial age, and now the information age. These futurists predicted a complete change in our societal values, and the reforms that would be necessary to accommodate the change from an industrialized to an information based society. In many cases, these futurists were correct in their predictions, and our society today is indeed mired in the process of adjusting itself to accommodate this new age of information and technology.

In looking at our educational systems and the population of students that these systems serve we find quite a vast array of scope and difference among students. Demands upon and within the educational sectors are changing. For higher education, demographics and workforce changes are fundamentally altering the student population. In 1995, 44 percent of all college students were over 25 years old, 54 percent were working, 56 percent were female, and 43 percent were attending college part time. In 1997, more than 76 million American adults – 40 percent of the adult population – participated in one or more adult education activities, up from 32 percent in 1991 (National Center for Education Statistics).

Today a students' lifestyle and objectives are also very different than those students of yesteryear. It is not at all uncommon to find that today a typical student may be a single parent, who may be working two or more jobs to make ends meet in order to provide for their family. This same person may want to pursue a higher education, but may be unable to do so as a result of time commitments and constraints that are usually and traditionally required in institutions of higher learning. Additionally we find that many students do not have specific available time blocks, which they can reserve or allocate to a particular course or educational unit of instruction on a regular basis.

More students than ever before engage in learning programs that offer courses at nights or weekends. Some educational institutions even offer courses on Sundays – which in some religions could be considered sacrilegious! Schools have realized that in order to sustain themselves and to remain competitive they must adjust their offerings to accommodate this diverse and ever growing population of students.

As a result of newfound technological advancements in the fields of computer technology, education, and instructional technology, we find that web-based instruction is becoming somewhat commonplace in what would be considered traditional higher educational settings. Many schools now conduct a minimum of some type of web-based instruction. Additionally an entire new industry of web-based instruction has risen to compete with the universities in this endeavor.

In those otherwise traditional institutions where the implementation of web-based instruction has been implemented, the school is assisting the non-traditional student in the meeting of their educational goals and objectives. The school is also meeting its' own social obligation to educate even the most non-traditional of students. With the movement toward web-based instruction well underway, the question and thesis of this paper, is whether prevailing instructional and design practices are suitable to effectively support the non-traditional student in their use of web-based instruction.

Instructional Paradigms & Theory

A paradigm as defined in Webster's Encyclopedic Unabridged Dictionary of the English Language is an example serving as a model and/or a set of forms all of which contain a particular element...based on a single stem or theme. Therefore in extrapolating and interpolating the term instructional paradigm we could state that the definition would be a set of forms or examples of educational theory and practice based upon particular elements. You could in a broader sense regard this as the practice or pedagogy of instruction and/or design.

Probably the most noteworthy expert on instructional design paradigms is Robert M. Gagne, who authored the *Principles of Instructional Design*. Gagne bases his paradigms on the belief that instructional design efforts must meet intellectually convincing standards of quality and that such standards need to be based on scientific research and theory in the field of human learning. Gagne takes into consideration learning outcomes, including intellectual skills, cognitive strategies, verbal information, attitudes, and motor skills. He also considers the knowledge, skills, and abilities of learners and how the differences among learners affect instructional planning and design.

Behaviorism was a term coined by the American psychologies John Broadus Watson (1878-1958) in his paper, *"Psychology as the Behaviorist Sees It."* It is a theory of animal and human behavior holding that actions can be explained entirely as responses to stimuli, without accounting for the profound influences of interpretation on introspection. Thus an educator who believes in behaviorism would tend to attribute learning as a reaction to an event or action that would stimulate the student, but would be provided by the educator. To the behaviorist, teaching is essentially a matter of arranging contingencies of reinforcement so as to produce and maintain prescribed behaviors.

Constructivism is quite an opposite paradigm of behaviorism as described and defined above. Jerome Brunner first proposed the concept of constructivism in the mid-1960's and builds on earlier ideas of Jean Piaget. Basically, the theory of constructivism holds that the learner rather than the educator develops or constructs knowledge and that opportunities created for such construction are more important than instruction than that which originates from the educator. This is certainly not to state that there is not educator guidance or involvement, but that the student essentially will have a very strong voice in the selection and completion of tasks that will aid her in their learning approach to the given subject matter.

Web-Based Instruction

If we look at the delivery of information and learning via web-based instructional systems we find some similarities to traditional learning, however we find more differences than similarities. We find that many web-based instructional systems do indeed make use of stimulants such as movies, sounds, and graphics. We also find that the best web-based instructional sites provide a reference library of sorts, to assist the student in their understanding of the material elements of the particular course. These reference libraries are usually hyper links to other educational or related web sites, which the student can use as a resource to further enhance their understanding of the materials. Some hyperlinks use video and animation to gain and hold the attention of the student, while others are merely "page turner" type of information sites.

But what of the interaction that takes place in the traditional classroom? What becomes of the theoretical arguments that an experienced educator would foster, stimulate, and encourage among the students and/or the educator? What becomes of the personality, fervor, and strength of conviction that normally results as a benefit of these stimuli? What becomes of the vocal intonations, inflections, and the facial expressions exhibited by the student? Are these qualities lost in web-based instruction? Can a chat session accomplish and achieve the finer points of theoretical argument without having the face-to-face stimulants and reactions that are readily apparent in a traditional classroom?

The correct response to these questions is that it depends upon the design of the course and the process of delivery that is used. If a web-based course is designed along the lines of the Gagne theory of instructional design, it could certainly achieve and accomplish its' objective. However while the elements of design are crucial and critical, so is the interaction of the students with both each other, as well as the educator. Regardless of how well web-based instruction is designed, if it is designed solely as a stand-alone product without any human interface or interaction it will, at the very least, not meet its' learning objectives or in the worst case, the ultimate goal to educate. Most students need interaction and human intervention so as to gain and experience the sociological elements of instruction.

The focus of a recent study by West Texas A & M University on the attrition rates for 15 graduate business courses offered on campus as well via a web-based instructional method reveals some interesting statistical patterns. During a three-year period beginning in 1997, it was convincingly found that MBA courses delivered via web-based instruction experienced a substantially greater attrition rate than did the same courses taught by the same professors in a traditional setting. The only variables between the two settings were the students and the delivery medium. The overall combined attrition rate for the web-based courses was a resounding 50% greater than the on campus courses, with several web-based courses experiencing an attrition rate of greater than 100% of those taught using traditional methods on campus! Some of the explanations of the higher attrition rates offered by the authors of the study include but are not limited to the following factors:

- Students were not able to adjust to the self-paced approach.

- The rigor of the study was greater than anticipated.

- Lack of student and faculty experience with web-based instruction.

Of particular concern and note is that courses in the various business disciplines that rely upon mathematics appear to be especially ill suited to web-based instruction. As an example a Statistical Methods course on campus experienced a 13% attrition rate, while its' web-based equivalent experienced an attrition rate of 43%, or greater than 3.3 times the attrition rate of the on campus course. A Quantitative Analysis in Business web-based course experienced an attrition rate of 33% as compared to the same on campus course which experienced an attrition rate of 17%, or about half that of the web-based course! These differences in attrition rates should not and cannot be ignored.

In a survey of online teachers and learners recently prepared for the Project Steering Committee of the VET (Vocational Education Teachers) Teachers and Online Learning Project the report author indicates that there are several themes running through the comments that are cautionary. These include the need to ensure that the instructional design is correct, and that motivation concerns, as well as the difficulty and confusion of on-line users is taken into consideration during the design process.

Could it be that our quest to satisfy the masses and provide an educational forum for such a diverse audience is somewhat poorly designed or ill conceived? Could it be that the lack of human intervention or contact is a contributor to the causes of frustration and ultimately to the significantly higher attrition rates of web-based instruction?

In my own teaching experience in web-based instruction, I have found that even on the best graphically designed web site, the student needs and will actually seek out interaction with another student or the educator. This human intervention and interaction is crucially required of many students, but not all. Some students are perfectly content viewing and reading information from a computer monitor and learning in this way. But the two fundamental design questions remain: what is the objective of the particular course, and what is the desired instructional outcome? If these two questions do not include the learning of social interaction among culturally diverse students, have we not failed to meet our social obligation to educate?

To illustrate further I have discussed web-based instruction with Professor Margaret West, Ph.D. of Northern Illinois University. In any course in which Dr. West provides web-based instruction she insists on face-to-face class meetings at various points throughout the semester. This allows the students to interact not only with each other but also to be mindful of the humanness of the educator. It allows the educator also to view the humanness of the student, who may be shy, or intimidated by either the web-based instruction, or the human interaction with fellow students. In any event this human interaction provides a further development of the educational endeavor, and allows for the student to learn the intricacies of the social environment of learning. In a written response to my inquiry as to the necessity of these activities, Dr. West responded as follows:

> "In the past, I taught the course entirely online with just a face-to-face kick off and a face-to-face debrief. Feedback from students in the debriefs indicated that they were seeking more external support for avoiding procrastination in the course. They also wanted opportunities to meet with their partner for the partner consulting activity. With that feedback, I decided to add a face-to-face meeting approximately once a month. The goal of the face-to-face meetings is to provide a "check-in" on course assignments so the student paces the assignments throughout the semester, and to provide an opportunity to meet with their partner."

In having the opportunity to bring to fruition a mix of the traditional class room environment along with a constructivist educational attitude, I believe that the student will learn a great deal more as a result of human intervention and interaction than when merely left alone at the web site to learn. The fact of the matter is that much of web-based instruction includes the ability of the student to engage in forum discussions with other students, and at predetermined times with an educator leading the course of discussion. Additionally in many web-based instructional settings the student can and does frequently send e-mails to the educator or other students. Fundamentally however, these interactions are not human interactions at all. These keystrokes are merely a very weak substitute for the actual human interactions that would readily take place in a traditional classroom setting and provide only for the instantaneous delivery of inquiries and work product.

Certainly there are numerous other theories of instruction that could possibly demonstrate arguments on either side of this thesis. As an example, lets briefly consider problem-centered learning, within the element of web-based instruction. One of the most noteworthy educators of our times, Dr. Thomas M. Duffy of Indiana University and Unext.com is a strong proponent of problem centered learning in a web-based environment.

While I certainly do not possess neither the education, the credentials, nor the experience to argue this point with Dr. Duffy, I believe that I can respectfully suggest at a minimum that problem centered learning on the web, may not be suitable to every student. Once again, without human intervention and the social implications and benefits that this type of interaction provides to the student, the student may eventually find themselves lost in their ability to intellectually and emotionally engage in the most simple of arguments or discussions.

Aside from the normal fears that some students have relative to their ability to function within a personal computer environment, what other fears may exist if we enroll this student in a web-based course to which she may possess little or no knowledge, and then "throw her to the wolves" using a problem centered scenario? I fully realize that even in a problem centered scenario there are on-line resources available to the student including chat forums, additional reference materials, and even periodic and timely assistance and feedback by the educator. However, without having any academic knowledge of the subject matter, coupled with these other fears within a problem centered scenario, with little or no in-person intervention available would appear to be a situation that would have a high likelihood of failing to meet the learning objectives of that particular course of study. Even if specific learning objectives were met and determined to be successful, have we not failed to provide the student the type of human interaction and socialization that may assist them overall in their particular vocation? Why would we want to place a student in the position of potentially passing a course of web-based instruction, but not learn the art and beauty of social interaction and behavior coupled with intellectual stimulation and constructive argument?

On the positive side most web-based instruction does provide discussion forums, discussion groups, and e-mail capability. Collectively these various venues enhance the students' ability to write philosophically and intellectually. Using these forums will indeed enhance the educational benefit of web-based instruction, but not necessarily to the same extent that web-based instruction coupled with human interaction could or does.

Conclusion

The solution to the issue of designing an effective web-based instructional model lies in the answer to the following question. In which ways can web-based instruction bring both the best instructional process to the student, as well as bring about the convergence of a stimulating and encouraging environment of learning while also meeting learning objectives within a social environment? Is a shift in design and practice paradigms necessary, or are what we are experiencing merely a juxtaposition and congruency of the instructional design principles of Gagne, coupled with the principles and practices of either the behaviorist and constructivism approaches to learning?

Is or will it ever be possible for us as a society to provide the same type of interaction that takes place in classrooms via web-based instruction? If so, will we loose any of our abilities as educators, or will web-based instruction create more clearly defined challenges and obstacles to the educational process? Will web-based instruction be able to take advantage of alleviating distances between the masses while still being in a position to provide a quality education, or will web-based instruction fall by the way side as merely a technology fad that was temporary at best?

With only limited research or empirical data and/or analysis available on this topic or of the effectiveness of web-based instruction to accomplish learning objectives, we can all pontificate and engage in this type of hyperbole. However with the emergence of preliminary research as referenced earlier, there are strong indications that web-based instruction may not be achieving its' educational goals. What may be necessary is that a combination of the tried, tested, and scientific principles of instructional design and educational pedagogy must be employed in order for web-based instruction to succeed. Unequivocally, under no circumstances should proven instructional principles be sacrificed in order to serve the masses more efficiently.

In order for web-based instruction to succeed with the same or exceedingly difficult goal of increasing the benefit of the educational experience to the student, a new type of web-based design and instructional practices, principles, and pedagogy will emerge. A new type of instructional delivery system will continue to emerge and evolve as a result of technology advances and convergence in the way of high-speed video conferencing, tele-immersion, and real time conversations using a readily available and affordable high capacity bandwidth.

A new type of educator will also emerge. This will be an educator who has had the successful experience of teaching in a traditional classroom setting but is able to take advantage of the technology to bring forth a better delivery method of instruction within a web-based instructional setting. This will be an educator who believes that personal intervention within a web-based environment is not only necessary for the student, but also for the educator and indeed will provide a valued sociological benefit to both.

Is web-based instruction a suitable alternative for all subjects, for all students, and/or for all institutions? The unequivocal response to this rhetorical question is of course not. Each of us possesses certain behaviors, skills and attributes, which allows us to learn. We are as different in these processes as the night is from the day. Web-based instructional methods are only a single source utilized to expedite instruction. Some students will continue to use the services of a traditional institution, coupled with web-based instruction, while other students will be more suited to the rigors of a traditional classroom situation.

Will we require making a committed and concerted effort in a paradigm shift in order for web-based instruction to succeed? I am not certain that a complete shift in tried, and tested philosophies, paradigms, and methods is as necessary as is the return to the fundamental approach to education which is to recognize the uniqueness and differences in learning style's and learning patterns that distinguishes us as human beings, students, and individuals. Only with the acceptance of these learning differences can we as instructional designers, and educators utilize the technology resources to reach the masses. Only with this recognition of differences will we be in a position to challenge and to establish new paradigms of instructional design philosophy. Only with the recognition of these differences will we establish and possibly redefine the instructional philosophies and practices, which currently exist within a web-based learning environment.

Time, experience, technology and the dedication of educators and students to attempt new methods of delivery and instruction will be one of the bases of foundations for any new or re-configured paradigms and/or instructional practices that may come into existence in the future. The evaluation of these success and/or failed attempts coupled with only the passage of time will eventually allow us to effectively evaluate the changes necessary to determine if a shift in educational paradigms, philosophies, dogma and practices are required to suit the information age, and more specifically web-based instruction.

It is imperative and essential that the reader understand that I am not as a professional just another contrarian opposed to web-based instruction. If web-based instruction is to be utilized as yet another delivery mechanism for instruction, it must be designed in accordance with instructional technology principles that take the humanness of both the student and the educator into full consideration. Ultimately if the human factor is incorporated into web-based instruction we as a society will have successfully merged technology with the human elements of communication to ideally suit a generation of students raised upon tried and proven principles of education, coupled with the use and the excitement of technological resources.

In any event, we as educators are very fortunate indeed to be involved on the "cutting edge" of a distance learning evolution and revolution! What an exciting opportunity for each of us to participate in the development and establishment of a new paradigm ideally suited to this new and ever changing technology as well as meeting the needs of the student and society. What an exciting time to be involved in the educational process and in the future development of intellectual stimulation, inquiry, and argument using advanced technology!

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eLearning in Education at Vocational Teacher Education College in Hämeenlinna

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Abstract: For the first time at teacher education sector in Finland the Vocational Teacher Education College in Hämeenlinna offered basic pedagogical studies (10 credits) in the net-based environment. This pilot project and development work created new possibilities for teacher education by producing and representing new, creative and innovative but at the same time clearly functional solutions and alternatives.

New developments

Hämeenlinna Vocational Teacher Education College (VTEC) at Hämeenlinna Polytechnic is coordinating a 3-year-project designed for vocational adult education centers in Finland. Altogether over 700 teachers are developing their own work and functions of the adult education center by studying 35 credits in this project.

Purpose

The purpose of this action research is to design, develop and realize a 10 credit course in basic pedagogical studies in a network based learning environment during the year 2000-2001. In the research, attention is also paid to the Information Strategy Program for Education and Research of the Ministry of Education for 2000-2004.

The action research is linked to a beginning post-graduate qualitative research focusing on these 10 credits of basic studies in this project. The results of the studies will be reflected to the goals of vocational teacher education. The research design is emphasized in the mutual development together with the students (Heikkinen, Huttunen & Moilanen 1999; Hart & Bond 1995.) The cyclical process of this action research is brought about by the development work. The purpose of participatory action research is to produce knowledge and action, which is useful for the acting group, and which empowers people on a deeper level through the processes of constructing and using knowledge. The knowledge and experience of those involved in the research is respected and valued in participatory action research according to the emancipatory interest of knowledge. (Reason 1998.)

The point of developing adult education centers becomes important in connection with these studies. Network based learning gives the opportunity to study simultaneously with learning at work and students get personal experiences of e-learning, so that these instructional designs could become more popular in adult education centers.

Framework: Basic Pedagogical Studies 10 credits

These studies are designed according to the Hämeenlinna VTEC's mutual agreement with Helsinki University, Faculty of Education. The studies are divided into three modules. The pedagogical planning of these modules is based on the latest research in open and distant learning environments and pedagogy in web-based learning (Matikainen & Manninen 2000; Kiviniemi 2000; Pyykkö & Ropo 2000; Aarnio 1999 and Enqvist 1999). The main challenge was to design functional solutions and select the tools, which enabled reflective learning processes through e-learning in WebCT learning environment.

Each module was based on the constructivist view of learning (Rauste-von Wright & von Wright 1994). The pedagogical implications were developing metacognitive skills, emphasizing understanding, situational and problem based learning, and different ways of producing knowledge (Tynjälä 1999). Because all these students already work as teachers, they were frequently asked to give feedback about this course to enrich and facilitate the development of virtual learning.

Results

In the first module, Basis of Education (4 credits), the students conducted their studies by course discussions, group discussions, reading circles, discussion summaries, research presentations and an individual brief essay through web-based learning. The learning process was supported by systematic follow-up, personal and group instruction and tutoring together with instant encouraging and directive feedback. In the beginning of the first module there were 45 students in six teams. Six of them changed from network based alternative to writing essays after the first month. Only 15 students completed their tasks on schedule. Rest of the tasks have been handed in later for assessment.

In the second module, Society and Education (3 credits), the students perform their tasks in new teams. The success of the study is based on interdependence among team members (see Lave 1995; Lave & Wenger 1991). Students were encouraged to find new ways to present their assignments in the digital portfolio. The assessment was based on the individual digital portfolio. The 23 enrolled students formed six study teams. Nine students finished the module on schedule and a few weeks after the course most of the students had completed the tasks.

The third module, Teacher's Work in Change (3 credits), finished at the end of March this year. The learning process was directing the course design towards transformational learning (Mezirow, 1995; Kauppi 1998), context creation, setting up own targets, acquiring profound knowledge, critical thinking, self-evaluation, reflection and shared expertise (see Hakkarainen, Lonka & Lipponen 1999). The students were challenged to invent their own individual learning path for this module. So the process was also linked to each institution's development projects for personnel. The module ended at digital portfolio presentations and team discussions about them. There were altogether 15 students at this module and all of them completed their tasks in time.

Conclusion

For several years Hämeenlinna VTEC has offered web-based instruction and tutoring to support students' learning processes. This was the first time that basic pedagogical studies were offered in the net-based environment at any of the vocational teacher education colleges in Finland. This pilot project and development work created new possibilities. The feedback and information will be thoroughly and systematically analyzed to further develop this way of studying. The basic pedagogical studies, 10 credits, will hopefully later be available in international market through the Finnish Virtual Polytechnic. Thus there could be international cooperation and networking in the future.

From the perspective of vocational adult education centers, the students became familiar with net-based studies. They are equipped with skills and experience to plan, implement and tutor web-based studies as teachers in their different vocational fields. This will be a challenge to the institutions in the future as well.

The impact of these studies is obvious. As a leading unit of vocational teacher education in Finland, Hämeenlinna VTEC has great challenges in the complex and changing working life of the future and this project and action research produced and represented new, creative and innovative but at the same time clearly functional solutions and alternatives. Open and distant learning environments are the future and on our part we are making it come true.

Feedback in Virtual Learning Environments

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The use of virtual learning environments is expanding rapidly in all areas of education including the instruction in the universities. A lot has been written about the university students' and teachers' experiences in virtual (on-line) environments. However, it's still hard to base on the user's experiences the answers to questions like this: which characteristics in environments are beneficial for learning and which are not?

This research tries to develop methods for answering this question and for utilizing the answers. Methods are developed for gathering feedback from students and teachers working in different learning environments in universities. During and after the courses the students and the teachers send feedback via e-mail, discussion groups and digital questionnaires. This feedback is processed both statistically and with other methods. The results of the feedback system are utilized in different groups who are working with on-line environments, evaluation of instruction in universities or developing Finland's virtual university e.g. the virtual environment for counselling and evaluation. The feedback system will be developed further in cooperation with these user groups

Organizing web based discourse

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Abstract: We present a system that makes it a simple task to create web pages that provide explanations based on images or diagrams. The result approaches the dynamic presentations teachers are used to do with the help of a blackboard or overhead projection system. This naturally leads to the question of what constitutes a good explanation. We will show that some intelligent adaptive properties have to be included into the system in order to tailor the explanations to the needs of individual learners. The Easy-Web-Explainer is used to create pedagogic resources to be inserted in a curriculum.

I - Introduction: Explanation presentation versus explanation generation.

Most of the literature associated with Computed Intelligent Assisted Education (Wenger 1987) has concerned itself with the automatic generation of explanations from first principles (sometimes embedded in a micro-world) or from more or less structured knowledge bases. The work presented here takes another, complementary point of view. Given some knowledge available in one or several alternative forms, the objective is to adapt the presentation to learners needs and preferences. For many subject domains the state of the art in Artificial Intelligence limits the kinds of reasoning that can be simulated, or if not, the amount of required coding work is prohibitive. Without trying to reinstate CAL with its rather inflexible ways of driving a learning session, we show here that there is ample room for works to improve the way more or less rigidly structured information can best be presented to learners.

The proper temporal sequencing and spatial layout of information is considered here as a major factor in facilitating the understanding of complex information, even though their importance can vary from individual to individual (Luger 94). The usefulness of carefully exhibiting the structure of a reasoning can be linked to diverse sources. Clearly, some learners can be helped by information displays that alleviate demands on short term memory. For instance, in it has been argued that a proper indentation of solution steps in Mathematics and Physics problems significantly facilitates problem solving (Ramsey 83). In the Dynaboard project (Kaltenbach & Frasson 89), the case has been made for laying out a reasoning spatially in such a way that important properties of the reasoning, such as symmetry, would appear more clearly. Also, it has been found that spatial layouts of formal reasoning facilitate processes of abstraction and the discovery of useful analogies. The main idea underlying Dynaboard was to provide computer facilities that could significantly support the editing and reading of complex mathematical proofs displayed as demonstration graphs. It was shown that of necessity, in order not to surcharge the graphic layout of a proof, the graphic objects, such as arrows, had to carry ambiguous meaning. However, this defect could be eliminated by providing ways of dynamically refining the interpretation of a graphic object at the time of reading. The nesting of information levels and the spatial metaphor were subsequently introduced in order to achieve a good compromise between computer screen area usage and the need to display spatially rather complex and large information structures (Kaltenbach, Robillard & Frasson 91). The Easy-Web-Explainer system presented in the following aims to generalize these effects in the context of the web, by making the structuring and re-structuring of information units rather simple and natural.

The current system proposes a generic structure that can be used in the context of many teaching disciplines (from concrete, such as how to operate some kind of equipment to perform a task, to abstract such as understanding a proof in Mathematics) that can be helped by embedding pictures and diagrams in a discourse. The next section shows how the current system is used by a learner. The following one describes the authoring processes. Finally, based on the limited experimentation so far, it is shown how the advantages of a greater exploitation of student modeling could improve the system.

II - The Easy-Web-Explainer system

1 - The explainer explained

Our objective in creating an explainer system is essentially to help learners structure information sequences into meaningful units that can be inserted in ever increasing contexts. These units are traversed in forward mode by the learner as many times as necessary before proceeding to the next unit.

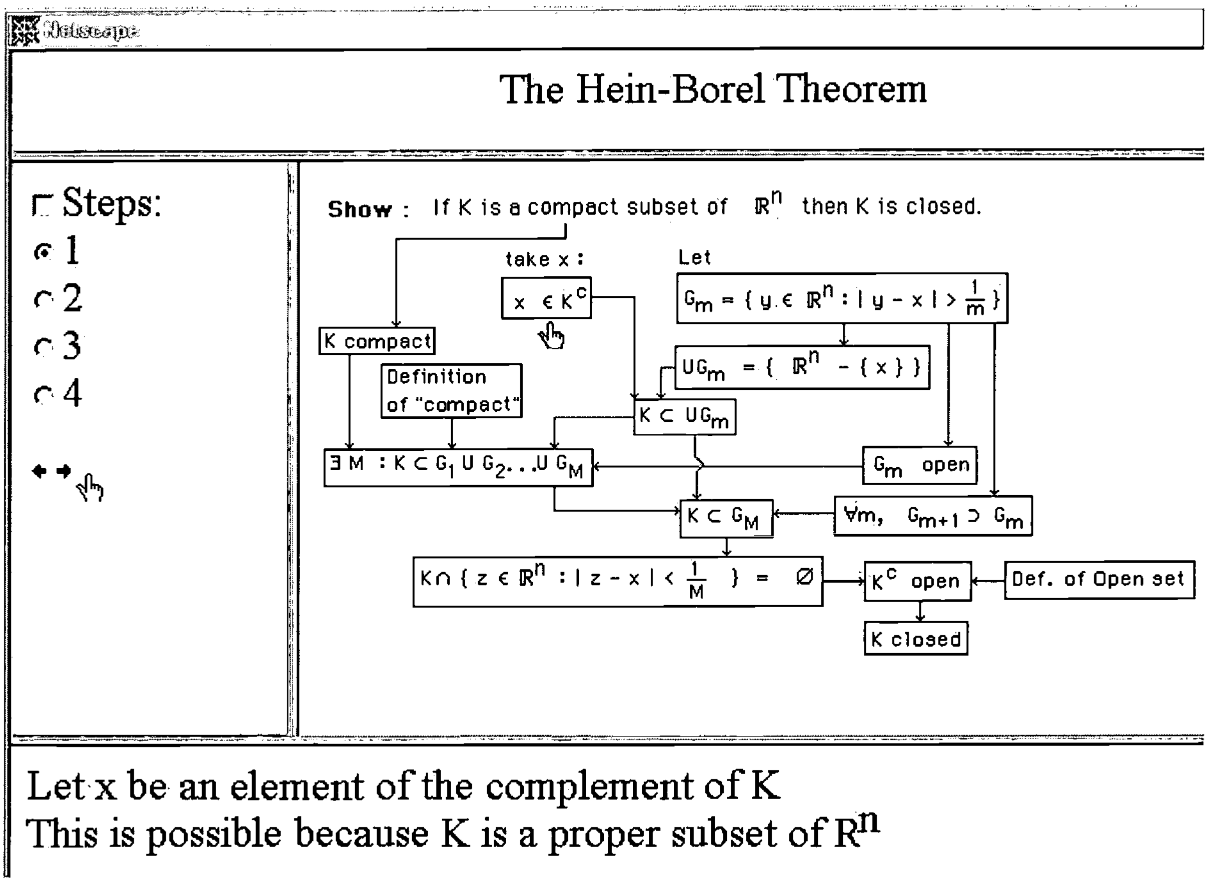

Figure 1: Starting an explanation associating text and diagram.

Figures 1 presents the basic structure of the explainer for a single level of explanation. This is a framed web page in which the top frame contains the title of an explanation in Mathematical Analysis. For students to follow the successive steps of the explanation they must click successively on the white hand in the left panel. The red hand in the panel on the right points to a part of the diagram for which a text explanation is given in the bottom panel. The bottom frame explanations are web pages and so can contain multimedia components in addition to text. In particular the text can be spoken so that learners do not have to alternate their gaze between the bottom text and the diagram. An explanation proceeds by pointing successively at various points of the diagram (called here " focal points" or "foci"). The left panel in Figure 1 lists the successive steps of an explanation. Each step can contain several foci. The steps are designed as a compromise between two extremes; on the first hand each explanation step should constitute a meaningful unit and on the other hand each step should be reasonably brief. If in the design of an explanation, the explanation author cannot get a good compromise, this is a sign that the explanation should be presented with more levels. The current implementation provides for two levels of explanation. Ideally, as we shall ails in the third part of this paper, the way of structuring the information to be displayed by the

In Figures 1, not much textual (possib
the traversal of the successive focal points of an explanation step rather fast. The idea is to try to approximate the dynamics and tempo of explanations provided by human teachers so as to facilitate in the learner's mind the chunking of significant knowledge units. When checked the check box just above the list of explanation steps will automatically chain one explanation step after the other, meaning that by default no explanation is repeated. However by clicking on any radio button of the explanation step sequence, the learner can go to the start of any explanation step. If the checkbox is unchecked the explanation step proceeds until a statement indicating the end of the step is indicated. If the learner does not click on the next step, then the expianation is repeated.

2 - Creating an explanation with the Easy-Web-Explainer

The Easy-Web-Explainer software is presented here by roughly following the successive stages of the creation of an explanation. When the application is started the user gains access to the main panel presented in window "Control Panel" shown in Figure 2.. Explanations are structured according to the file and directory hierarchy of Microsoft Windows. An explanation corresponds to one directory and explanations can in principle be nested to any arbitrary level since an explanation (directory) may contain several explanations (sub-directories). The "New Explanation" button opens a files/directories browser that enables the explanation author to position a new explanation in the current explanation hierarchy. The system distinguishes between two types of inserted new explanation; an explanation that gets inserted in the sequence of already existing explanations and an explanations that comes as a refinement of an existing explanation step. This second case is used to provide a deeper or alternative explanation to an existing explanation step. In either case the new explanation is positioned by simple clicks on Windows Explorer types of structures. Hyperlink management is automatic; buttons and links are inserted or created on existing explanation pages and the new explanation to reflect the new organization. As a result of this operation a directory is created at the proper place in the directory hierarchy with a name requested from the user and a generic framework of an explanation is created as HTML pages in that directory.

By clicking on the button "Open" the user gets a directory selection box to select an existing explanation. With a click on button "Steps" the user can then see a list of current explanation steps (Window "Get Explanation Steps in Figure 2). This window can be used to go directly to view or edit an explanation step as described in the next paragraph. The captions for the successive explanation steps can be edited (replacing the default numbering system). Currently the suppression or addition of an explanation step not at the end of the existing sequence of steps is possible but awkward, requiring a form of successive copy and paste operations to create a new sequence from the old one. The automation of this process is under way. More generally a graphic editor for explanation sequences in the form of graphs (as in Figure 4) should be developed.

To Edit or create a new explanation step the user clicks on button "Edit/Fill a Step". This brings forth a window "Get Foci" as seen in Figure 2. The explanation step number is displayed on the top right text field and is incremented automatically with each new explanation step. This window enables the user to enter the name of a Gif or Jpeg file to be used in the explanation (here "FPanel.jpg"). Though it is possible to vary this image with each new focal point, usually the same image is used throughout an explanation step. The graphic files have to be prepared outside of the current Easy-Web-Explainer with adequate graphic software. Currently the user has just to place these files in the directory of the current explanation. To get the graphic to display in the right window panel, the user clicks again on button "Fill a Step" of the control panel. At this point the user is ready to enter the information relative to the focal points of interest (foci) for this graphic. In the current version of Easy-Web-Explainer is necessary to calibrate the graphic in order to insure that the focal points defined in it will be reflected exactly in the Netscape Navigator browser. Then it suffices to click on a point of the image to get the coordinates. To enter a particular focal point, the user clicks on button "New Focus", then clicks on a particular point of the diagram. This writes the coordinates of the point as the last item in the focus point list on the XY text field. Of course the information already entered can be edited. The window "Get Foci" in Figure 2, show the focal points associated with a presentation of the user interface of a car radio/cassette player. The user has clicked on the first focal point explanation, the explanation author cannot get a good compromise, this is a sign that the explanation should be presented with more levels. The current implementation provides for two levels of explanation. Ideally, as we shall ails in the third part of this paper, the way of structuring the information to be displayed by the

In Figures 1, not much textual (possib
the traversal of the successive focal points of an explanation step rather fast. The idea is to try to approximate the dynamics and tempo of explanations provided by human teachers so as to facilitate in the learner's mind the chunking of significant knowledge units. When checked the check box just above the list of explanation steps will automatically chain one explanation step after the other, meaning that by default no explanation is repeated. However by clicking on any radio button of the explanation step sequence, the learner can go to the start of any explanation step. If the checkbox is unchecked the explanation step proceeds until a statement indicating the end of the step is indicated. If the learner does not click on the next step, then the explanation is repeated.

2 - Creating an explanation with the Easy-Web-Explainer

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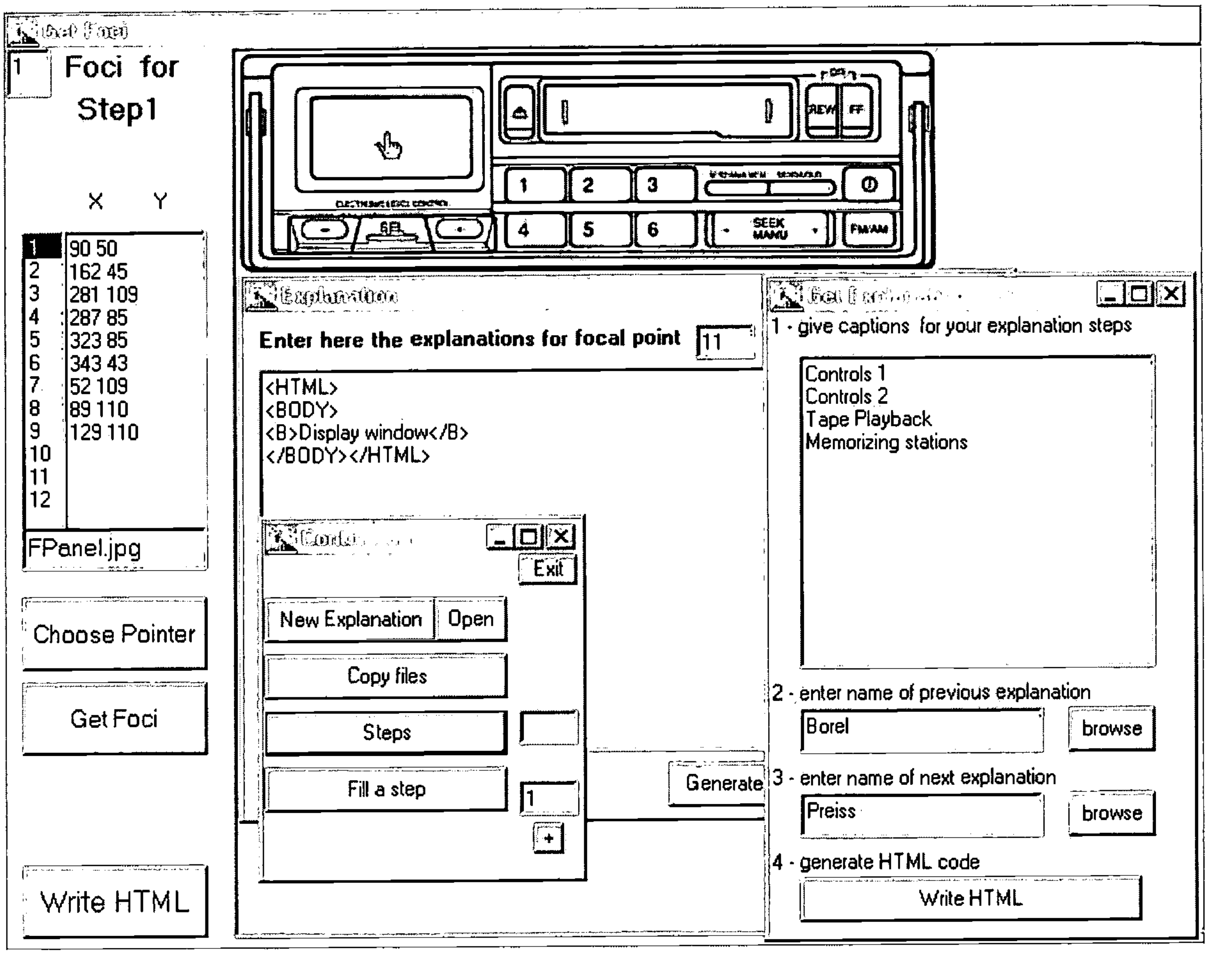

Figure 2:

The "Select pointer" button allows the user to select a particular form of pointer to point to be displayed over the graphic. Currently there are two pointer types available, a hand and arrows with different orientation angles. More choices will be available in the future, in particular a tool to highlight particular areas of a diagram or image. Eventually, users should be able to use highlights of their own design. It is also projected to make it possible to handle several highlights at the same time, or several highlights in automatic succession (i.e. without intervention by the user).

On terminating an explanation step the user needs to save the information by clicking on button "Save/Update". It is easy to add more focal points to an explanation step. As mentioned before, rearranging the sequence of focal points is more complex and should be attended to in the next version of the software. Figure 3 shows the focal point corresponding to Figure 2, as seen by a learner.

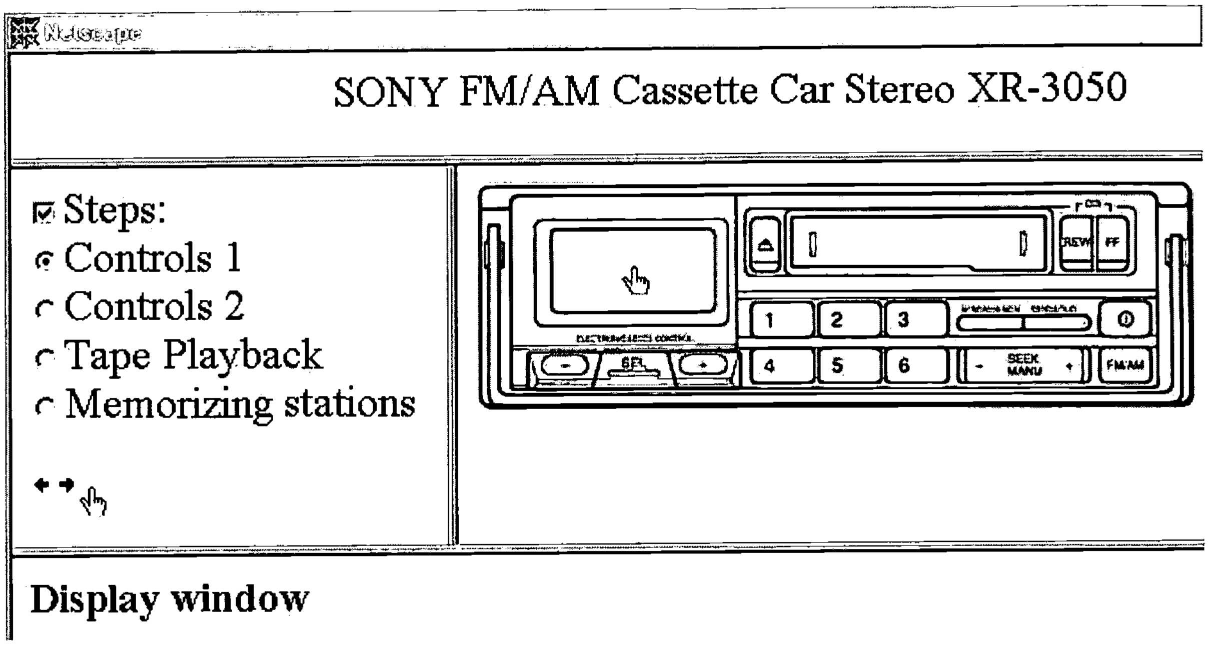

Figure 3: What the learner sees resulting from the explanation step programm igure 2.

- Experimentation and proposed extensions

The Easy Web-
course to taught at Université Paris-Sud (France). Following some preliminary testing with a
Faculty, it was considered that the dynamic explanations contributed positively to student's understanding of difficult points.

However it has been found that the system could manage better the transitions between the successive levels o -Web Explainer, in addition to the introduction of a sophisticated preference system in which the learner can prescribe the way in ted, the system is designed to record the past navigation choices the learner has made and learn from that information the best way to proceed in the future.

Figure presents a diagram of how the various levels of an explanation are arranged at present. Four levels

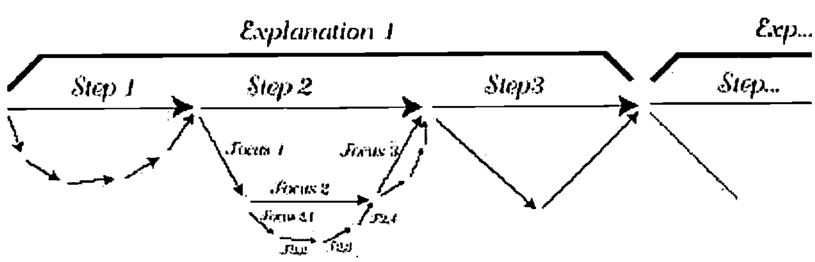

Figure : Nesting of explanations

The elements of hypertext concept in some monographs published between Hypertext '87 -conference and the launch of World Wide Web: in progress -report

Juha Kämäräinen, Department of Information Studies Univ. of Oulu, Finland

Concepts of hypertext introduced in several textbooks published after Hypertext '87 -conference and before introduction of WWW are analyzed by using grounded theory methodology to build models of dimensions of hypertext concepts. The hypertext concepts are mostly based either on orientations of text or database. E.g. the concept of network obtains different interpretations according to the basic orientation.

By focusing on monographs instead of articles or compiled works it is aimed to find out what kind of conceptual environments the authors prefer and how they situate hypertext into them if the form allows authors to develop broader approaches. The interval used here is chosen to concentrate one's attention to the period, during which the interest in hypertext was increasing rapidly but a particular technical environment was not dominating.

The study is intended to create a basis for re-conceptualizing the hypertext authoring activities and can be relevant in developing authoring skills.

Using Computers in the Programming of Qualifying Teachers of Arabic in the Faculties of Education in Egypt

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Abstract :In Egypt, the teacher of Arabic does not study computer in the syllabus of his preparation in Faculties of Education. Moreover, he does not use it in studying any of the syllabi till he graduate as a teacher .
This research attempts to pointing out the importance of using computer in qualifying the teacher of Arabic and showing some primary aspects of the relationship of Arabic language to computer.

This issue seems to have been lost between the extreme simplification of technicians from one side, and the sharp overlook of linguistics from the other side; the issue is inevitably difficult and interrelated so that simple solutions or tricks will not do. It is also so important and vital to the extent that its importance is in the first priorities of preparing our Arabic societies for the information society where the labour of information, its industries and services will prevail.

Behind this research is on invitation to modernize the outlook of the Arabic language as a whole. It is a demand that corresponds to the duality of computer and English language, and many other languages such as Russian, French and German. Such a demand needed a full revision of all the sides of the linguistic system, where the mechanic system impose on the topic it handles a degree of accuracy and completion without which it can not be subjected to the logic or the machine. Maybe in our approach to this problem on this level an indication of how the computer may compensate for our linguistic backward: theoretically, regulationally and implementationally . Using computer in preparing the teacher of Arabic is based on showing the relationship of Arabic to computer; this requires the subjection of accurate science handling.

The attempt at adjusting the linguistic theorizing of Arabic and handling in mechanically is the aspect that helps to reveal the position of super theoretical knowledge on the side of scientific maturity of applied sciences.(16), (19)

The present research is an attempt at showing the duality of culture which prevails over our Arab societies; such duality is one of the main reasons of the deformity of our cultural and scientific view, and the deformity of our intellectual and educational product.

Introduction

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The English basis imposed technical restrictions on the mechanic handling of most languages. Such limits reach the utmost with the broadening of the field of linguistic variety between these languages and that of the basics i.e. English. English and Arabic represent from the point of view of computers two extremes; this, in turn, led to the emergence of many technical obstacles in arabizing computers which made of language another barriers added to another group of barriers separating the Arab user from that new comer which emerged and grew in a various linguistic milieu. [(1)]

Language is the container of thought. The structure and system of language impose a certain pattern of method of thought on its users; this is known as linguistic determinism. Change in any language requires an important change in the nature of language which the society uses for the existence of a mental revolution necessitates the existence of a linguistic on first.(17:205), (15), (18), (13)

Computer illiteracy in our Arab societies does not only require the availability of Arabic programmed language but also the existence of practical means to use Arabic language itself to converse with the computer.

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Previous Studies:

There are various previous studies which pointed out the importance of using computer in teaching generally. (8), (9), (11), (6), (7)

The impact of teaching expertise on educational software selection: An examination of the strategies used by teachers and novices in their approach to software selection

Expertise in teaching has been associated with a comprehensive knowledge base, well organized schemas resulting from a deep understanding of the problem, to concrete situations, and the ability to recognize features of the problem central to the solution (Borko & Livingston, 1989; Leinhardt and Greeno, 1986; Sabers, Cushing, & Berliner, 1991.) The introduction of computer technology to the classroom has added, for some teachers, an unfamiliar dimension to the classroom environment, a dimension in which their problem solving expertise may not be as effective. This study examines the impact of computer technology on teachers' approaches to the problem of evaluating educational software packages for instructional merit. Sixteen teachers and 14 novices evaluated two educational software packages for educational merit. Two of the teachers had expertise in educational technology. The remaining teachers and the novices had no formal training in using educational technology. Participants' “think-aloud” responses were recorded, by audio and video tape, as they evaluated the software, and their responses to a brief interview and survey were collected. Teachers generated a greater percentage of technical and pedagogical statements, but did not differ significantly from Novices in their attention to specific Pedagogical variables. A qualitative analysis revealed that teachers and novices had different approaches to the problem solving task directed in part by schemas they held for effective instruction. Further, the technology-trained teachers appeared to have greater access to their schemas for effective instruction than those teachers for whom the computer was an unfamiliar environment. These findings suggest that technology training may need to be an integral part of teacher education programs.

Computer skills for pre-service teachers: Perceptions and implications for curriculum development

The purpose of this study was to examine the national profile of necessary technology skills for teachers and the perceptions of school administrators, cooperating teachers, and student teachers regarding specific technology skills needed by pre-service teachers. A survey of literature provided a national profile through standards adopted by the National Council for Accreditation of Teacher Education. The perceptual data, compiled from a survey instrument developed for this study, were self-reported and limited to administrators, cooperating teachers, and student teachers currently participating in a teacher education program in rural northwestern Pennsylvania. Descriptive data analysis, including survey mean scores data and standard deviation were utilized to determine existing technology use and the profiles of perceptions from target populations. Mean rank analysis was applied utilizing the Kruskal-Wallis procedure to identify significant differences among sample populations. The results showed that perceptions of necessary specific technology skills vary significantly among populations. Also, notable variance was found within target populations, however, a number of technology skills were clearly identified as priorities for pre-service teachers. The data revealed that word processing skills have the highest priority among groups. Other high priority skills included use of e-mail, accessing the internet, utilizing CD ROMs, and knowledge of computer terminology. Low priority skills included knowledge of programming languages, MS DOS, web page design, Ethernet function, and reformatting hard drives. The blend of priorities identified in this study and the perceptions of experts in the field of technology in education, grounded in the general standards advocated by NCATE, should be the basis of technology curriculum for pre-service teachers in northwestern Pennsylvania. The results of this study were consistent with literature and research that suggests technology curriculum in teacher education should be developed with a wide variety of populations in order to best reflect the needs of pre-service teachers and society.

The effects of a self-paced modular computer-training program on in-service teachers' attitudes and sense of computer self-efficacy

The issue of technology integration for schools can no longer wait as business, government, and education call for students to be prepared to use the tools of the 21<super>st</super> century. Pre-service teachers are presently receiving some training with the publication of the National Council for Accreditation of Teacher Education standards for technological literacy. In-service teachers are also being called to meet the needs of the 21<super>st</super> century student, but, lacking the teacher preparation training in technology and having honed successful classroom strategies without the use of technology, they are finding the acquisition of these skills more difficult. As professional development programs begin to address the needs of the in-service teacher, the issues of attitudes toward computers and computer self-efficacy must be considered. Successful training programs must address the special needs of in-service teachers, a population of adult learners with little experience or exposure to the digital world. Investigated in this study were the effects of a self-paced modular computer-training program on teacher attitudes and computer self-efficacy. Forty-two in-service teachers at St. Paul's Episcopal School participated in a four-module self-paced computer-training program that included modules covering an introduction to computers, Windows 95, word processing, and telecommunications. Two computer attitudes instruments were used: Delcourt and Kinzie's 1993 Attitudes Toward Computer Technologies scale which measured comfort/anxiety and perceived usefulness constructs and Shaft and Sharfman's 1995 Attitudes Toward Computers Instrument which measured a global computer attitude construct. These attitude measures were administered at the beginning of the self-paced computer-training program and again at the completion of the last module. The Compeau and Higgins' 1995 Computer Self-Efficacy measure was administered upon completion of each module for the purpose of assessing the impact of each module on the participants' sense of computer self-efficacy. Results indicate that participation in a training program that meets the needs of the inservice teacher and includes self-pacing, independent and collaborative learning opportunities, and the presence of support personnel positively impacts the attitudes of comfort with computers and perceived usefulness of computers as well as a global attitude toward computers. The participants' sense of computer self-efficacy is also impacted positively. In-service teachers who feel positive toward and efficacious with computers are more likely to feet comfortable bringing the tools of technology to their classrooms and their students.

A comparison of paper-based, computer-based, and voice-mail study media in relationship to student achievement in information systems courses

The problem investigated in this study was the use of paper-based, computer-based, and voice-mail-based study media and their relationship to student achievement in information systems courses. Providing information on the usefulness of study media to schools, businesses, and textbook publishers to assist them in decision making was central to this study. This study may be useful to professionals interested in the larger framework of comparing study media and test performance. This research also examines the relationship between student achievement and a particular study medium when compared with number of questions studied, amount of study time used, age, income, gender, distance from campus, grade-point average, full-time employment, part-time student classification, previous computer skills, and access to a computer. An experiment was conducted using a quasi-experimental posttest-only control group design. Statistical procedures were used to pretest the data to determine randomness of the groups. Two information systems courses were used to test each study medium. An introductory business course in information systems and an advanced course in which all students would have computer experience were used to test each study medium. This experiment was conducted at a public university. The majority of the students were part-time students who were employed full-time. The university does not have residential students. Quiz, midterm examination, and final examination grades were used as the measure of student performance to determine if there was a significant relationship between study medium and student achievement. The hypothesis that there is a significant relationship between study medium and student achievement was not rejected.

Utilization of computer technology by teachers at Carl Schurz High School, a Chicago public school (Illinois)

This case study investigated computer use by teachers at Schurz High School and identified the factors affecting their use. Current and desired computer skills were also evaluated to make appropriate recommendations regarding inservice training to help increase the use of computers among faculty at Schurz. Descriptive data was gathered on Schurz by interviews, sign-up sheets, software documentation, and reports and pertained to demographics, academic probation, technology plan, school improvement plan, staff development, funding, computer inventory, computer labs, vocational educational programs, and technology support. A survey was used to gather descriptive information on how computers were used in classrooms and interactive labs. Survey items were designed and revised to gather data relevant to seven research questions. The population for this study involved the 133 classroom teachers on staff at Schurz High school during the first semester of the 1998–99 school year. One hundred usable surveys represented a response rate of 75%. The respondents represented 12 departments in the school, including business/computer education, math, physical education, English, special education, technical, foreign language, science, music, social studies, art, and English as a Secondary Language. The major findings of this study show that the vast majority of teachers used a computer for personal or school use; almost all teachers with 1–10 years of teaching used a computer; teachers with 31–35 years of teaching represented the largest group of noncomputer users; the highest percentage of use for both computers and the Internet was for preparing instructional materials; the lowest percentage of use of computers and the Internet was for instructional use for students; teachers used word processing the most for preparing instructional materials, for instructing students in the classrooms, and in the interactive labs; the second greatest computer use was for web searching; and few teachers used software other than word processing in their classrooms. The factors that affected computer use included the direct relation between use of computers and number of computers in the classroom; lack of computer projection devices in the classrooms; lack of duty-free time to prepare lessons including technology; other educational commitments; and insufficient teacher training, support, and follow-up.

Secondly, there are various previous studies which pointed out the importance of using computer in teaching Arabic in particular such as the following :

1. Analysis of heritage for determining the date of its emergence and its source; the ***Illiade*** as a myth was analysed by computer; it was found that it is composed of 15694 lines of verse, 112000 words and it was ascertained that Homer is its poet. Also the plays of Shakespeare have been analysed to ensure that he is the writer.(10)

2. Thematic identification of the degree of influence of men –of- letters on others. The most well known uses of computer in that field is that study which was performed to know how far the poet Shelly was influenced by his predecessor Milton. The statistic comparsion of Shelly's famous poem "***Prometheus unbound***" and Milton's "***Paradise Lost*** " the sphere of common lexicon and the relative distribution of the ranges of the two poets using of them. A comparison of the sentences of both poems -which included the most common lexicon- was performed to give a quantitative criterion of Shelley's being influenced by his predecessor.(10)

3. **A comparative discourse analysis of output produced by learners of German in a chatroom and a face-to-face discussion group, and its potential implications for foreign language instruction.**

The purpose of this research project is to contrast written German discourse as it was produced by 63 learners of German as a foreign language in 4<super> th</super> semester German in a synchronous computer-mediated communication environment, i.e. in a chatroom, with the oral discourse produced by 63 learners of German in a small group face-to-face discussion groups. This study uses a variety of measurements to better describe and define the language produced in chatrooms and face-to-face discussion groups. First, the level of participation is measured by coding the data with communication-units, or c-units. The final statistical analysis indicated that the different levels of participation in the chatroom and the face-to-face discussions were significantly different. Second, this study hypothesizes that the output produced in real-time synchronous computer-mediated communication constitutes a new type of orality in a virtual world, a hybrid between spoken and written discourse. Communication in a chatroorn environment allows students to write as they would speak. The written output produced in a chatroom during this experiment shows features of oral language. The term <italic>virtual orality</italic> describes this type of orality in a virtual space. <italic>Virtual orality</italic> is derived from Walter Ong's <italic>secondary orality</italic>, which delineates an orality that is produced by speakers in our society who have the awareness and consciousness of literacy, i.e. they live in a society that is knowledgeable of and influenced by writing. In the third part of this study, the Type-Token Ratio is used to measure the variety of different words in relation to the total number of words produced. In an effort to determine the language level of the students, this study uses a scale of language stages as they are described by Erwin Tschirner, followed by an analysis of verb morphology, and attributive and predicative adjectives. The last chapter asks if and how computer-mediated communication can be productively employed in a foreign language teaching environment. Tentative recommendations about the use of real-time computer-mediated communication and face-to-face discussion groups for instructors conclude this study.

4. Reading instruction of first-grade students within a whole learning reading program using CD-ROM versus traditional print storybooks

effective in increasing beginning readers' sight word vocabularies (word list) and their ability to retell a story. This outcome was particularly found to be true for low achievers, who performed better on these tasks using electronic books than traditional print. Students generally gained more on reading from context (word passage) and answering questions using traditional print.

This researcher investigated the use of technology within a whole learning reading program to determine whether statistically significant differences in reading achievement develop between instruction using traditional text in a classroom setting and electronic print in the form of books on CD-ROM used in a computer lab setting. Participants were 92 first-grade students from a large, semi-rural elementary school in Orange County, New York. All of the subjects received instruction under both control and treatment conditions. Subjects scores on a district-wide fall reading matrix were used as pre-treatment observations to determine equality of groups. Three days following a sequence of instruction led by the teacher were conducted using traditional and electronic print books. Three books were completed under each method/medium. The books on CD were selected from Level B in the Scholastic Beginning Literacy System WiggleWorks. The same books used on CD were used in traditional print. Post testing was conducted individually after instruction on each book. Assessment included a 20 item word list, a 70–80 word passage (both taken from the text of the book used), 5 factual comprehension questions, and a retelling. Information on or about the computer's effectiveness as a source of language development through pre-literacy experiences to increase sight word vocabulary and in improving comprehension were addressed. The study served to evaluate the effectiveness of books on CD as a delivery mode for whole learning instruction in reading. Results indicate that the use of books on CD are particularly

5- Synchronous computer-mediated communication in the intermediate foreign language class: A sociocultural case study

Synchronous computer-mediated communication (also known as <italic>chatting </italic>) has become an extremely popular Internet application in contemporary society, as a way to communicate electronically with persons from all corners of the globe. While members of academic and business communities are increasingly using synchronous CMC to hold serious discussions, conferences and classes, chat communication is still for the most part recreational in character (Werry, 1996). Only recently have educators come to realize that chatting may provide valuable learning experiences to its participants. The purpose of this study was to investigate interactional and linguistic features of communication among intermediate-level Spanish learners and their teacher in a synchronous CMC context. The study evoked some fundamental constructs of Vygotskian sociocultural theory in order to describe and explain how learners and their teacher collaborated with each other to co-construct meaning in chat rooms. General patterns of learner-learner and learner-teacher interaction were analyzed, as well as learner and teacher perceptions of the use of chat as a language learning tool, and finally, changes in learner output over time. First, it was found that learners appropriated the chat room environment to create their own community of language practice in which they transformed tasks that were assigned to them, went off-task when they wanted to, and had the opportunity to make use of language functions that are not typical of the L2 classroom environment.

Second, the learners and the teacher put forth a great deal of perceptions regarding the use of chat rooms in the L2 class, which brought an emic perspective to the study. Third, the Spanish verbal morphology system served as a springboard for illustration and discussion of changes in learner output over time. Specifically, learners made unique uses of the Spanish verbal morphology system, which the emergent grammar perspective was called upon to explain. Also, learners branched out from overuse of the Spanish present tense, gradually using the other available verb tenses and moods more of the time. The study suggests pedagogical uses for synchronousCMC,aswellasfutureresearchdirections

. 6. The relationship of universal grammar to second language acquisition: A meta-analysis

The purpose of this investigation was to synthesize (by means of a meta-analysis) the results of primary research studies, which examined the relationship between Universal Grammar and Second Language Acquisition, in order to discern whether second language learners do have full access to Universal Grammar. In order to proceed with this investigation, primary research studies were retrieved through a multiple channel approach: a combination of manual and computer searches. A set of criteria was established to determine which of the retrieved studies would be included in this meta-analysis. Using these criteria, fifteen primary research studies could be included in this meta-analysis. The unit of analysis for this study is the sample unit of analysis. These fifteen studies yielded 22 independent samples, on which the subsequent analyses were performed. Using effect sizes (Cohen's d-index) as the measure of the outcome of the primary study's sample(s), 70 effect sizes were generated. Each of these effect sizes was weighted and averaged to produce an overall effect size for this meta-analysis. The overall mean effect size produced was 1.25 with a standard deviation 0.68, a very large effect size. In addition, a confidence interval was calculated on this mean effect size. The lower limit was 1.17, and the upper was 1.31. Based on the premise that the mean effect size would approach zero if second language learners do have full access to Universal Grammar, the above results indicate that they do not. Moreover, the confidence interval test does not contain zero, which confirms that second language learners do not have full access to Universal Grammar. Sixteen variables associated with the Publication, Participant and Design characteristics were analyzed to determine if any of these variables had an influence on the effect size generated for each sample. This examination shows that the Target Language being tested does have an influence on the effect size associated with each particular sample. Overall, the results of this investigation contribute to a better understanding of the relationship of Universal Grammar to Second Language Acquisition. Implications for future research are discussed. In addition, implications for teaching of a Second Language are discussed.

From such previous studies, we see clearly the importance of using computer in Education in general and in teaching language in particular; while the teacher of Arabic does not study computer as a syllabus in the programms of his preparation in the Faculties of Education in Egypt and he does not use it in studying any of the other syllabi till he graduated as a teacher.
It has appeared clearly the impotence of the printed book as a means of presenting the educational matter and also the inefficiency of the other conventional educational aids in face of the inflation of the educational matter and its complexity. All this makes us suggest the computer as a logical substitute to increase the efficiency of education, the productivity of education and facing the deeply rooted problems from which educational system suffer especially those of surficial and demanding nature. Many view the computer as a source of hope to make the inevitable change that has long been waited for in the programmes of preparing the teacher in general and the teacher of Arabic in particular. Our success in this depends, primarily, on how successful we are in preparing flexibly the technical means of the requirements of teaching Arabic language

Web-Based Knowledge Construction System: REAL(Rich Environment for Active Learning)

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Abstract: Two preliminary case studies were conducted to investigate the knowledge construction process of an individual and a team. On the basis of the results, a conceptual model of REAL system has been constructed and the programming for the system has been completed and the beta version is out to be evaluated. Therefore, this paper briefly presents the whole process including the results of two case studies, the conceptual model, and the major functions of REAL system.

Introduction

Ever expanding knowledge-based society puts heavy emphasis on knowledge generation of all members in a society. In order to meet this current need, REAL system was developed to assist members of a society to generate and construct knowledge in their own interested domain as an individual or as a team. Two preliminary case studies were conducted to investigate the knowledge construction process of an individual and a team. On the basis of the results, a conceptual model of REAL system has been constructed and the programming for the system has been completed and the beta version is out to be evaluated. Therefore, this paper briefly presents the whole process including the results of two case studies, the conceptual model, and the major functions of REAL system.

Case studies

First case study on individual knowledge construction identifies four major activities and three influential factors. Information-acquisition(17%), information-transformation(27%), knowledge-construction(42%) and monitoring(14%) are identified as major activities which individuals perform to construct knowledge. Learning strategy(77%), metacognition(18%) and motivation(3%) are identified as influencing factors on knowledge construction.

Second case study on team knowledge construction investigates the knowledge sharing process of members in a small group with a common goal. Twelve weeks of knowledge sharing activities were recorded on videotapes and analyzed using protocol analysis. Interview data of each group member were also analyzed. The study identified the knowledge sharing process as three distinct stages: 'input' stage where the shared goal is identified, 'collaboration' stage where the knowledge is shared, and 'output' stage where the team knowledge is constructed. Major factors that influence knowledge sharing process are summarized into three dimensions: individual, group, and environmental dimensions. Then the sub-categories of each dimension are also identified. Personality, willingness to share knowledge, perception of others in a group, and communication skills are under the individual dimension. Group dynamics, facilitating skills, and incentives are under the group dimension. Information type, time and space factors, and knowledge sharing channels are under the environmental dimension.

Conceptual Model of REAL

A conceptual model for a web-based knowledge construction system, REAL, that may assist an individual as well as a group was constructed by integrating all the activities, dimensions and factors from the previous case studies. Since the knowledge construction process iterates and circulates based on the cognitive and communicative activities as an individual and as a team, the model represents continuous support for an individual as well as a team to construct knowledge. The model also describes the phenomena of internal as well as collaborative knowledge construction. Internal knowledge construction means that Individual learners select their own tasks, acquire and transform information, and construct new knowledge with incoming information at a given moment. On the other hand, collaborative knowledge construction means that learners collaborate with one another by questioning and/or answering, and exchange ideas for constructing knowledge.

On the basis of the conceptual model, REAL system has been designed and developed to support individual knowledge construction which involves information acquisition, information transformation, knowledge generation /construction, and monitoring. It also embeds functions to check the learning strategies, metacognition, and motivation factors of an individual. For the collaborative team knowledge construction, two types of collaboration – intra group collaboration and intergroup collaboration – are to be supported. Intra group collaboration refers to collaboration among members of the same group. Inter group collaboration refers to collaboration among members in different groups. The system allows intra group facilitator s as leaders of a group to provide important information to others, to manage communications with other groups, and to dismiss the members who do not fit in a group. Also, the facilitator in an inter-group collaboration exists as a guide, stimulates information exchange among groups, and answers questions.

In order to function properly as described in a conceptual model, REAL system includes (1) cognitive tools for an individual knowledge construction, (2) collaboration tools for a collaborative knowledge construction, (3) individual and collaborative knowledge base construction tools for expanding the database by the users, and (4) various agents for assisting participants.

The system also provides concept map generating functions and project schedulers from the cognitive tools, synchronous and asynchronous communications and CSCW(Computer Supported Collaborative Work) functions from the collaboration tools, knowledge base construction functions from the knowledge construction tools and intelligent searching, footprint checking, and other help functions using agents.

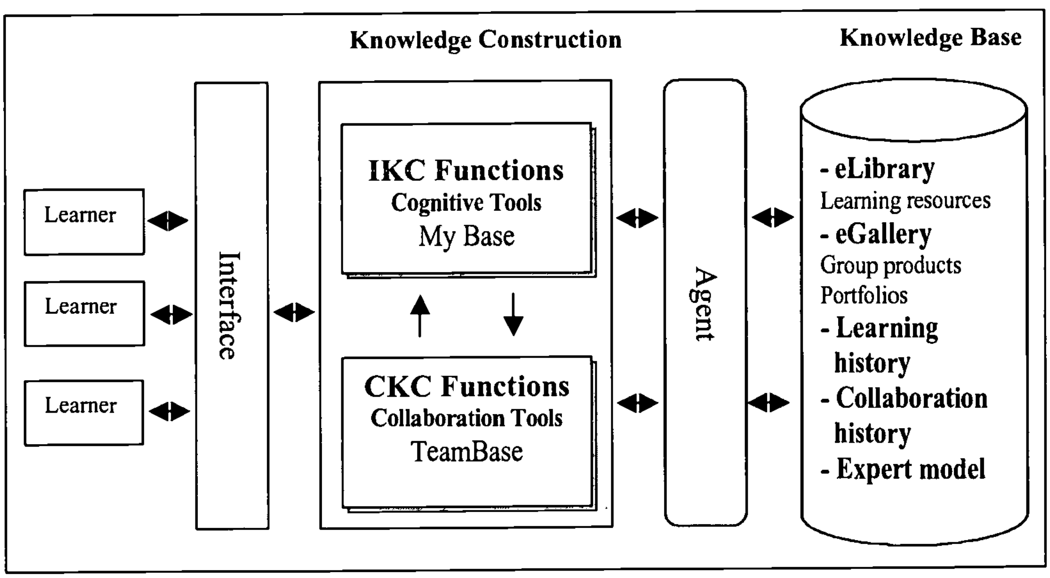

Figure 1. Conceptual Model of REAL

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Web-Based Collaborative Architectural Design System *C@D*

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Abstract: This paper describes a web-based collaborative architectural design system, C@D which has five features. C@D system provides an integrated collaboration design environment, a set of multimedia databases, visual communication tools, architectural design tools and schedule management tools. Theories and principles of contructivist learning environment design from the field of educational technology have been integrated to develop C@D.

Introduction

Computer applications to architectural design involve a distinctly rich hybrid of geometric, geographic, and annotated information. This condition raises opportunities for collaboration, needs for data integration, and examples of the increasing importance of rich databases as a basis for design work. This paper describes these general issues of collaboration in architectural design integrated into C@D system. Some examples from recent collaborative design studio works, and a specific implementation of software integration where a prototypical data interface and translation tables for multimedia linkage are integrated. And capacity to work together with a web browser will also be presented in the session.

C@D system

People in architectural design work together on shared objects of design, and these objects define the nature of interactions to occur. Thus collaborative design includes more than simple document exchange. It compiles, adds value to, and conducts dialogues over sophisticated artifacts. Increasingly, then, complex data sets may become the focus of research in computer-aided design. Therefore, theories and principals of Educational Technology were applied to design and develop a Web-Based Collaborative Architectural Design System *C@D.*

Notable features of C@D system

1. C@D system provides an integrated collaboration design environment.
   Collaboration design environment requires a number of networked computer application softwares which enable multiple users at different locations to share ideas, design information and data both synchronously and asynchronously. C@D system supports this kind of work environment.

2. C@D system has a number of rich multimedia databases.
   Architectural design information is documented in tow primary formats; text and geometric objects. Project database, case database and scheduling database are constructed with various multimedia formats such as graphics,

images, animated data, video and voice data. In an era of multimedia generation, it would be quite natural to store, search and use multimedia data for design projects.

3. C@D has convenient visual communication tools.
General purpose communication tools such as web mail, text and voice chatting are included in the system. Furthermore, synchronous whiteboard for sharing ideas and data is embedded in the system. Therefore, synchronous / asynchronous and text/multimedia communications are supported in C@D system.

4. C@D has outstanding web-based architectural design tools.
In architectural design, visual objects are used for effectiveness and efficiency in communicating with other members who are involved in the same project. At the early stage of design, visual objects are sketched images. As the design proceeds, they become geometric objects that have mathematical properties. To be more precise, physical object specification annotations are added to the objects. For C@D system, web-based visual tools for sketching, 2D drawing and 3D modeling are implanted.

5. C@D has near-perfect work schedule management tools.
Design project management involves precise scheduling of design process and workers in various areas such as construction, electrical field, etc. Therefore, C@D system provides work calendars for keeping track of work progress. That could be used as checking points.

C@D System Environment

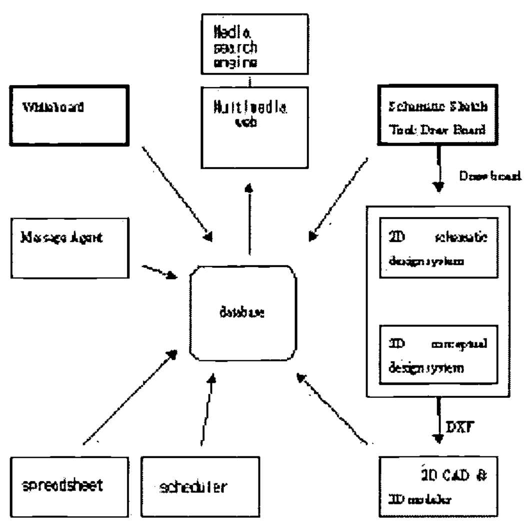

Figure 1. Collaboration Design System Environment.

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PICCO - the Pictorial Computer Simulation of a Selected Natural Phenomenon: Description, Demonstration and Research Results

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The purpose of this presentation is to demonstrate the new version of the PICCO –program, to describe the aim of PICCO as children's spontaneous exploration tool and to introduce research results when using PICCO in day care centres and at school. The chosen natural phenomenon for the pictorial computer simulation, PICCO, was the variations of sunlight and the heat of the sun experienced on the earth related to the positions of the Earth and the Sun in space. It is important to investigate children's science learning and knowledge construction process in new multimedia technology environments, to find the possibilities of new technology for science learning and to reveal those integrated and intertwined cognitive and social processes which are the basis for science learning and thinking by children.

Exploring the use of electronic portfolios in international contexts

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Abstract: One of the most exciting developments in the school reform movement is the use of alternative forms of assessment to evaluate student learning and teacher development. Different alternative assessment systems and forms must be judged based on the value of the information they provide for students, teachers, curriculum specialists, principals, parents, and community members. Nowadays, alternative assessment can be supported by technological applications. In this interactive session one alternative assessment form, namely electronic or digital portfolio is discussed as a means of documenting, displaying and sharing student or teacher progress and expertise over long time periods. The interactive session of electronic portfolios is a collaborative effort of researchers and teacher educators from Australia, Finland and United States. The aim of the session is twofold. First, to present the electronic portfolio development process. And second, to explore the experiences on applying electronic portfolios from kindergarten to professional development portfolios. Examples are presented from each of three countries. The presentation is followed with a discussion of similarities and differences in the rationale for the various levels and countries.

One of the most exciting developments in the school reform movement is the use of alternative forms of assessment to evaluate student learning and teacher development. Different alternative assessment systems and forms must be judged based on the value of the information they provide for students, teachers, curriculum specialists, principals, parents, and community members. Nowadays, alternative assessment can be supported by technological applications. In this interactive session one alternative assessment form, namely electronic or digital portfolio is discussed as a means of documenting, displaying and sharing student or teacher progress and expertise over long time periods. The interactive session of electronic portfolios is a collaborative effort of researchers and teacher educators from Australia, Finland and United States. The aim of the session is twofold. First, to present the electronic portfolio development process. And second, to explore the experiences on applying electronic portfolios from kindergarten to professional development portfolios. Examples are presented from each of three countries. The presentation is followed with a discussion of similarities and differences in the rationale for the various levels and countries.

There are many definitions for portfolios, since each definition depends on the purpose of the portfolio and on the perspective of its evaluation. Synthesizing several definitions, a portfolio is a student's or a professional's collection of samples of tasks and achievements, compiled by the person him/herself in order to display and review student' or professional's knowledge and competencies in relevant and broadly representative manner. Often portfolios also include descriptions about the environment and processes associated with learning and working, as well as one's own ideas or philosophy on learning, teaching or working in general. (Linnakylä & Kankaanranta 1999.)

For some time now, portfolios have been used by professionals, especially in occupations requiring creativity, originality and independence (e.g. Hartnell-Young & Morriss 1999). In such occupations professional competence is varied and calls for various kinds of knowledge, being typically hard to demonstrate by means of mere education or certificates. The use of portfolios has increased in recent years in the academic world as well.

Purpose is fundamental to portfolio development and portfolios can be prepared for many purposes. The portfolio is always a way of communicating with an intended audience. Previous experiences have attributed electronic portfolio at least with the following advantages:

- minimal storage space
- easy to create back-up files
- portability
- long self life
- learner-centered
- increases technology skills
- through hypertext links it is easier to make argument that certain standards are met
- accessibility (especially web portfolios)

There are specific custom-designed software products for making portfolios, but a portfolio can also be compiled using some general-purpose multimedia software. When planning for drafting an electronic portfolio, one needs to relate his/her user skills and time resources to the features offered by available software applications. The custom-designed portfolio design tools have been made as user-friendly and easy-to-use as possible. Portfolios are often published on discs, CD-ROMs, videotapes, or as paper copies, as well. An increasingly popular option is to publish the digital portfolio on the Internet, as a web portfolio. When creating these web portfolios the tools and programs are typically the same as when making WWW pages. (e.g. Barrett 2000; Linnakylä & Kankaanranta 1999.)

By using technology to store student or teacher portfolios, their work can be made portable, accessible, and more easily and widely distributed. However, the choice of appropriate assessment strategies or programs depends on the assessment context and a variety of other factors, human and technological that exist in a classroom, school or district. Thus, the construction of electronic portfolios should be preceded by a careful examination of diverse strategic questions about the functions and uses of assessment in general and portfolios in particular, but also about the human and technological resources available (Barrett 2000).

Barrett (2000) has derived a framework for electronic portfolio development from two bodies of literature: portfolio development in K-12 education and the multimedia or instructional design process. These complimentary processes are both essential for effective electronic portfolio development. Understanding how these processes fit together and how standards or goals contribute to electronic portfolio development, faculty gains a powerful tool for demonstrating growth over time. From the discussion of both the multimedia development process and the portfolio development process, five stages of electronic portfolio development emerge. These five stages will be discussed in more detail in the presentation with experiences derived from student portfolios.

In schools and universities in Australia, experienced teachers are being encouraged to develop portfolio as part of performance review requirements, or for planning professional development, while beginning teachers are increasingly asked to submit a portfolio to determine suitability for employment (Hartnell-Young & Morriss 1999). Student portfolios are also becoming more frequent. At the same time, Australian educators are being urged to develop skills in the use of information and communication technologies. The Australian example describes the background and content of a project, which is based on creating digital or multimedia portfolios to give purpose for learning technology skills. The project was piloted in 1999 and continues to develop.

The project was devised to link the two trends – ICT and professional portfolios – by assisting teachers to develop multimedia portfolios as a means of learning about technology while reflecting on their philosophy of teaching and their professional achievements. Hartnell-Young and Morriss (1999) suggest that teachers who engage in developing multimedia portfolios will increase skills in technology, enhance self-knowledge, gain in self-esteem and present a forward-thinking image to their employers.

Finnish example presents an action research study, in which digital school portfolios are used interactively as a means for teachers to collaboratively display and assess the pedagogical practices of kindergartens and primary schools. The digital portfolios were published on the web in order to emphasize direct, technology-enriched communication and collaboration among teachers and also to share and discuss the work with a wider audience, e.g. other teachers, teacher students and parents. Participants in the kindergarten and school network were teachers from eight kindergartens, one preschool group situated in a primary school and two primary schools in the region of

Central Finland. Teachers felt encouraged to participation by the need of multilevel collaboration in order to develop qualitative teaching and learning in pre- and primary levels of education.

The project has proceeded through five inter-linked cycles, which will be presented in the session. In the different cycles of the project the processes of portfolio development and becoming computer literate were intertwined. At the same time teachers adopted an interest to utilize ICT in the instruction, as well. Already the first cycles showed that there is an enormous need for the teacher support in computer literacy and in the construction and use of portfolios. This is crucial before teachers can become independent users of information and communication technologies and before they can collaboratively construct expertise in virtual groups.

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Facing the Vast Information Network: Finnish Primary School Student Teachers reflect on their Relationship with the Internet

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Abstract
Finnish primary school student teachers' (59 individuals) relationship to the Internet was investigated by means of a questionnaire in 2000. The relationship was analysed in three dimensions. The first involved their emotional attitudes: whether they loved or hated it, or if they were worried about being left by the wayside. The worries were examined in detail. Different ones, such as technical, pedagogical and organisational, information-processing and cultural, were analysed from the student teachers' and from their pupils' points of view. Secondly, the student teachers' images of the Internet as an organisation with typical characteristics were analysed. Finally, the proportions of innovation adopter categories in the use of the Internet were summarized. The main results showed that the student teachers worried considerably about their future pupils' relationship with the Internet, especially about information-processing issues. Emotional attitudes were mainly positive and the students usually grew to like the applications once they had tried them. The students described the Internet mostly by using positive attributes regarding its useful contents. It was often seen as a combination of different kinds of people or as an organism. The proportions of respondents in the early innovation adopter categories, such as early adopter and early majority, were larger than might have been assumed according to innovation diffusion theory.

Theoretical Background

In Finland, Tella (1995) created a classification of end users' emotional attitudes towards modern information and communication technologies (MICT) in general (Tella 1997). His categories include the pioneers; those who love them, or hate the technologies, at first sight; those who are skilful enough to adapt to them: hackers or crackers; those who slowly become fond of new technologies; those who imitate others; those with a superficial attitude; those who are worried about or scared of them; those who dislike even the thought of using information technologies and finally those who are left by the wayside: the dropouts.

The Internet could be compared to other organisations. Morgan (1986) used different metaphors to describe organisations likening them to machines, organisms, brains, the theatre, a political system and a psychical prison. In the context of the Internet, the first three are the most interesting.

The theory of innovation diffusion, developed by Rogers (1983, 1995) consists of several subtheories, one of which concerns adopter categories. According to the theory, these categories are proportionally constant in a population and consist of, in the sequence of adoption, Innovators (3% of population), Early adopters (13%), Early majority (34%), Late majority (34%) and Laggards (16%).

The Empirical Study and Research Problems

Students in Finnish primary school teacher education take a Master of Education degree. The education programme includes a course and lectures in media education, worth two credits. The author of this article distributed a questionnaire to students on the course in media education in 2000. The research problems dealt with the student teachers' relationship with the Internet:

1. What are the main concerns of student teachers in the use of the Internet?
2. What are their emotional attitudes towards the Internet?
3. What do they see as the main characteristics of the Internet?
4. What kind of organization is the Internet, according to the students?
5. In which adopter category do they classify themselves in their use of the Internet?

The themes of the worries and attitudes were assessed on a six-point scale ranging from "not at all" (1) to " very much" (6). Representations wcrc invcstigatcd in opcn-ended questions. The innovation adopter categories were explained to the students during the course, and they decided into which category they fitted.

The Results and the Discussion

The main results were that the student teachers worried considerably about their future pupils' relationship with the Internet, especially about information-processing issues and about the danger of learning bad things. Emotional attitudes towards the Internet were mainly positive, and the students usually grew to like the applications after having tried them. The students described the Internet mostly using positive attributes showing appreciation of its useful contents. The Internet was often seen as a combination of different kinds of people, or as an organism. The proportions of people in the early innovation-adopter categories, such as early adopters and early majority, were bigger than might have been be assumed according to the innovation diffusion theory.

The student teachers' attitudes towards the Internet and how they gradually grew to like it reflected the results obtained from kindergarten student teachers (Kankaanrinta 2000b). Large proportion of early adopter categories was also seen in other student teachers and in-service teachers (Kankaanrinta 2000a).

The student teachers' relationship with the Internet was revealed to be complex. On the one hand, the students thought that the Internet contained useful and interesting information, but on the other hand they were afraid of the huge amount. This aspect of the Internet is its main characteristic, SWOT: strength, weakness, opportunity and threat to both the pupil and the teacher.

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Computer-based Tools for the Development and Investigation of Mental Model Reasoning about Causal Systems

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Abstract: We live in a world of complex relationships, united by a myriad of connections, existing in continuous granularities and multiple dimensions. Discovering truths in this complexity requires an ability to decipher causality amidst endless potentially spurious associations. It is our belief that underlying investigative skills are internal representations of external systems. Effective inquiry strategies evolve out of strong internal models of the mechanisms of both the specific and general systems of inquiry. This paper outlines a work-in-progress, involving the creation of technologies which foster the development of more advanced internal mental models of causal systems during inquiry, thus improving reasoning competence.

Introduction

Craik (1943) presents the notion of mental models as internal representations of a system. Black (1992) implies that mental models are the highest form of knowledge representation, an amalgamation of propositions and imagery capable of generating procedures. Schwartz and Black emphasize imagery in mental models, describing them as "depictive simulations" (1996a) representing particular system mechanisms, from which rules are derived (1996b). Kuhn, Keselman, Black, and Kaplan (2000) present the notion of mental models in reasoning as abstract internal representations of causal systems, which underly the use of advanced investigative strategies. The goals of our current project are to extend our existing computer-based study environment, for the purpose of advancing development of reasoning strategies, by building visualization features to induce mental models representing 1) that more than one factor can contribute to one outcome, and 2) of correct system mechanism.

Program Design

Constructivist instructional design frameworks for computer-based study environments emphasize the relevance of self-directed knowledge construction, as opposed to direct instruction of objective knowledge (Wilson, 1996). Research indicates that instruction "situated" or "anchored" in meaningful contexts, with focused pre-set goals, have been effective vehicles for self-discovery learning (Schank, Fano, Bell & Jona, 1993; Black & McClintock, 1996; Brown, Collins & Duguid, 1989; Cognition and Technology Group). Anchored instruction is especially befitting in science education (Goldman, Petrosino, Sherwood, Garrison, Hickey, Bransford & Pellegrino, 1996).

Problem Scenario: Flood Predictor

Flood Predictor, a multimedia research program, created with Macromedia Director, is founded upon anchored, situated and goal-based instructional design principles, supporting the investigation of causal relationships in the domain of elementary hydrology, and induction of evidence-based deductive reasoning strategies, via self-discovery.

Students are situated in the role of a builder working for a construction company, and assigned the job of determining how high to build stilts under houses near a group of lakes. Employees are informed, via text and audio, that, in order to avoid flood damage and to minimize the cost of expenditure on unnecessary materials, they must determine which factors in the region will cause flooding and which will not. To do this, they must call up records of sites by creating unique combinations of features, predict how high flooding will rise, and make conclusions about whether features matters, don't matter or haven't found out yet. As well as being asked to make conclusions about whether features matter or don't matter after each instance of examining records, as a metacognitive que, students are asked to respond to a multiple choice question about how they know that certain features matter or don't matter in causing flooding.

Five factors are introduced as potentially causal in flooding: Water Pollution (high vs. low), Water Temperature (hot vs. cold), Soil Depth (shallow vs. deep), soil type (clay v. sand), Elevation (high v. low). Three factors (Water Temperature, Soil Depth and Soil Type) are causal within the program scenario. There is one interaction between Soil Depth and Soil Type. The other two factors are not causal within the program scenario.

Reasoning Activity

Within all *Flood Predictor* versions, participants are guided through investigations modeled upon previous research by Kuhn et al. (1992; 1995). Reasoning activity is operationalized as design of investigation, number of variables held constant & controlled comparisons, outcome predictions, outcome inference and interpretation, and theory change. Metacognitive awareness is activated/reinforced by declarations of inquiry intention, causal prediction, and inference justification. Theory assessment involves participant declaration of initial and final theoretical conclusions about whether factors matter and in which direction, and levels of theory certainty. Inquiry designs are determined by record comparisons made by the participant, who has the opportunity to call up records of any combination of factor values.

A menu set of five menus, one for each factor, permits students to select one of two values for each factor. Records include unique identities of site, the value of each factor in the site, and the true outcome of the unique combination of factor values. For each record selection, before discovering the true outcome, participants make predictions about flood levels, and indicate which variables would be responsible for predicted results/change. Upon receiving true outcomes of a site flood level, participants check whether each factor "matters", "doesn't matter" or "haven't found out". For each variable participants claim to find out about, they are asked how they know what they know, from: A notebook is available to store notes at any point during the investigation session by clicking on the "open notebook" button. After each record instance, participants are asked if they would like to type anything in the notebook. Participant activity, including time and ID, is recorded into a text document on the local hard drive of the computer on which the program is installed.

Mental Model Manipulations

Simple Geographic Information Systems (GIS), made up of transparency map layers representing factors and factor values, are introduced as tools for eliciting development of the additive effects mental model. Depiction of environmental system components in space are intended to illustrate that more than one component exists in the same location, leading to easier analyses of combined relational effects. Differently than in previous causal reasoning research, qualitative evidence about each factor is presented, in the form of a "field report," in addition to evidence about covariation evident in record comparisons, with the intention of stimulating a correct internal representation of the particular mechanism of causality. It is expected that experiencing one and/or more of these interventions will lead to more advanced mental models, thus more strategic inquiry strategies. Mental models are assessed using a rubric, partially based upon Jonassen's (1995) suggestions for consideration of coherence, relevance, integration, fidelity of with real world, imagery, complexity, transferability, and inferential ability in assessing mental models, which measures some of these qualities in open-ended responses to how and why flooding occurs.

Results and Future Directions

Studies underway are revealing that GIS are useful educational tools, as well as analytical tools, instigating more advanced additive effect mental models, thus improving reasoning activity, measured as use of controlled comparison inquiries and evidence use, and knowledge acquisition, measured as correct theory changes. Qualitative evidence about factor attributes, leading to more depictive mental models of the particular system, appears to be improving prediction, reducing misprediction, and knowledge acquisition. Results will be reported in a future publication.

Near future goals include incorporating the GIS layers into the computer program, so that students can investigate with the external map layers. Ultimate goals include building a data-based driven web application, capable of distributing and receiving evidence about any system, allowing teachers/students to specify particular content, and displaying system components and relations in diverse depictions and dimensions, as 2-dimensional maps layers, as sets of menus, as particular depictions, as networks, hierarchies, illustrations, etc. The production of such an artifact would allow students to improve reasoning strategies across domains and surface features, and permit researchers to compare cognitive development with various content and knowledge representation.

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Emerging Issues in Information Economy & Electronic Commerce: A Strategic Analysis

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Abstract: The dramatic growth of electronic commerce (e-commerce) is ushering in a new era of business opportunities we have witnessed in decades. The convergence of information technology, communications and entertainment, reflected in the Internet itself, has the potential to generate significant economic growth. The pace of this growth is reflected by the growth in the information technology sector – the producer of the infrastructure for the *information economy*. The main interest of this brief report is how this technological revolution will impact upon the global businesses considering its applications, key issues, strategies and challenges in the Internet-driven economy.

Introduction

The *information economy* & *e-commerce* are comparatively new phenomena. The heart of the information revolution is that the medium through which people do the important things in life is changing. Now we can communicate and make many everyday transactions electronically. This is the world of *e-commerce* – where the buyers and sellers conduct their business electronically, by means of online technology. E-commerce increases productivity and can create competitive advantage.

A global overview of e-commerce

E-commerce is growing dramatically and it was approximately U$43 billion in 1998, but it is estimated that online business may sour to U$1.4 trillion by 2003[Los Angeles Times, 1999]. With the growth in Internet usage, there is a corresponding increase in e-commerce. A recent Angus Reid survey of 28,374 worldwide Internet users, or about 200 Internet users in each of 34 countries gave the following statistics for adults shopping online (Gengler, 2000):
United States: 31%, Sweden: 21% Switzerland: 19%, Canada: 18%: Australia: 14%
Japan's Ministry of International trade and Industry estimates e-commerce could account for business worth 3.16 trillion yen (about U$18 billion) by 2003 (Zielenziger, 2000). The USA is the leader in driving e-commerce due to its dominance on the Internet. Currently over 60% E-Business is taking place in the USA. A report by the US Department of Commerce – *The Emerging Digital Economy II* says online sales will be about $US300 billion annually by 2005. Internet demographics are changing rapidly. The development is very rapid among many developing countries, for example, China, India, Korea and Malaysia.

Strategic Approach & Benefit

A strategy consists of a fundamental pattern of existing and intended targets, action-guiding principles, the use of resources and interaction between an organisation and market, competitors and other environmental factors. E-commerce should be developed through a strategic framework for running business in cyberspace. The enormous benefits due to the adoption of e-commerce in an organisation and thus contributing further to information economy have been identified many authors (Karmakar, 1999, Karmakar 2000a & 2000b, Karmakar 2001, Tapescott, 1996). To be competitive in the global information economy, and to ensure the participation by all people, national government must remain committed to a world class telecommunications infrastructure that is highly competitive, characterize by high bandwidth at an affordable price, and readily available virtually anywhere in the country. It is essential that the supporting infrastructure be in place for the effective business and community use of online applications and service.

It is widely recognized that a deregulated, competitive telecommunications market is the best way to drive down costs, encourage innovation and increase quality of service. E-commerce allows business to be done more efficiently, as it is driving change many sectors of the economy and producing a more efficient allocation of resources. The main strategy should include global cooperation among companies in this era of rapid technological changes when the reduction in product development cycle is a key competitive requirement.

Getting into electronic business has several advantages (Amor, 2000):

- **Global Accessibility and Sales Reach** – Businesses can expand their customer base, and even expand their product line & equal access to new markets,
- **Closer Relationships** – Business – to-business sellers can grow closer relationships,
- **Free Samples** – Products can be sampled via the Web fast, easily and free of charge,
- **Reduce Costs** – Reduced design and manufacturing cost,
- **Media breaks** – The Internet reduces the number of media breaks that are necessary to transport information and thus reduction of advertising cost,
- **Time to Market** – Shorter time to market and faster response time to changing market demands,
- **Customer Loyalty** – Improved customer loyalty and service through easier access to the latest information and never closing site,
- **Competitive Intelligence** - Improved market intelligence and strategic planning & also customer involvement in product and service innovation.

According to the Organization for Economic Co-operation and Development (OECD), the economic performance of countries like Canada, the USA and the UK now compares favorably with that of former leaders Japan and Germany, and a significant part of this is their aggressive exploitation of Information technology(IT), especially the Internet (Norris & West, 2000).

Strategic Priorities

The Internet as an information-sharing tool, and potential as a medium for transactions, create an attractive electronic marketplace (Adam et al., 1999). To gain maximum benefit of e-commerce in the era of information economy we have identified a number of strategic priorities:

- Providing opportunities for all population to benefit from the information economy,
- Delivering the education and skills population need to participate in the information economy,
- Promoting the growth of the world class infrastructure for the information economy,
- Identifying new competitors and market shares in the new market in cyberspace,
- Developing a legal and regulatory framework to facilitate e-commerce,
- Developing a Web-centric marketing strategy,
- Unlocking the potential of the health sector,
- Influencing the merging industrial rules and conventions for electronic commerce,
- Implementing a world class model for delivery of all appropriate government services online,
- Promoting the integrity and growth of content and culture in the information economy,
- Participating the creation and development of virtual marketplaces and intermediaries, now.

E-commerce promises, in some cases, to revolutionize a company's operations. But this revolution requires that the company has the backing, dedication, resources, focus and commitment to move company to e-commerce. It is one of the most significant information innovations that lie at the root of productivity and economic growth. Exploiting Internet's capability allows an organization to create wealth by trading products and services with entities it has never met before (Mougayar, 1998). Management of Technology is also very important in this knowledge era to gain competitive advantage.

Conclusions

Electronic commerce requires an evolutionary approach that addresses each piece of the puzzle both separately and as part of an overall strategy. Few organizations are handling the electronic commerce phenomenon as a whole. Rather, they are breaking it into pieces, and implementing different areas separately or in a fragmented manner, mainly because of a lack of understanding of how to manage the complexity of issues and barriers.

Some key criteria for success in e-commerce area: brand-name recognition, low-cost structure, legacy systems integration, leverage of applicable technology, and casc of use. Direct communications between suppliers and customers streamlines the supply-chain and delivers new relevant information to manufacturers in real-time (Kalakota, 1997). Finally, it is worth remembering a quote of Bill Gates, Microsoft Co-Founder & Chairman: 'Going digital will put you on the leading edge of a shockwave of change that will shatter the old way of doing business. A digital nervous system will let you do business at the speed of thought, the key to success in the 21st century'.

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Interactive History with Learning Affordance for Knowledge Construction• in Web-based Learning

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Abstract: The main problem addressed in this paper is how to help learners construct knowledge in exploring existing hypermedia/hypertext based learning resources on the Web. Our approach to this problem is to provide a learning tool, which affords knowledge construction activities involving reflection on the exploration process. In this paper, we describe an interactive history that encourages learners to annotate their exploration history with the reasons why they have explored, which reasons have a great influence on knowledge construction in hyperspace. It also generates a knowledge map from the annotated exploration history, which map spatially represents the semantic relationships among the Web pages explored by the learners. This paper also describes an evaluation with the interactive history system. The results indicate that the system affords rethinking exploration process.

Introduction

An increasing number of hypermedia/hypertext based resources for learning/education has been available on the Web. These web-based learning resources generally provide learners with hyperspace where they can explore the Web pages by following the links among the pages to learn the domain concepts/knowledge in a self-directed way (Nielsen, 1990, Kashihara, Ujii, and Toyoda, 1999). The exploration often involves integrating the contents of some pages that have been explored to construct their knowledge (Thuering, Hannemann, and Haake, 1995). These knowledge construction activities would enhance learning (Jonassen, 1999, Chan et al., 1993). However, learners often fail in knowledge construction since what and why they have explored so far become hazy as the exploration progresses. To what extent the learning has been carried out also becomes unclear (Thuering, Hannemann, and Haake, 1995). Knowledge construction in hyperspace consequently requires reflecting on exploration process that learners have carried out (Kashihara, Ujii, and Toyoda, 1999).

The main issue addressed in this paper is how to support the reflection for knowledge construction in hyperspace. Current work on educational hypermedia/hypertext systems has provided spatial/concept maps as representative reflection aids (Brusilovsky, 1996). The suitability of these aids is founded on semantic relationships among domain concepts/knowledge embedded in the learning resource. However, these can not be always available to existing web-based learning resources since it is hard to identify semantic relationships among the Web pages without analyzing the contents of the learning resources.

Another approach to proper reflection support is to provide a learning tool, which affords reflection activities for knowledge construction (Laurillard et al., 2000). We call such feature of the tool *learning affordance*. The word *affordance* is borrowed from the psychology of perception (Gibson, 1979). The concept of *learning affordance* can be viewed as a basis for evaluating the suitability of learning tools. Web browsers such as Microsoft Internet Explorer and Netscape Navigator, for example, are regarded as web-based learning tool for popular use. Do they have proper learning affordance for knowledge construction in web-based learning? The web browsers provide learners with back buttons and browsing history. Although these facilities afford revisiting the Web pages that have been visited (Tauscher and Greenberg, 1997), they would not always create activities of knowledge construction such as integrating the contents of some pages explored. The browsing history also provides no information of why they have explored, which information plays a crucial role in knowledge construction (Kashihara, Ujii, and Toyoda, 1999), and does not allow them to sufficiently rethink knowledge that they have constructed so far. We can consequently say that the web browsers are not very suitable for knowledge construction in hyperspace.

Table 1: Exploration Goals and Visual Representation.

Exploration Goals	Visual Representation
Supplement	Inclusion
Elaborate	Set or Part-of tree
Compare	Bidirection arrow
Justify	Vertical arrow
Rethink	Node superposition
Apply	Arrow

Starting page Terminal page

Designing a more suitable tool needs a careful consideration of exploration process and of what kind of activity should be supported by the tool. Following this idea, we have proposed an interactive history for learning with existing web-based learning resources (Kashihara, Hasegawa, and Toyoda, 2000). In this paper, we describe the interactive history system and its evaluation. The results of the evaluation indicate that the interactive history system affords rethinking exploration process particularly in more complicated hyperspace.

Before demonstrating the interactive history, let us first consider exploration process in hyperspace to discuss what kind of knowledge construction activity should be supported.

Exploration in Web-based Learning Resource

Learners generally start exploring hyperspace with a learning goal. The movement between the various pages is often driven by a local goal called exploration goal to search for the page that fulfills it. Such exploration goal is also regarded as a sub goal of the learning goal. We refer to the process of fulfilling an exploration goal as primary exploration process, which is represented as a link from the starting page where the exploration goal arises to the terminal page where it is fulfilled. The whole exploration process can be modeled as a number of primary exploration processes.

Exploration goal, represented as verb, signifies how to develop or improve the domain concepts and knowledge learned at the starting page. We currently classify exploration goals as shown in Table 1, which are not investigated exhaustively.

An exploration goal arising from visiting a page is not always fulfilled in the immediately following page. In such case, learners need to retain the goal until they find the appropriate terminal page/s. While searching for the fulfillment of the retained goal, it is possible for other exploration goals to arise. The need to retain several exploration goals concurrently makes the knowledge construction more difficult to achieve.

Executing a primary exploration process, learners also make a semantic relationship among the domain concepts and knowledge in the starting and terminal pages (Tauscher and Greenberg, 1997). The semantic relationship is shaped according to the exploration goal. Each exploration goal provides its own way to make relationship between the starting and terminal pages (Kashihara, Hasegawa, and Toyoda, 2000). Integrating several primary exploration processes, learners construct their knowledge structure.

The above consideration of exploration process in hyperspace indicates that it is necessary to rethink primary exploration processes and their integration for succeeding in knowledge construction.

Interactive History

Overview

In order to encourage learners to rethink primary exploration processes that they have executed during exploration, the interactive history provides an exploration history annotated with primary exploration processes. It also provides a knowledge map, which visually represents relationships among the primary exploration processes, to help the learners to rethink knowledge structure that has been constructed.

The interactive history system first enables learners to annotate an exploration history, which includes Web pages sequenced in order of time they have visited, with primary exploration processes. In order to help learners note down primary exploration processes during exploration, the system provides them with a list of exploration goals, and requires them to select one from the list when an exploration goal arises. The learners are also asked when they find the terminal pages. The interactive history system annotates the exploration history with the information noted down. The annotated exploration history enables the learners to retain their primary exploration processes.

The learners are also enabled to directly manipulate the annotated exploration history to modify/delete the primary exploration processes and to add new primary exploration processes after exploring hyperspace. Such direct manipulation enables them to reorganize their exploration process.

The interactive history system second transforms each primary exploration process, which is extracted from the annotated exploration history, into a visual representation by means of a visualization scheme that describes the correspondence of an exploration goal to a visual representation. It then combines each visual representation to generate a knowledge map. The knowledge map does not obviously represent the contents included in the explored pages, which may be summarized by the page titles. However, this summarized information would be substantially fruitful for learners to reflect on what they have learned.

Annotated Exploration History

In the interactive history system, learners can use a user interface as shown in Figure 1. They can also explore a hyperdocument on a WWW server with one learning goal in the left window. When they want to set up an exploration goal in visiting a page, they are required to mouse-click the corresponding page in the *Annotated Exploration History* window. The *Exploration Goal Input* window then appears as shown in Figure 1. The learners can select one corresponding to the goal from the exploration goal list in the window. The page visited currently is also recorded as the starting page of the exploration goal. After inputting the exploration goal, the *Exploration Goal Input* window disappears.

When the learners find a terminal page of the exploration goal, they are required to mouse-click the exploration goal in the *Annotated Exploration History* window. The *Exploration Goal Input* window then appears. They can input the terminal page by dragging the title of the terminal page and pasting into the terminal page section in the *Exploration Goal Input* window. They can also add the object of the verb describing the exploration goal. It means what to develop/improve in the current page whereas the exploration goal specifies how to develop/improve.

Figure 1 gives an example where a learner explores a hyperdocument on a WWW server with the learning goal of understanding the occurrence of earthquake. The annotated exploration history shows the sequence of the pages visited and primary exploration processes that have arisen. For example, he/she visited the page *Animation of the Mechanism* in order to rethink the description in the page *The Mechanism of Occurrence of Earthquake.* He/she then visited the page *Seismic Wave* since he/she did not know the meaning of the term used in the previous page.

The system also provides another support for helping learners store part of the contents of the page visited currently with Cut&Paste function although they may not always need this support. In hyperdocuments on WWW, in addition, the title tags of the pages do not always represent the contents of the pages. If the learners want to change the page titles, they can input new titles in the *Exploration Goal Input* window, which new titles should represent the contents the learners explored in the pages. The pasted information and the changed page titles are also used in the annotated exploration history.

Using the information inputted from the learners, the system generates the annotated exploration history as shown in Figure 1 so that the primary exploration processes can be viewed clearly. In the annotated history, each page has the page title. The starting page of each goal is linked with the corresponding terminal page/s. There may be some primary exploration processes without terminal pages since they have not been found yet. The learners can look at the annotated exploration history on their demand during exploration. They can also click the pages in the history to review the content information, which they have inputted with Cut&Paste function.

Directly manipulating the annotated exploration history, learners can reconstruct their exploration process. Each manipulation is done by means of mouse-clicking/dragging parts of the primary exploration processes. There are three basic manipulations: deleting and changing exploration goals/links between starting and terminal pages, and adding new primary exploration process.

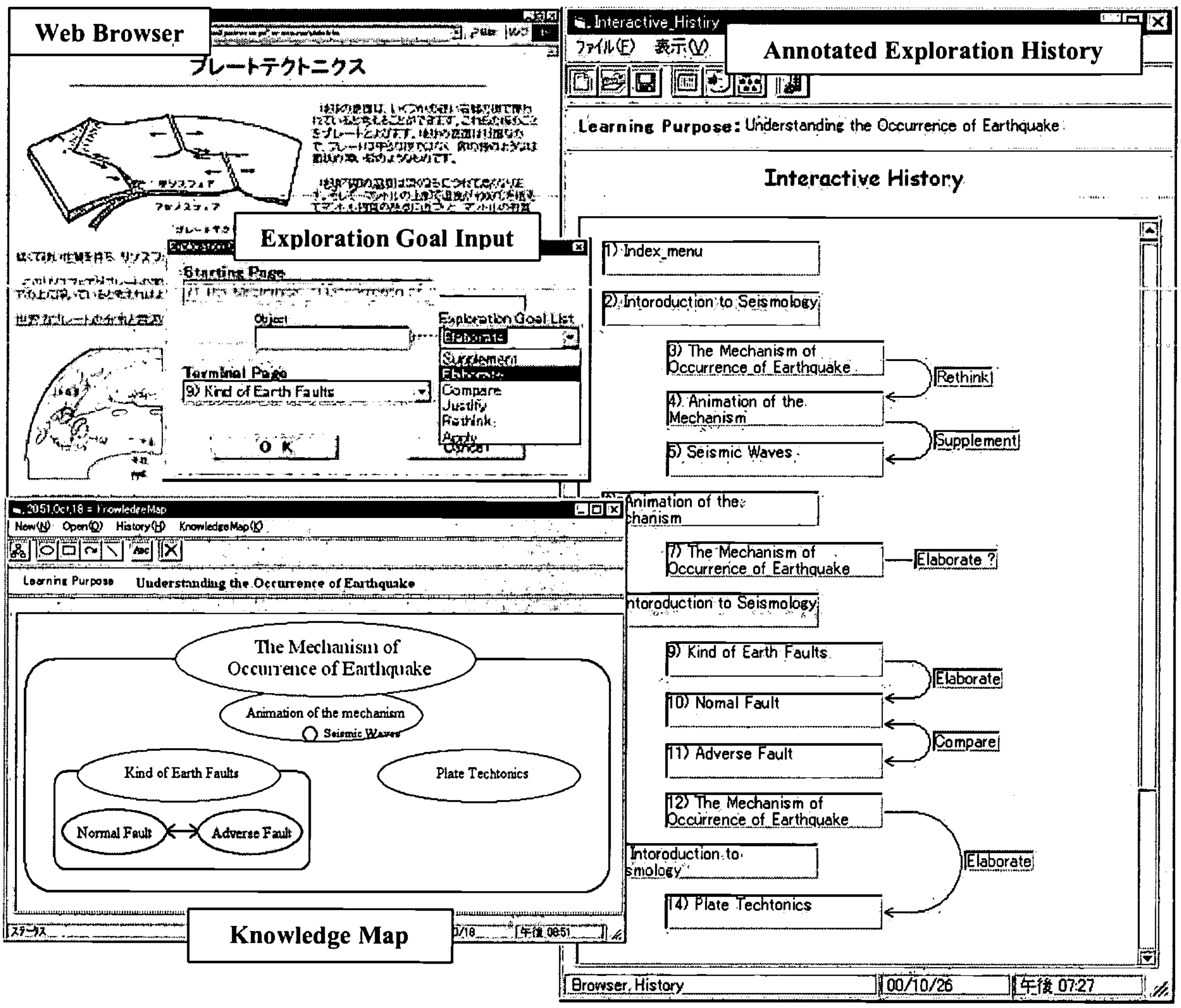

Figure 1: User Interface of Interactive History.

Learners are not always required to input the above information whenever they visit pages. Nevertheless, inputting the information during exploration may be troublesome for learners. On the other hand, it enables the learners to make their exploration more constructive. The annotation, in addition, requires a meta-cognitive skill that is indispensable for managing knowledge construction process in existing web-based learning resources. The interactive history system could distract learners, who do not have it, from their learning tasks in hyperspace. We believe, however, it is educationally important to train the learners to improve the meta-cognitive skill so that they can learn in a constructive way. The interactive history can be viewed as a potential tool for this training.

Knowledge Map

In order to make the knowledge map understandable, we have adopted a visualization scheme shown in Table 1. This table shows the correspondence of an exploration goal to a visual representation of the relationship between the starting and terminal pages. For example, an exploration goal to *Elaborate* is transformed into a set that visualizes the starting page as a total set and the terminal page as the subset. Following such correspondence, the system generates a knowledge map by combining visual representation of each primary exploration process in the annotated exploration history. The knowledge map generation is executed on learners' demand before/after manipulating the annotated exploration history.

Figure 1 shows an example of the knowledge map that is generated from the annotated exploration history shown in Figure 1. Viewing this map, the learner can reflect on the relationships among the primary exploration processes. For example, he/she can recall that he/she elaborated *The Mechanism of Occurrence of Earthquake* by exploring *Kind of Earth Faults*, and that he/she furthermore elaborated it by comparing *Normal Fault* and *Adverse Fault*.

Before using the interactive history system, in addition, learners need to know how to interpret the visual representation used for the knowledge mapping. In order to explain it, the interactive history system demonstrates few examples of annotated exploration history and knowledge map before starting the actual learning support.

Preliminary Evaluation

Experiment

In order to evaluate the interactive history system, we have had a preliminary experiment. The main goal of this experiment was to analyze the utility of the system and to ascertain if the interactive history affords rethinking exploration process compared to learning without the system. We also prepared two web-based learning resources as shown in Table 2, which had comparatively simple and complicated hyperspace. Table 2 describes the number of pages, and the number of links per page, which was calculated except for navigation links such as Next, Back, and Top. These can be viewed as the indicators of the complexity of hyperspace each learning resource provides. The learning resource 2 accordingly had a more complicated hyperspace. Subjects were thirteen graduate and undergraduate students in science and technology.

We set four conditions, which were (1) learning in the learning resource 1 with the system (Simple-With), (2) learning in the learning resource 1 without the system (Simple-Without), (3) learning in the learning resource 2 with the system (Complicated-With), and (4) learning in the learning resource 2 without the system (Complicated-Without). Subjects were provided with Internet Explorer as WWW browser under each condition. In this experiment, each subject learned one learning resource with the system, and learned the other without the system. In other words, he/she was assigned two conditions, which were Simple-With and Complicated-Without (or Simple-Without and Complicated-With).

Before learning, subjects were given a learning goal for each learning resource. Under Simple-With or Complicated-With, they were also given the explanation about how to use the interactive history system, and were asked to try it in a sample learning resource whose hyperspace is simple. They were then asked to explore hyperspace with or without the system to accomplish the learning goal. The time of learning in each condition was limited to thirty minutes.

In this experiment, the utility of the system was analyzed with the dispersion of pages visited, the number of revisit per page (Tauscher and Greenberg, 1997), the number of primary exploration processes executed, and the number of revisiting pages that were included in the primary exploration processes. Comparing the averages of them under Simple-With and Simple-Without or under Complicated-With and Complicated-Without, we evaluated the utility of the interactive history system.

Results and Discussion

Table 3 summarizes the analysis of the utility. The average number of revisit per page on Complicated-With was larger than that on Complicated-Without although there was a slightly difference between Simple-With and Simple-Without. The average dispersion of pages visited on Complicated-With was lower that that on Complicated-Without although there was a slightly difference between Simple-With and Simple-Without. These results indicate that the interactive history system makes learners' exploration more intensive in a more complicated hyperspace.

We further analyzed the utility of the interactive history system on Simple-With and Complicated-With. Table 4 shows the average number of primary exploration processes executed, the average number of starting and terminal pages, and the average number of revisiting pages that are included in the primary exploration processes. The average numbers of starting and terminal pages on Simple-With and Complicated-With corresponded to about half of the average numbers of pages visited as shown in Table 3 (54.8% on Simple-With and 51.0% on Complicated-With). In other words, half of the visited pages were related to the primary exploration processes. The average numbers of revisiting the starting and terminal pages on Simple-With and Complicated-With accounted for 74.5 % and 79.9 % of the whole revisits shown in Table 3. These ratios were very high. These results indicate that the interactive history system can afford rethinking each of primary exploration processes and their relationships.

Table 2: Learning Resources.

	Learning Resource 1	Learning Resource 2
Number of Pages	73	158
Number of Links per Page	1.2	2.3

Domain of learning resource1: Mechanism of earthquake
Domain of learning resource2: Life in Sea

Table 3: Utility Analysis.

	Total Number of Pages Visited (a)	Number of Pages Visited (b)	Dispersion (b/a)	Revisit (a-b)	Revisit per Page ((a-b)/b)
Simple-With	70.6	23.9	0.34	46.7	1.95
Simple-Without	69.8	22.7	0.32	47.1	2.07
Complicated-With	71.6	25.3	0.35	46.3	1.83
Complicated-Without	57.2	30.2	0.53	27.0	0.89

Table 4: Analysis of Revisit on Primary Exploration Processes.

	Number ofPrimary Exploration Processes	Number of Starting and Terminal Pages	Revisit
Simple-With	11.2	13.1(54.8%)	34.8 (74.5%)
Complicated-With	11.6	12.9(51.0%)	37.0 (79.9%)

Conclusions

This paper has claimed that knowledge construction in hyperspace requires learners to reflect not only what but also why they have explored, and that learning tool should afford rethinking their exploration process and knowledge structure being constructed by them.

This paper has also demonstrated the interactive history with the learning affordance. The interactive history encourages learners to annotate and reorganize the exploration history to rethink their exploration processes. It also generates a knowledge map from the annotated exploration history, which allows the learners to reflect on what they have constructed during exploration. In addition, this paper has described an evaluation of the interactive history system. Although we need a detailed evaluation with more subjects, the results indicate that the system affords rethinking primary exploration processes particularly in a complicated hyperspace.

In the future, we will have a more detailed evaluation. We would also like to classify exploration goals in detail to represent learners' exploration process more precisely.

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Learning Objects Metadata and Tools in the Area of Operations Research

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Abstract: Information technology and the Internet are making inroads into almost all areas of our society. The requirements of students and professionals are fast changing, the information society requires lifelong learning in practically all areas, especially those related to information technologies. The educational sector can profit in particular from the benefits IT adds to the ways of learning. The core techniques exists, still the integration into the curricula and the integration of learning environments and traditional knowledge management systems and libraries cannot keep up with the pace of technology development. This article focuses on the use of so called "learning objects" in the field of Operations Research and Management Science (OR/MS). Learning objects refer to pieces of information of different granularity which can be combined, linked and reused. We will demonstrate some of the concepts mentioned above by the LOM editor of the Technical University of Darmstadt and prototype systems developed in the project OR-World of the University of Paderborn and give an outlook on the future development.

Introduction

The idea of learning objects follows a constructivistic view of learning where students actively construct knowledge rather than are being taught by a teacher. Web environments can be considered as an ideal platform for persons holding this frame of mind. Though a traditional web based approach (HTML) is a first step into the right direction, it is not optimal in terms of structure, consistency and manageability. If we consider large scale systems with a very large amount of documents, authors need tools to assist them while creating and maintaining educational material. On the other hand readers often get lost when retrieving documents, the amount of hits often turns out to be irrelevant. The flat description model which HTML offers is not precise enough to allow an efficient search and retrieval process. Due to the lack of support for efficient structuring, retrieval, and linking among very large amounts of documents by standard Web technologies, namely HTML, new technologies which allow a more sophisticated retrieval method, such as a structured Metadata approach, are emerging. In the context of learning objects the Learning Object Metadata standard (LOM) is widely accepted and becomes more and more important (see section 3 for further details, other examples for Metadata classifications are Dublin Core or IMS).

HTML is not consequently separating content, structure and representation of a document. Furthermore HTML is not extensible by additional tags. If we think of learning objects, other tags than <heading> or <bold> for example are desirable. The tagging of learning objects with specialized tags is simply not possible in HTML. Links among documents can only be defined as untyped, unidirectional links. In order to minimize maintenance efforts and costs it would be desirable to use single source documents (e.g. in the form of XML documents) published on demand in a format of one's choice (e.g. HTML, paper, e-book, WAP, etc.). A dedicated markup language stores structured document information besides the content and enables the rendering of different representations of the source document. This way the maintenance costs for material can be decreased and the material can be made available to different people with adaptive views. Open technologies standards such as XML and dedicated markup languages for documents offer the chance of constructing content which can be (re)used by people independent of their location. The standardization of metadata descriptions has the effect that tools dealing with metadata descriptions become universally applicable. LOM and IMS are excellent examples that a widely used specification which is accepted as a standard can promote immensely to the exchange of data.

2 OR-World

After being developed since about 40 years, contents of OR/MS have reached a high level of maturity. The basic algorithmic and modeling techniques form a stable core of the discipline, whereas implementation issues develop rapidly with new perspectives offered by information technology. This justifies the high amount of developing effort necessary to create such systems. The core contents are well-suited for hypermedia learning because they essentially consist of processes and algorithms, thus implying a dynamic nature. While the dynamics cannot be fully represented in paper-based books, it can very well be illustrated interactively by animations on a computer screen.

The knowledge domain OR/MS is highly interrelated, basic algorithms and methods can be applied to practical problems in varying contexts. Thus, in a graphical representation of the knowledge domain, a graph instead of a strict hierarchy would be drawn. A previous structuring of a content area is helpful for building the links among objects in a hypermedia network. Because OR/MS is already well-structured, it is very suitable for the representation within OR-World.

OR-World is funded within the Fifth Framework Programme of the European Community. The goal of the project is to develop a hypermedia network of learning objects where:

Each object is well described by a Metadata description.
Object granularity from media elements to thematic metastructures can be stored.
Objects can be reused in the sense of combining objects of lower granularity to objects of higher complexity.
Dedicated Document Type Definitions for different types of objects are available.
Renderings in varying target formats can be generated by the system (see [OR-World2000])

LOM is highly accepted and will be used for the Metadata description of our learning objects. In the project. The advantage of a data centered, standardized approach is obvious: An externally developed editor such as the LOM editor of TU Darmstadt can be integrated in OR-World without many hassles. The interfaces to the files/databases where the descriptions are stored may have to be adjusted but the basic data structure is fixed. This way the efforts in software development can be focused on building stable software components which can be reused just like the documents created in the standardized format.

Core technologies such as XML and XSL lay the foundations on which applications can be built. Metadata description is not the only application which can be imagined. One of the main drawbacks of HTML is that one kind of general document template serves to represent the whole variety of imaginable documents from small fragments to articles, books, etc. On a micro level, documents differ significantly in their structure. Within the project dedicated document type definitions for the varying granularities of learning objects will be developed. Currently document type definitions for large documents such as books or technical documentations are available. One example is the docbook DTD which stems from SGML but is also available for XML [Docbook 2000]. Media elements differ significantly in their structure from case studies, tests etc. and for optimal use this has to be reflected in the applied document structure. XML and XSL in this sense are just a means to specify he desired behavior. The structure of documents in the learning context still has to be defined. When a set of document type definitions will be available, the documents built consistently on these definitions can be rendered in different visual representations. Most obvious examples are renderings in the HTML or Acrobat PDF format. We use standard technologies from the XML Apache project [Apache XML 2000], see Figure for a visualization of the process.

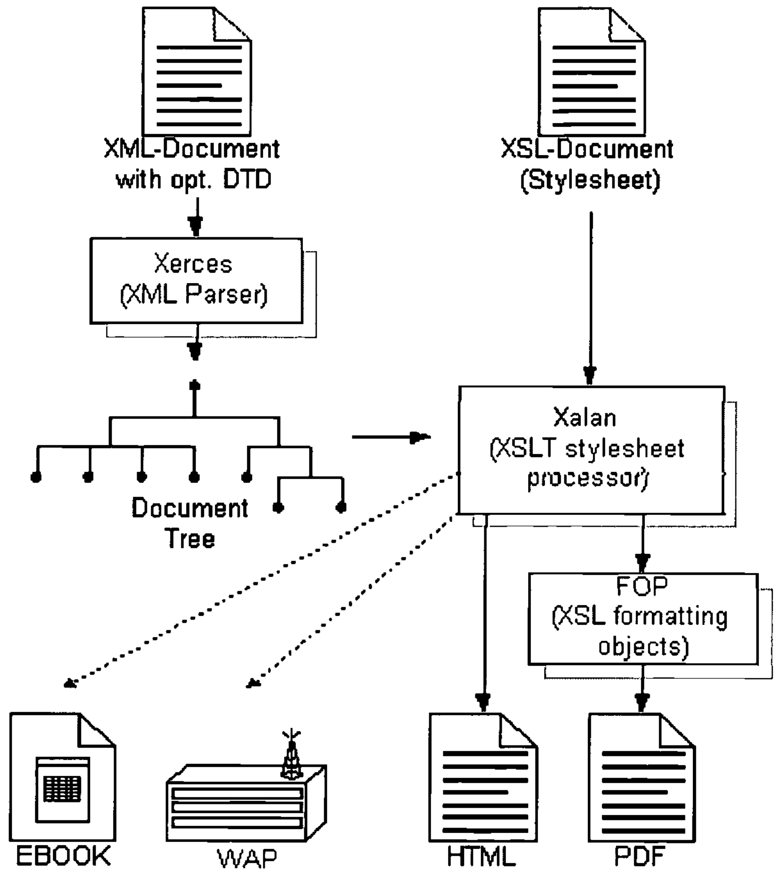

Figure 1: Process of generating varying renderings for XML source documents

The output format can also be varied in terms of extent. A case study for example can reveal more and more details or hints of the case. This allows students to approach a case gradually and helps them to solve the case finally. Besides the rendering an interesting point is that information to be stored in the metadata description according to LOM is already existing in a structured document. E.g. the title or author are often stored in the source document. Since the metadata description is physically another entity mechanism to derive metadata information from the document to be described would be very useful. Most authors in our experience find it annoying to complete the task of setting up the Metadata appropriately. This is correlating to the experiences the TU Darmstadt made and since he appropriateness of the Metadata information determines its value the ease of use is a crucial issue.

3 LOM-Editor

In the following we describe the tool that we use to create the metadata. As the resources are only described it is neither necessary to change the resource nor needs the author of the metadata description physical access to the resource Therefore it is possible to publish metadata records for various resources, e.g. documents, images, audio clips, videos, animations, virtual reality worlds, or multimedia exercises. A metadata record consists of a set of elements, describing a multimedia resource. Examples of these elements are date of creation or publication, type, author, format, or title of a resource.
To access and discover multimedia information resources in a comfortable way, we developed a user-friendly tool, the LOM editor (Figure 2), based on the IEEE-LOM scheme version 5. IEEE's specification of Learning Object's Metadata (LOM). LOM extends the well known Metadata approach for general documents Dublin Core (DC) with elements to describe additional educational properties of multimedia resources. The elements are grouped in categories which are listed below.:

General: General metadata, such as the title, language, structure, or description of a resource
Life Cycle: Status, version, and role of a learning objet
Meta MetaData: Information about the metadata used to describe the learning object.
Technical: All technical information about a resource, such as the format, the length, browser requirements, which are necessary to use the resource.
Educational: Information about the educational objective of a resource, such as interactivity, difficulty, end-user type, etc
Rights: Commercial use and ownership of a LO
Relation: Links between Learning Objects, to express dependencies, or semantic connections
Annotation: Used to provide additional, eventually more detailed information about a resource
Classification: Elements to classify a resource according to existing classification schemes

Based on the LOM 5.0 draft and a DTD developed by the IMS, we have specified a XML DTD according to the actual LOM scheme. It is therefore possible to save an LOM description as an XML file and also to import existing descriptions . With the use of a free middleware broker implementation called CASTOR [Castor 2000] the Metadata descriptions can also be stored in a relational database like Oracle or IBMs DB2. The editor is implemented in Java, so it can be used on all platforms.
The time effort to describe all properties of a resource is considered as a hindrance to a wide distribution and usage of a metadata scheme. To offer users a faster way to describe the learning resources, the editor is using a template mechanism. If one author is describing similar resources many elements like the name of the author, the target audience or the access right stay the same and don't have to be changed. Using templates with common values, can avoid the necessity to fill a lot of fields again and again.
Another property of the LOM scheme which can be used for building a user friendly editor is the use of the vocabulary elements of a LOM description. For many elements the LOM scheme suggests to use an integer value, which can be mapped to different descriptions in different languages. With the use of Vocabularies it is possible to guarantee a fixed set of values for specific elements to avoid ambigious descriptions when searching for resources. Figure 2, shows a screenshot of the current implementation of the editor. One can also see the use of the Vocabulary element for the structure element of the General category. Depending on the selected language to describe a resource, the editor can offer the set of values to the user as a list. It is then easy for the author of the metadata description to select the appropriate value. Changing the language of the user interface, will also change the language of the possible values. As the mapping between the integer value and the language descriptions, is stored in an external text-oriented file. additional language mappings can be added very easy.

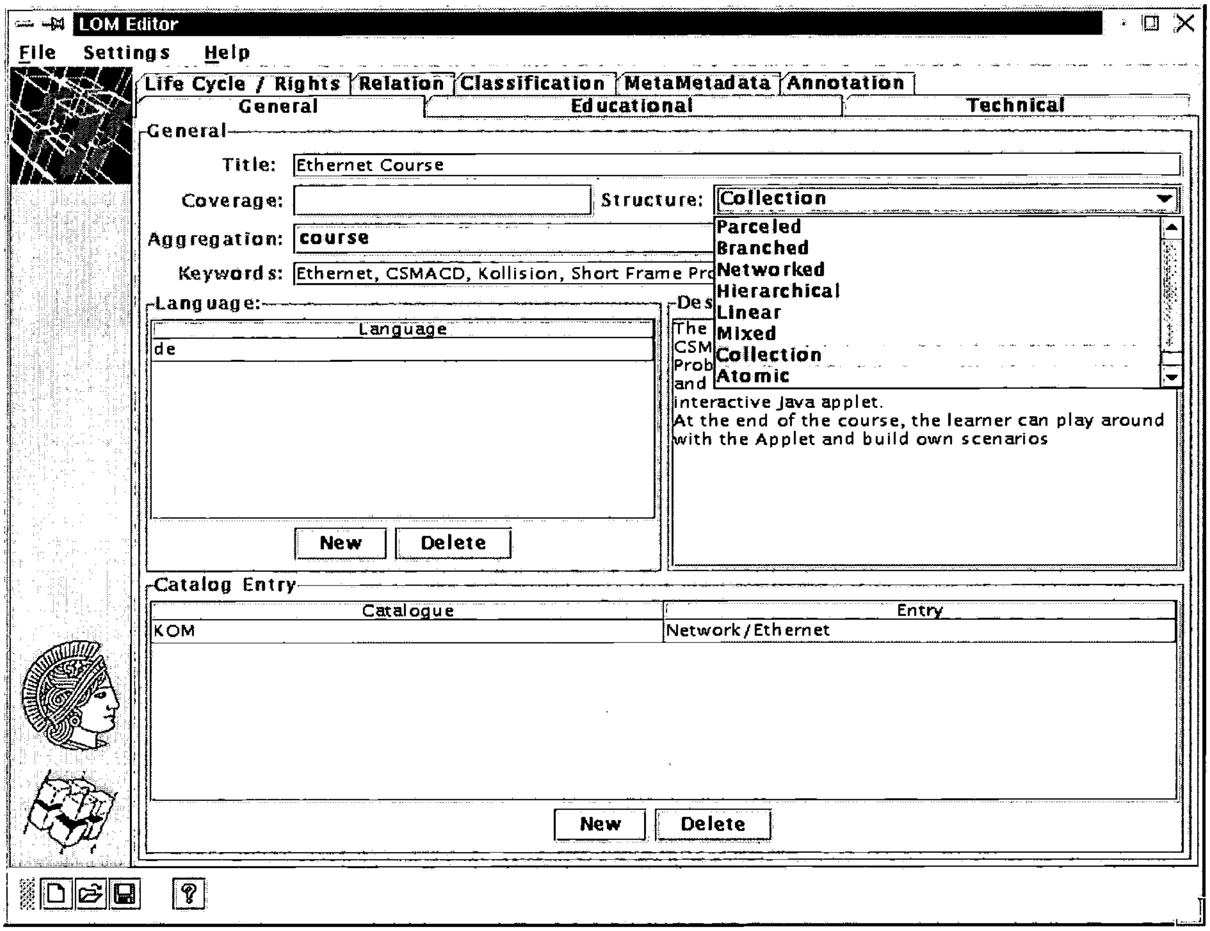

Figure2: Screenshot of LOM-Editor

Conclusion

As more and more descriptions in a standardized form will become available, it will become increasingly attractively for software developers to invest in developing these tools. The critical mass of learning objects has to be reached if they should be successful. Especially in today's
information society the ability to find quickly the right information is a crucial factor. The whole band width of educational activities would benefit from one consistent description model and LOM could be the key to transport the structuredness of databases to the World Wide Web,
nothing more and nothing less.

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Development of a Japanese Reading Support System based on Activating Visual Information

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Abstract: The purpose of this study was two-fold: 1) to investigate the effects of visual information, background knowledge and academic reading experience and 2) to identify the nonnative readers' problems in comprehending Japanese academic texts. Sixty-three foreign students studying at universities and graduate schools in Japan participated in this study. Major findings were as follows: 1) the exhibition of charts and text diagrams did not promote reading comprehension, 2) the students' past experiences of academic text reading influenced the score of the reading comprehension test and strategies of activating visual information, and 3) there was not significant correlation between the amount of background knowledge and the score of reading comprehension tests. Moreover, the cluster-analysis of descriptive data seemed reasonable to support that there would be differences of activating visual information between advanced and novice readers.

1. Introduction

In Japan, there are many foreign students studying at graduate schools of science and technology who have already completed some academic courses or researches in their major fields, but do not have sufficient Japanese language ability for the Japanese academic life. Due to the rapid increase in the number of such foreign students, language institutes and international student centers provide intensive language courses and arrange tutoring programs. Supporting systems like this, however, do not work effectively, due to the fact that students don't have enough time to use such opportunities, as they have to devote most of their time to doing research work in their laboratories.

To solve this kind of problem, some of language learning support systems on the Web have been developed, and proved to be of great help. Indeed, many universities and institutions created such Web-based language learning support systems that are free and open to all users. Unfortunately, almost all systems that have been developed by technological researchers include various complex functions, such as morphological analysis and structure analysis, or use such techniques as natural language processing (Tera et al, 1998; Kitamura et al.1999; Ochi, 1999; Nishina, 2000). Although all of these proprieties are attractive at the first glance, these systems do not have sufficient functions based on real teaching experience and on the insights of language teachers. A possible solution is to base the new language learning systems development on empirical studies of the learners' problems, difficulties and needs.

From the standpoint of a Japanese language teacher, Yamamoto (1995) suggested that intermediate and advanced level learners had some troubles in understanding the parallel structures and long sentences rather than the technical terms (from the results of a Japanese language course for scientists and engineers). She also indicated that the learners needed some help to understand the standard report parts of introduction, conclusion and discussion, which include a complicated structure of sentences and show the relations among many concepts and ideas (Fukako, 1994; Yamamoto, 1995).

On the other hand, it has been proposed in a guidebook of technical writing that readers could grasp the whole structure of a scientific text by using charts and diagrams effectively (Nakajima & Tsukamoto, 1996; Yamazaki et al.1992). It has also been demonstrated in psychological researches that annotated illustrations promoted learners' understanding of scientific explanations (Harp & Mayer, 1997; Mayer et al., 1995; 1996; Shah et al., 1999). Although a large number of researchers have mentioned the effects of visual cues, the question of how to use such information effectively is still open (Shah et al.,1999).

2. Research Goal

Our goal with this research is to investigate whether visual information, learners' background knowledge and academic reading experience influence the reading comprehension of Japanese scientific texts. This study was developed, in part, to provide preliminary data for the development of an effective academic reading support system, which implements instructional devices for nonnative readers.

The following problems were investigated in this study via a questionnaire, designed to analyze the effects of visual cues, learners' background knowledge and experiences on the reading comprehension:

1. *How does the presentation of visual cues promote the learners' reading comprehension on scientific texts?*
2. *How does the readers' experience in academic text reading influence the score of the reading comprehension of scientific texts?*
3. *What is the relationship between the amount of learners' background knowledge and the scores of the reading comprehension tests?*

3. Method

3.1 Subjects

The subjects were 63 foreign students studying at Universities and Graduate Schools in Japan. They were intermediate and advanced learners of Japanese who had received 1-2 years of formal instruction and passed the Japanese proficiency test. There were 42 students majoring in humanities and social sciences, and 21 students majoring in natural sciences and engineering. The percentages of males and females were 63.5% and 36.5% respectively.

3.2 Materials

The testing materials consisted of two parts: (1) a participant questionnaire, (2) a reading passage with some corresponding comprehension tests. The participant questionnaire was designed to investigate the learners' background information and academic experience, such as major, learning experience of Japanese language, existent knowledge on mobile computing, and experience of academic text reading. For the reading passage, we used one chapter from an article that appeared in the Journal of Information Processing, which concerns the application of mobile computing in disaster and emergency situations. The comprehension tests were designed to examine the comprehension achievement corresponding to each of the 3 paragraphs of the reading chapter.

In order to investigate the effects of visual information, we revised the first and third paragraph of the original chapter. First, we divided the students into 2 groups, an *experimental group* and a *control group*. The original, unaltered chapter was used for the experiment group, and the revised one, which had less charts and diagrams than the original one, was for used for testing the control group. The second paragraph was used as a pre-test, to examine the hypothesis of similar Japanese language ability between the two groups above. The details are shown in table 1.

Table 1: Elements of the two tests

Control group	Experimental group
Paragraph1 *No Diagram*	Paragraph1 *Diagram1*
Paragraph2 *Chart1*	Paragraph2 *Chart1*
Paragraph3 *No Chart*	Paragraph3 *Chart2*

3.3 Procedure

Subjects were tested individually on both parts of the testing material in a single session. In the first part, subjects answered a participant questionnaire aimed at determining the background knowledge and academic experience related to the academic field of the text sample. In the second part, each subject had to fulfill three different tasks: (a) filling in the blanks of an incomplete text, with the adequate words from the chapter text, (b) describing the main characteristics contained in the charts and diagrams, and finally (c) summarizing the whole reading chapter. Data were collected from students from various universities and graduate schools in Japan by mail. There were 21 subjects in the control group and 42 subjects in the experimental group.

4. Results

We classified the subjects of the experimental group into two sub-groups, based on their reading experience of academic journals:

- experimental **group 1**: novice reader, and
- experimental **group 2**: advanced reader.

4.1 Results of the pre-test

To examine the Japanese language proficiency, we first analyzed the scores of pre-test (the second paragraph) that was common to all three groups. There were no significant differences among them, as could be seen in Table 2. The scores were from 0 to 5, with 5 being the best grade and 0 the worst.

Table 2: Means and Standard Deviations at Pre-test

Group	Group 1	Group 2	Control group
Number	20	22	21
M	4.59	4.80	4.85
SD	1.10	0.41	0.36

M: mean; SD: standard deviation

4.2 Analysis of Comprehension Tests

We also examined the comprehension tests of the two remaining paragraphs (paragraph 1 and 3) in order to investigate the effects of the presentation of visual information (see Table 3). The presentation of visual cues produced significant differences between the experimental group 1 and the control group (t (41) = -2.77, p<.01). There was not significant difference, however, with respect to the comprehension score of the paragraph 3 and the summary writing capacity between the control group and the two experimental groups. This suggests that the students' previous experience of academic text reading would influence the scores of reading comprehension with the diagram for scientific texts.

The analysis of test data indicated that the subjects, who have already experienced academic journal reading in Japanese language, were able to interpret the main ideas of the chapter correctly. On the contrary, less experienced subjects could not connect the information from visual cues with textual information.

Table 3: Means and Standard Deviations for Paragraph 1 and 3, Summary

	Paragraph 1	Paragraph 3	Summary
Group•	2.95	3.64	3.07
(n=20)	(1.84)	(1.56)	(1.31)
Group•	3.95	4.05	3.59
(n=22)	(1.90)	(1.50)	(1.05)
Control	4.62	4.05	3.73
(n=21)	(1.98)	(1.16)	(1.30)

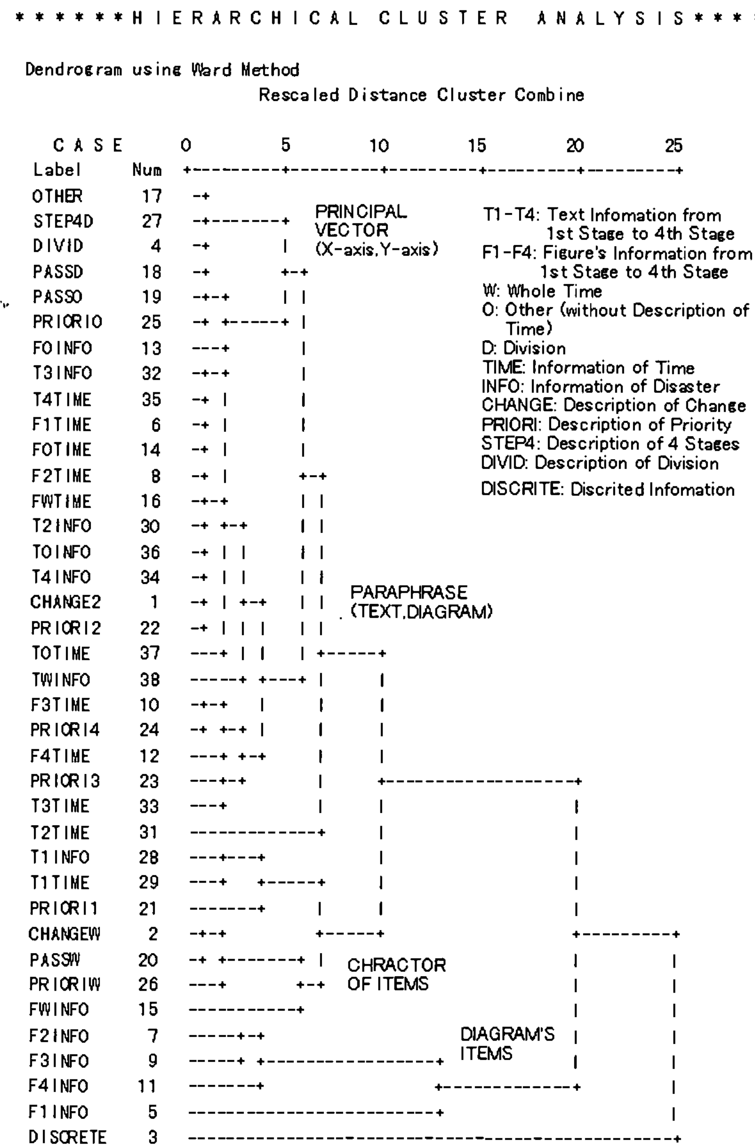
Note. Standard Deviations are in parentheses.

4.3 Analysis of descriptive Data

We collected the descriptive protocals explaining charts(paragraph 3) and diagrams(paragraph 1) in order to investigate effective strategies for activating visual information.

The following procedure employed in this research was as follows. First, the subjects of experimental group were told to describe the characteristics of the diagrams embedded in the paragraph 1. Second, the written protocals were collected from each subject and divided into a word as an idea unit. The number of words summed up 573 units totally. Third, 573 units were • • • • classified by their sources and content and placed into 38 categories. Forth, Ward's hierarchical clustering procedure was conducted to compute a distance matrix among categories (i.e. time information category, disaster information category) As a result of cluster analysis, the dendrogram suggested four distinct categories in Figure 1.

Figure 1. Dendrogram of Cluster Analysis



4.3.1 Description of the Four Clusters

As stated above, four clusters were identified form the hierarchical clustering techniques. *Claster1* consisted of seven categories concerning both X-axis and Y-axis of the diagram. In the diagram, X-axis showed the time series and Y-axis indicated the priority of information. *Claster2* included both textual and visual information of the same time series, which summed to nineteen categories. *Claster3* consisted of seven categories concerning the characteristics of individual items in the diagram. *Claster4* consisted of four categories, which demonstrated the items of the diagram. All four clusters should be regarded as the meaningful factors to affect activation of the visual information.

4.3.2 Data Analysis

We collected the descriptive data form subjects of experimental group in order to identify the effective strategies for activating visual information. To investigate strategic differences between the advanced readers and novice readers of experimental group, in regard as the comprehension scores of paragraph 1. We divided both group 1 and group 2 into high-scored readers and low-scored readers. The Table 4 showed that the means and standard deviation associated with this analysis.

We conducted a 2 (level: high-score or low-score) x 4 (strategic clusters: strategic clusters: principal vector, paraphrase, characteristics of items, diagram's item) analysis of variance (ANOVA) to examine the relationship between the readers' level and four response categories. The Table 4 showed that the means and standard deviation associated with this analysis. The result of ANOVA were indicated the interaction between level and cluster variables reached significance, $F(3,112) = 2.69$, $p<.05$, $MSE=5.67$. Compared with the simple effects on two variables, the results were displayed inTale5. A post hoc test using Fisher's least significant difference (LSD) procedure revealed that high-scored readers used significantly more Cluster2 (paraphrase) than both Cluster1(principal vector) and Cluster4(diagram's item). And it was also showed that they used Cluster3 (characteristics of items) significantly more than Cluster1. On the contrary, low-scored readers used significantly more Cluster3 than the remaining three clusters *(MSE =5.67, 5% level).*

Table4: Means and Standard Deviations on Response for the Four Clusters

	Cluster1	Cluster2	Cluster3	Cluster4
High-Scored Group	1.93	5.13	3.67	2.67
(n=15)	(1.84)	(3.07)	(2.66)	(1.80)
Low-Scored Group	1.33	2.27	4.20	2.07
(n=15)	(1.80)	(2.15)	(3.08)	(1.58)

Table5: ANOVA results

	SS	df	MS	F
A (level)	23.41	1	23.41	4.13*
B (cluster1)	2.70	1	2.70	<1
B (cluster2)	61.63	1	61.63	10.87**
B (cluster3)	2.13	1	2.13	<1
B (cluster4)	2.70	1	2.70	<1
B (cluster)	107.89	3	35.96	6.34**
A(high-scored)	86.32	3	28.77	5.07**
A (low-scored)	67.33	3	22.44	3.56*
A x B	45.76	3	15.25	2.69*
Error	634.93	112	5.67	
Total	811.99	119		

Note. Standard Deviations are in parentheses. p<.05* p<.01**

4.4 Correlation Analysis

The correlation matrices reported in Table 6 were computed for both control and experimental groups. Subjects' knowledge correlations were calculated between the amount of background knowledge and the knowledge represented by the scores of the reading and comprehension tests, and the summary evaluation. There was no significant correlation between the amount of background knowledge and the scores for reading and comprehension.

Table 6: Correlation Matrices for Subjects

	KN	C.1	C.2	C.3	SAM
KN	1.00				
C.1	-.15	1.00			
C.2	.12	.05	1.00		
C.3	-.03	.27	.10	1.00	
SAM	.16	.29	-.01	.40**	1.00

KN: background knowledge; C.x: comprehension of paragraph x; SAM: summary P<.01**

5. Discussion

The present study investigated the effects of textual cues, learners' knowledge and experience and tried to identify the nonnative learners' problems in Japanese academic reading.

Concerning the first research question, our results suggest that the presentation of visual cues does not always promote reading comprehension. In other words, It seems that original charts and diagrams embedded in the text may interrupt the reading comprehension of nonnative readers.

Related to the second question, the analysis of the descriptive data related to the charts and diagrams indicated that the experienced learners could integrate textual and visual information and deduce therefore the main ideas of the chapter. On the contrary, less experienced learners just picked up the raw information from the visual cues and could not comprehend the relation between the various pieces of information. This was due to the fact that less experienced learners had the tendency to choose the words embedded in visual cues as the keywords of the text. In the first text paragraph, however, the diagram showed just examples of the key ideas. As a result, the beginner students were inclined to consider this peripheral information as representing the main concepts.

Related to the third research question, there was no significant correlation between the amount of background knowledge and the scores for reading and comprehension. However, the way to examine the learners' background knowledge could be inadequate, because it just checked whether subjects knew the definition of the technical terms frequently used in the text. Useful knowledge should not be represented only by lists of discrete words and phrases.

In order to develop an effective reading support system, we should closely analyze readers' difficulties in academic texts reading and construct an effective learning/teaching model for nonnative Japanese language learners.

From the viewpoint of reading pedagogy, we have to reconsider how to teach the vocabulary and to show learners how to access visual information. Especially, in order to build up the background knowledge that they need for academic reading, we have to relate the new concepts and knowledge with their existing knowledge. As a future research, we study the design of a method and implementation to relate the new vocabulary with existing knowledge. Moreover, we consider decreasing the difficulty of reading charts and diagrams by showing only a part of the visual information at a time, via simulations and animations.

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Teacher Survival in a Web-based Constructivist Learning Environment: A Malaysian Experience

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Abstract: Educators are well aware of teacher support as a form of scaffold that helps learners reach their "zone of proximal development" (Vygotsky, 1978). An online case study conducted over 4 weeks in an elementary school in Malaysia showed that teacher support came in six multiple forms. However, the nature of an online constructivist learning environment presents a difficult task for the lone teacher in supporting all students reach their desired learning level. This paper will discuss the need for intelligent agent technology to support the teacher reach his/her 'zone of proximal support'.

Introduction

Much has been discussed and researched on instructional strategies to support learning in an online environment. Among the reasons for creating an online learning environment are the following: meeting the needs of learners of varying abilities and allowing learners to access materials anytime, anywhere (Mathew and Dohery-Poirer, 2000); accommodating learners of different learning styles (Franklin & Peat, 1998); enhancing communication, information retrieval and sharing (Hackbarth, 1997); providing learners the necessary skills in effective use of technology for the workplace (Freeman & Caper, 1998) and providing for active and integrated learning experiences (Susan, 1997). There is also little doubt with regards the ability of the web to enhance higher-order thinking skills and content acquisition (Vullo, 1993, Follansbee, 1996, Abtar, 2001). Online strategies that have supported such efforts include online discussion, collaboration, retrieval of information, quizzes, assessment, didactic teaching & mentoring (Lyons, Hoffman, Krajik & Soloway, 1997; Pitt & Stuckman, 1997; Hewson & Hughes, 1998; Abtar, Sapiyan and Mansor, 1999). Basically it's all about active learning, a phenomena prophesized by Dewey in 1910 and is possible now with the availability of the interactive and open nature of the web. However, how does the teacher fit into such an environment? With so many reasons to incorporate online strategies for better learning, why is it that these strategies are not easily adopted and practiced? Although there is a plethora of strategies and ideas to enhance thinking and learning, implementing them in the classroom is another matter. The reality of the classroom characterized by a web-based constructivist learning environment (WebClen) presents many challenges with regards the role of teacher. The following sections will briefly present an online scenario and suggestions on how the teacher can be supported to allow for easier and better integration of such strategies.

Teacher Role in an Online Learning Environment

An online template incorporating sound pedagogy (Abtar, 2000) was used to create a web-based constructivist learning environment for Year 4-6 students. Posttest scores showed that there was a significant improvement in student higher-order thinking skills and geoscience content acquisition. In such an environment, the teacher played multiple roles that is: a content expert, a technology specialist, a bilingual expert, a motivator, a cooperative and collaborative learning advocate, and a monitor of student progress. As a content expert, the teacher provided support at three levels. This three tiered approach first involved support at a topical level whereby students were introduced to the topic with the aid of an advanced organizer. An advanced organizer aids in activating students' schema when attention is drawn to the preceding and following topics of study. Second, the teacher zoomed into the content for the week and the teacher's role as an expert involved such skills as probing, clarification, exemplification and use of visual aids. Third, the teacher's focus shifted to the task at hand, whereby she clarified the task by drawing on local content and by modeling the processes students needed to employ in the understanding of concepts. The teacher provided technology support in three areas, namely hardware applications, general software applications and specific software applications. Hardware support included familiarizing students with computers and managing limited hardware resources. General software applications included helping students understand basic web-based concepts such as 'http', 'URL, 'search engine', 'refresh', and managing the MS Windows environment. Specific software applications related to the use of the geoscience web-template included introduction to such terms as 'username', 'password', 'next page', previous page' and use of specific functions such as 'save', 'edit', 'browse' and 'send'. As a bilingual expert, the teacher played a major role in helping students translate information from the English language to the native language (Malay language). This involved clarifying meanings of certain words, and translating words from the Malay language to the English language to help learners search the Internet. As an online motivator, the teacher gave feedback to students while evaluating their work online. Offline motivation was given when the teacher approached each group and discussed or commented on their work. Besides this, the teacher in an online environment also played an important role in promoting cooperative learning among learners. The teacher provided support by building group collegiality, by distributing workload, getting the students to handle logistical problems when using the computer and encouraging students to support each other. In monitoring student progress, the teacher gave advice and assessed student work. Advice came in various forms, such as advising students to attempt a particular task on their own before contacting their peers or geo-experts for help; checking student progress with respect to their tasks and giving advice on how to move on; advising students about intellectual property rights especially in a web environment; advising students to read printed notes when the access time on the Internet was slow; and grading student work online.

Engaging Agent Technology

The study found that teacher support was linked to the enhancement of higher-order thinking skills, information seeking and content skills. However, it was found that a constructivist learning environment presents a challenging and demanding work environment for the lone teacher. By virtue of the fact that each learner and each group is given the opportunity to individualize their own learning, the process-based outcomes are never the same at any given moment. As the teacher moved from group to group, so too did her mental, emotional and intellectual disposition. The teacher had to make an immediate an unconscious shift from the needs, responses and task variables of one group to those of another. In other words, a constructivist learning environment demands that the teacher be able to cater to the multiple outcomes during her interactions for a number of different learning contexts. This consistent shifting or changing of attendant gears for the teacher places a heavy emphasis on the human factor in the teaching-learning process. On the one hand, the teacher had to provide for, respond to and help create a positive learning environment in the classroom. On the other hand, there were some tasks that could have been more predictable i.e. tasks which could be performed by the technology itself. Herein enters the role of intelligent agents, which may allow for offloading of some tasks from the teacher herself.

Hawkins (1994) described intelligent agents as independent computer programs that operate within software environments such as operating systems, databases or computer networks (cited in Baylor, 1999). From an educational point, Seiker (1994) sees intelligent agents as computer programs that are capable of simulating humanlike relationships by aiding the user just like another human would do (cited in Baylor, 1999). Aroyo and Kommers (1999) see agent technology as promising in addressing the challenges of learner directed educational environments which have been designed to harness the information and Internet technologies. In this respect, Baylor (1999) prefers to call the intelligent agent a cognitive tool, which is an intellectual computer device that supports learners' thinking processes. In an educational context, intelligent agents can be created to do the following: a) manage large amounts of information, b) serve as pedagogical experts, and c) create programming environments for the learner (Baylor, 1999). The following section elaborates on two areas of support: managing large amounts of information and providing pedagogical expertise.

Intelligent agent technology has progressed from generic learner support to specific learning support and initiatives taken to create such agents include those by Seiker, (1994), who forwarded COACH, O'Riordan and Griffith, (1999), who created UMAgent and Baylor and Kozbe, (1998), who conceptualized PIM. With such a proliferation of agent technology and the advantages in supporting the teacher, it is timely that such intiatives be considered for the WebClen. However, for the WebClen, intelligent agents are needed more specifically to help learners to self-assess, get help in translation as well as generate student portfolios, which the teacher can refer to, to keep track of student progress. As an example, the agent can help learners identify errors and suggest alternative strategies in the online activity of gathering information for report writing and writing of critical summaries. Students' answers can be checked against suggested formats, according to each student's ability and progress to the next higher level of learning. Intelligent agent technology can also be incorporated to monitor students working on group projects in an online environment as suggested by Whatley, Staniford, Beer and Scown (1999). The agent can monitor progress made on a collaborative project and suggest ways for improvement as well as how to enhance communication between group members. In the WebClen, two issues that were of concern related to student collaboration with experts were, one, when students copied in verbatim everything that an expert had suggested and, two, when students did not act on suggestions given by the expert. To overcome such weaknesses, agent technology could be created to alert students on the need to paraphrase their answers and probe the learner, alert the expert or supply alternative websites to the learners.

Thus, it can be said that the role of the teacher in a web-based constructivist environment has shifted from that of an information provider to that of a manager of learning. Thus the teacher needs a more efficient support structure to enable the teacher to reach his/her 'zone of proximal support' to manage learners' diverse learning experiences. The power of the computer can be harnessed for this purpose.

Conclusion

This paper has identified the many roles played by the teacher as a manager of learning which inadvertently lead to more demands place on the teacher. The paper also identified how teacher load may be reduced with the incorporation of agent technology. A step forward will be to create these agents and test run them to identify their effectiveness in a web-based constructivist learning environment.

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Developing a Collaborative Learning Environment in Physiology – Using an Online Architecture to Link Faculty and Institution Needs

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Abstract: A Collaborative Learning Environment (CLE) for second year Physiology students, involving timetabled tutorials, a student-friendly learning space and variety of computer-based and traditional resources, has been previously shown to impact positively on student learning. In these sessions, students used a semester-long group project to explore a topical question in physiology, exercising skills in scientific writing, analytical thinking, communication and collaboration. Limited flexibility of the course management system used in the first iteration of this activity prompted its redevelopment in 2000, this time using a more flexible database system. The redevelopment involved an action research collaboration between faculty teachers and Multimedia Education Unit staff, who put together weekly online activities based on the previous week's experience. Outcomes of the development included a suite of practical pedagogical structures, increased personal understanding of the operation of computer-facilitated CLEs, and refinements to the database system grounded in the coal face implementation experience.

Background

The development of a model for student-centred learning within a Collaborative Learning Environment (CLE) was a response of the Physiology Department to an increased level of lecture-dominated teaching. The CLE was first set up in 1998 to encourage student interactions between peers and tutors in a friendly study environment in which the tutor acted as a 'facilitutor', to guide and assist. The two-hour time tabled tutorials employed a variety of software and teaching approaches, with the students encouraged to work in groups. Results so far suggest that this general approach has had a significant positive effect on student learning outcomes (Kemm, Kavnoudias et al. 2000 p10).

The philosophy behind the redevelopment of the CLE is in line with calls by Reeves for instructional technology research to be driven by 'use-inspired goals' (Reeves 2000). These goals focus on developing creative approaches to particular learning requirements, while at the same time establishing generalised design models to guide future development practice. In our case, the Multimedia Education Unit (MEU) is interested in generalised online pedagogical architectures for application across the University.

The Physiology Group Project

Part of the weekly Physiology CLE tutorial in Semester 1 1999 was devoted to a semester long project to help students develop higher level scientific communication and writing skills. Each week, student groups were given a task through which they could engage in analytical thinking, reflection and discussion with peers and tutors. The original Group Project utilised the TopClass learning management system which however proved insufficiently flexible for the kind of environment we required. It was necessary to produce detailed instructions on the use of discussion lists, email & course navigation controls, and tutors found it inconvenient to review the discussion process and provide useful feedback to the groups. Students also found the peer review process too complicated and were inclined not to take it seriously. The Physiology team decided to redevelop the Group Project, with the same educational philosophy, but using MEU's OCCA framework which had greater potential to adapt to our intended learning and teaching model, without the limitations of predefined courseware functions.

Online Courseware Component Architecture

The Online Courseware Component Architecture (OCCA) is a low level component framework for implementing pedagogical structures that can support discursive interactions and reflection on learning (Fritze, Welch et al. 2000). It has been developed as an institutional approach for online learning, supported by a central server run by MEU and used in a variety of projects across the faculties. Key features include a generic database for managing learning records and server functions for accessing and embedding these data within Web pages. Using simple HTML pages, departmental staff can create their own learning activities and summaries of student work. Additional Shockwave components or Javascript functions can be used to support more specialised educational functions or discipline interfaces.

Redevelopment of the Group Project as a MEU/Faculty collaboration

The redevelopment of the Group Project provided the opportunity to address three key goals:

- to produce and evaluate the Group Project as a computer-facilitated collaborative learning activity using OCCA,
- to increase our collective understanding of pedagogical and delivery processes associated with CLEs, and
- to further develop OCCA through its application to a real teaching context.

We felt these aims could be best achieved through close collaboration between teaching staff and the MEU framework developer during the implementation. This would enable the developer to acquire a better understanding coalface teaching issues, and insights into how a technical architecture impacts on the real teaching world. The educational aim of the Group Project was for students to develop their understanding of, and ability to discuss, key Physiological concepts. They were to be introduced to the rigorous process of scientific writing and to engage in written debate on the topics. The students were to collaboratively develop a 500-word analysis of a topical physiological question over the semester which would be reviewed by their peers.

Development method

Our approach was to develop the online activities immediately prior to their implementation each week. In this way the content team could refine them in the light student observations, tutor feedback and evaluation questions of the previous week. We considered this a reasonable undertaking, given that there were only two or three tasks each week, the content design was already in place, and we had the safety net of a human tutor during each session. An end-of-semester evaluation and reflection completed the process.

We undertook the development as a form of participatory action research - a self-reflective research enquiry undertaken by us as joint participants in the process (Kemmis and McTaggart 1997 p5). Most of the day to day 'action' took place between Kavnoudias and Fritze, who kept reflective journals of the experience. Teaching and curriculum guidance was provided by Physiology lecturers Kemm and Williams, with other important communications occurring with tutors, students and teaching staff from other faculties using OCCA in different curriculum projects.

Structure of the Group Project

The structure of the project is illustrated on the group's overview Web page (Fig. 1). Each week involved several activities such as building a key concept list, a writing task, reflecting on previous work or reviewing the work of their peer group. The column headings displayed the group's work for one activity. For example, the 'Writing' link summarised the group's writing tasks from brainstorming to the final submission on the one page. The 'Peer interactions' page tabled the draft sent to peers, the peer review and the group's response to that. Each row heading linked to a summary of the group's work for that week.

Week	Key concepts	Writing	Discussion & reflection	Peer interactions	Tutor interactions
2	Individual research				
3	Brainstorm ✓ Identify keywords ✓	Draft 1 ✓			
4	Review ✓	Draft 2 ✓	Guided discussion ✓		
5		Draft 3 ✓	Reflection ✓	Send draft 3 to peers ✓	
7				Review peer paper	
8		Final submission	Evaluation	Reply to peer review	
					Editorial board assessment

Key: ✓ = submitted, = comments to tutor, = tutor feedback

Figure 1: Group Project overview page indicating weekly tasks, progress made and tutor messages.

Outcomes of the developmental research

Evolved pedagogical elements

Particular teaching elements were crafted on top of the OCCA framework, becoming our 'toolkit' of teaching resources. These were structures we found useful for the Physiology CLE, although we believe they would be generally applicable in other areas. Some of these ideas originated from previous projects (Fritze, Johnston et al. 1998; Fritze, Welch et al. 2000), while others emerged within this project.

Other pedagogical elements beyond the scope of this paper include an 'administrator view', 'tutor view', 'rubber stamp', confidence indicators, key word prioritisation task and facilitated group discussions. Various pedagogical features are indicated in the template page that was used by the tutors to review and annotate the work of each group prior to the next class (Fig. 2).

Changes in understanding arising from collaborative re-development

More subjective changes in our understanding are evidenced by reviews of journal entries, post-semester discussions, and reflection on student work. These observations do not form a generalised 'theory' of practice, but are important in developing our own personal conceptual models. We hope that they may also provide useful insights and promote discussion by others. Some of the emotional aspects and unpredictability of the real work environment are reflected in the observations in Tab. 2.

'Summary page'	A single Web page containing a collation of student work eg. for one week.
'Learning portfolio'	This started as an organised collection of weekly summary pages but was refined to include summaries of the drafting sequence, students' confident levels across the weeks and side-by-side comparisons of written work and key concepts. The instruction 'Submit to your Portfolio' emphasised that work remained accessible.
Student self-assessment of open-ended questions	We developed a self-assessment sequence commencing with an open-ended question, a self-assessment of this against certain criteria followed by an opportunity to redraft. A summary of the whole process was then provided.
Reflection on previous work	We used the online learning portfolio or embedded references to prior work to set the context for questions designed to promote reflection on the learning process.
'Importing' prior work	We provided a special button to allow students to 'import' a specific prior response, or collection of responses, into a text box on a later page for re-drafting.
'Posting work to peers'	With a simple button, groups could 'post' a piece of work to an anonymous peer group assigned by the tutors. The peers subsequently 'posted' their review back.
Tutor annotation template (the 'editorial board')	Tutors used an 'annotation template' page showing the final essay, peer review and response made by a selected group. They could scan through each group's work prior to a class, entering feedback via popup menus and comment boxes (Fig. 2).

Table 1: Some pedagogical elements emerging from the development

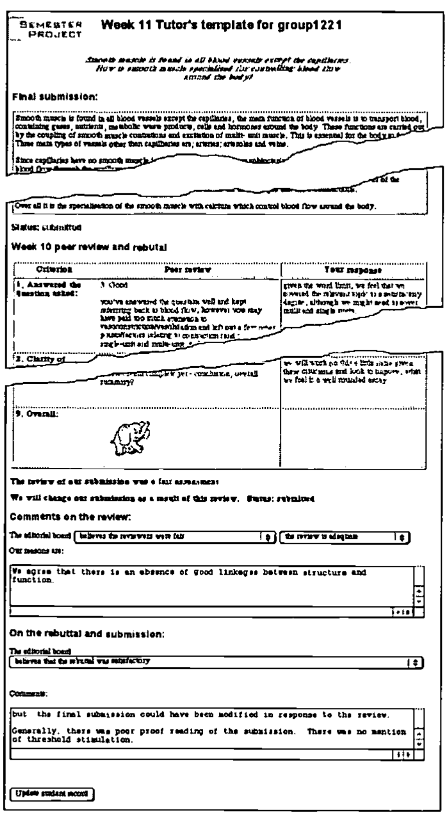

Figure 2: Web template used by 'editorial board' to assess the group essay and peer review process.

Thinking about teaching, not tools	In shaping each activity, we found ourselves trying to think in terms of face to face interactions eg. how we might write on pieces of paper and later arrange them on a table.
Serendipity	Delays in programming database reports prompted the development of the administrative page that delighted us with its usefulness. 'Naïve' users also sometimes provided ideas. A request to "paste in a picture" into the page made us think. After consideration, it was not included for pedagogical rather than technical reasons.
Value of effective teaching tools	The Physiology staff were excited by the effectiveness of the tutor annotation Web page for reviewing and responding to students.
Portfolios	Even though portfolios had been planned, all of us were delighted at their effectiveness in summarising a group's work. To the developer, the simple web frame structure meant that the teaching staff could easily extend the summary pages themselves. We realised this could be given to the student at the end of the course as a personal record of their learning.
Changed perspectives via new views	Despite the time spent in the CLE helping students, Physiology staff were interested in how the summary pages of students work increased their understanding.
Value of seeing tools in real use	The framework developer noted the additional insights gained from seeing the software in actual use in the CLE.
Time pressures	Completing the activities each week often placed pressure on us due to illness and other factors. We needed time reflect and were sometimes frustrated when we had no time to implement often quite small changes.
Change of direction	We originally planned to use immediate feedback in some tasks, but decided the reflective self-assessment tasks were of greater use to the student (and far easier to implement).

Table 2: Some changes in understanding emerging from reflection on the development process.

Revised functions and extensions of OCCA

The third class of outcome from the regular weekly development cycle involved changes to the OCCA system, necessary to implement emerging requirements of this project. These were either simple page components or more fundamental changes to the framework which are indicated in Tab. 3.

Administrator & tutor access	Ability for administrators to log on as any student in order to review their work.
Post record function	Ability for a user to 'post' a record to another user which could then be displayed in the second user's pages, eg. for the purpose of reviewing.
Group login	As we required students to sit together around the computer and create group responses, they needed to log in as a group, rather than individuals.
Resources for different assigned cases	Each group required a case question to be assigned by the administrator. The system then dynamically enabled certain pages according to the assigned case.
Specification of peer group	Each group required a peer review group to be assigned by the administrator.

Table 3: Fundamental changes to the OCCA system arising from the redevelopment project

Evaluation of the student experience

At the conclusion of the Group Project run in semester 1 and again in semester 2, we undertook a reflective examination of the whole process, as well as conducting a more traditional evaluation. Briefly, the 44-question questionnaire filled in by the students at the end of semester indicated that:

Seventy-two percent of students found the project enjoyable and eighty percent found that their ability to discuss physiology with others was enhanced. Ninety percent of the students found the program easy to use, instructions were easy to follow, navigation was easy and most importantly, that the instructions, questions and guidance helped to generate discussion amongst the students. The biggest revelation to us, which was not commented on in the previous implementation (TopClass framework), was that students appreciated the opportunity to hear and read different interpretations of a problem. A comment given referred to 'supporting and extending each others knowledge'. Other frequent positive comments related to the opportunity to peer review, that they enjoyed researching a topic in depth, it was good exam practice, or that they made new friends.

Negative comments concerning the group size led to us reducing this to 3 in Semester 2. Students indicated they needed more help in dealing with conflicting opinions and that not everyone pulled their weight.

Discussion

The re-development of the campus-based Group Project was a genuine collaboration between the Physiology teaching staff and MEU developers of OCCA. In the resulting process of negotiation and exchange of ideas, enhanced versions of the CLE model and generic online architecture emerged. We have shown how a low-level architecture can be used in a participant research study to create a flexible student environment involving open-ended tasks, reflective activities, and feedback between student and teacher.

Thinking about how a student will engage with a given activity should involve more than just consideration of what tool to apply. We found that even the simplest learning activity can be used as the basis of a rich variety of learning situations. For example, submitting a short piece of writing might have value added by associating it with self-assessment activities, feedback comments to tutors, indications of confidence, later reflection on the task, peer or tutor assessment and guiding comments, later re-drafting, incorporation of other existing work and placement within a portfolio of work for the whole subject. Applying these possibilities to a practical learning activity requires careful thought and reflection on the context of use, far more comprehensive than the initial simple task would suggest.

We have reported the outcomes of a development process carried out in a single setting, but more detailed comparisons of online frameworks should be undertaken. These should consider educational principles and the organisational context in a holistic way, rather than focusing on functions and features. We suggest that where learning systems are adopted on an institutional basis, the impact on teaching and learning should be carefully considered and monitored. Collaborative developmental research of the type we have conducted is one important technique that can help inform the implementation or development of such systems.

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Digital Broadband technologies and Handheld Devices opportunity for Modern Organisations and New Homo Mobiles

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Abstract: This Paper concerns new access technology in area of new transmission technologies for providing communicate facilities to the members of value chain – typically individuals and companies, with distance Education and Training, tourist information, stock trading, banking services, directory services, exchange rates, flight schedules, and train and bus timetables. Practical applications include WEB browsers, WAP Gateways and WAP terminals. Wireless Application Protocol (WAP) provides a universal open standard for pushing Internet and Intranet content and advanced Value Added Services to mobile phones, PDA's and other wireless devices. From the teleoperators and content providers' point of view, this provides a huge number of new business opportunities, demanding new skills and new approaches to the business itself. The product is no longer a communication line but a whole communication solution concept, derived from users needs and specific applications over the value chain.

The new Value Chain

Background

The present societal movement towards a network society and economy sets difficult renewal goals and puts developmental pressures on all segments of education and training technology. The development of network infrastructure and Wireless Application solutions makes it profitable to utilize new kinds of education services and business solutions, as the access to networking becomes easier. Content industries and telecommunications operators are intensifying their co-operation. Examples can be found in such areas as electrical publishing, satellite and digital television, information technology and software. The goal of this activity is to make the distribution of content more effective. This paper will grapple with problems and facts that appear in the creation of new applications; Education and content services based on new access technology and partnership network with a case focusing on mobile Wireless solutions.

Changes in the Educational, Publishing and Training Industry

The lines of demarcation within the area of training industry between service producers are becoming hazier with the development of digitalization, broadband information technology and internet based solutions. Until now, telecommunications operators have by in large owned their transfer networks. Today there are an increasing number of connections and routing services as well information network services providers. Increasing global competition, digitisation of content, the general use of SGML, XML and HTML formats and the adoption of broadband data transfer will produce co-operation agreements and strategic alliances among content production, telecommunications and information technology companies as well as large media concerns formed by mergers and acquisitions. Therefore is valuable to have different members side by side in value chain The development of a free market in telecommunications services and broadband cable technology will also effect TV and radio network operators. Bi-directional cable modem technology offers the possibility of developing faster cable connection that will facilitate multimedia applications and the broadening of the range of data and video services to several kind of end users and several organization. In figure 1. is example of value chain that have chance to make the different collection of active value chain.

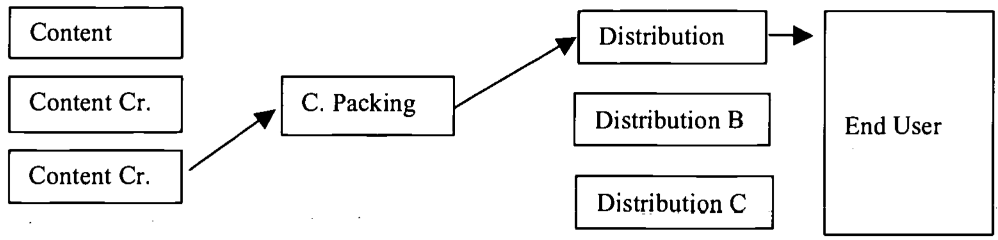

Figure 1. Form the active Value Chain

The member countries of the EU have encouraged free competition in telecommunications area which it is hoped will develop intensive product and service innovation as well as moderate prices. In some instances, as in Finland, national legislation has slowed development. Under Finnish law, the operator of an existing CATV network must lease bandwidth to the operator of a competing two way information transfer service at the going market rate. Forced leasing has been avoided by the building of the return loop through the telephone system, whereby the CATV network remains a one-way system and does not become part of the telecommunications industry. It is also feasible to produce interactive features so that watcher can use hand held devices and affect to TV program or get more information. These applications can base on HTML or WML languages and have possibility to use VRML. During of autumn 2001 is intention to start digital TV broadcasting operation by Platco Ltd that is a new common company and the members are Finnish digital TV multiplex, YLE, MTV Oy and SanomaWSOY's Swelcom. Company's task is to acquire the required licences for the technical solutions of digital-TV, and to is provide current and future multiplex companies with the necessary resources, applications and system. Platco also offers services and licensees to CATV companies. Main purpose is make digital terrestrial television easy to use and offer possibility to use Interactive services. Competition forced the members of value chain centre their working and competence quite narrow area. If value chain operate excellent it degrade operational and production costs.

Conclusions

Increasing global competition, digitisation of content, the general use of HTML and WML formats and the adoption of broadband data transfer will produce co-operation agreements and strategic alliances among content production, telecommunications and information technology companies as well as large media concerns formed by mergers and acquisitions. On the other hand the increased competition and the rapid development of technology will lead to formation of specialized companies in narrow segments of the market. The media and telecommunications giants strongly influence developments, but in order to remain current, utilize the skills of small, innovative companies. The competition among current telephone and internet operators will increase. Both groups are offering mobile services as well as additional services over the existing network. The understanding of telephone operations can be enlarged to touch on Internet operations because POTS services are also delivered via data networks and on the other hand it is possible to get onto the data network via the CATV network. The digitalization of the networks and broadband information transfer will increase the competition among telephone operations as well as with TV and radio broadcasters.

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Learning of key scientific concepts in a web-based on-campus collaborative learning environment.

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Abstract: We developed a collaborative learning environment (CLE) as a student-centred approach to assist students' understanding of difficult scientific concepts. Computer-facilitated investigative group projects were designed to enhance students' communication and reasoning skills, peer-learning and peer-teaching. Projects were structured around cost-efficient web-delivered tasks. incorporating re-usable interactive web components that store student responses in a server database (OCCA - On-line Courseware Component Architecture). These provide for group discussion, self-assessment and peer review. Student submissions were accumulated in a portfolio to enable them to reflect on their learning. 'Facilitutors' contribute to timely feedback using efficient templates for reviewing and annotating student work. Students work in groups (three per computer) for 4-6 hours on their project within scheduled weekly CLE classes of 40 students with one 'facilitutor' (repeated 8 times). Successful attributes of these tasks are described and evaluated, including strengths of on-campus collaborative learning and appropriate training of 'facilitutors'.

1. Background

The need for intervention in our approaches to teaching

Previous attempts to introduce critical reasoning skills into the curriculum has been attempted at several levels of our teaching program. The need for intervention was shown at many levels,:

Graduates: Our research supervisors have reported that our graduate science students are good at reading, understanding and collating information, but are notably weak in identifying, documenting and articulating key issues. Employers told us that our university's graduates need better communications skills (McInnis 2000).

Hons year: Four years ago we introduced a task for which students had to identify information in their literature survey that was seminal, novel, controversial or not confirmed. They needed to be able to justify their selection with a short reasoned and critical synopsis of the material. Students are still unable to complete this task effectively

3rd year: Two years ago we introduced a paper-based sequence of exercises on original articles with 50 students, in groups of 5. Scheduled collaborative assignments replaced 10 lectures. Student responses were very positive indicating that they thought it effectively improved their reading and writing skills, although they found it challenging. This format was very staff intensive and assessors still found deficiencies in students' ability to identify key concepts and to negotiate within a group.

Information from a 3rd Year Trial for 55 students in 1998:

This study clearly showed a student desire to improve their capabilities to interpret and communicate physiological information and communication skills. Students worked in groups of 5 on a topic covered by three original published manuscripts. They then followed the same schema as in Fig 1 shown below for this project, except that they had considerable staff and postgraduate assistance within the scheduled times and gave an oral presentation on their findings: dealing with key concepts, assumptions and the validity of the conclusions.

Outcomes: Students' indicated that the task introduced was challenging, and that they valued using methods of learning that were unfamiliar to them. The assignments still showed that students had difficulty in identifying key concepts and communicating ideas within their working group –even though they had significant individual and small group assistance.

These basic skills are integral to the successful learning of even our most basic courses and underpin the integration of the material covered in the three separate teaching approaches of our courses: lectures, practical classes and computer-assisted learning sessions.

The trial demonstrated the need to develop an additional element for our electronic deliverable teaching strategy to support this initiative. The objective was not introduce it as a separate skill, but to incorporate it as one of our basic approaches to student learning embedding it within overall teaching framework. Such an innovation sat well with the overall course, since electronic and online strategies already underpin all our teaching formats (lectures, practical classes and computer-aided learning).

Electronic Teaching Approaches in Physiology
Scheduled computer-aided learning (CAL) sessions were introduced into Introductory Physiology in 1997 as part of an ongoing strategy of decreasing lectures (from 4 to 3 per week) and increasing self paced learning (2 hour CAL sessions were introduced, (Kemm et al, 2000b).

This initiative was directed to help students with their individual self-paced learning, to be more perceptive about their approaches to reading ie. be analytical about what is presented so as to eventually reflect and make judgements about content and conclusions. Small groups were used to expose students to different views and interpretations from which they could resolve their differences and develop a "consensus" point of view. It was simply not feasible to run this innovation as a paper-based study with direct tutor involvement for up to 360 students in Introductory Physiology. - (see below)

2. Aims and Intended Outcomes of the Physiology Small Group Project

The development of a small group project, in which computers are used for presenting the problem, providing interactive feedback and also for peer to peer communication is an important element of our current computer facilitated collaborative learning environment.

Aims:

?? To introduce graded weekly tasks into Science Teaching using a Web-based learning structure to further transform our teaching.
?? To assist students to better recognise, understand and communicate key scientific concepts.
?? To extend existing software developed in collaboration with the University Multimedia Education Unit..
?? To build in students a strong skills base, thus preparing students for more difficult tasks in later years.

Our graduates would then have a good appreciation of the professional skills required as graduates (e.g. ability to identify key issues, critical understanding and review of scientific literature, team work, report and grant writing, symposia presentations).

The planned outcomes and benefits were for students to:

?? appreciate the words used to describe a scientific phenomenon,
?? appreciate the accuracy of the descriptions
?? identify key concepts underlying the explanations of physiological processes,
?? write with clarity and with the precision required for scientific disciplines,
?? develop the individual and team skills (and confidence) required for analysing scientific information from published sources and from peers,
?? develop a portfolio of their learning activities permitting them to reflect and revise.

<u>Integration within a course</u>. This program would take the students through the process of in-depth learning using one of the subject modules in the physiology curriculum for that semester. This skill is essential for developing their ability to critically read and question the Physiology in their final undergraduate and Honours years.
In particular, the project was designed to enhance our final year teaching that involves greater emphasis on group work, assignments and student presentations. Presently students are poorly prepared for these tasks. This electronic resource will be an ongoing development extended to different areas of physiology.

3. Description of the Initiative

Overview of the student activities:
Small groups of students were guided using electronic help through a graded reading task to identify and rank key concepts in a fundamental area of physiology (Hooper 1992). Web-based interactive-help was used to progressively reveal issues for consideration and to assist in the groups' identification and ranking of the key concepts underlying the problem. They were given a collaborative writing task to draft a concise treatment of the problem (500 words max.). Peer review assisted them in generating good writing structures, essential for effective scientific communication. Students undertook a series of tasks over several weeks as shown in the schematic in Figure 1. Although the duration of the project has been shortened in response to student evaluation, the essential features remain as in this first implementation.

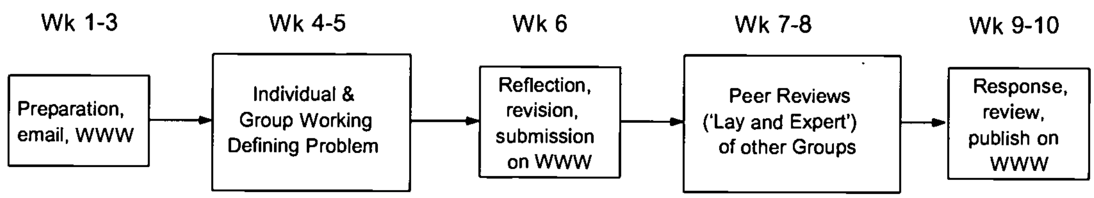

Figure 1.

Delivery of the Project:
The first implementation in 1999 used a proprietary learning framework, 'Top Class', to organise the web pages and to provide messaging between student groups and to/from the 'facilitutor'. (The term facilitutor seems appropriate to describe a tutor facilitating the collaboration amongst group members within a large class, assisted by a computer program). However students found the messaging system in 'Top Class' did not suit their purposes in this project and this framework did not allow us to provide the forms of feedback that we considered desirable.

In 2000, students undertook Group projects in both Semester 1 and 2. The rest of the report will discuss these implementations which were structured around cost-efficient web-delivered tasks that incorporated re-usable interactive web components which stored student responses in a server database. This is OCCA - On-line Courseware Component Architecture, described earlier (Fritze et al, 2000) and in another report at this conference, (Kavnoudias, Fritze et al, 2001). These components also provided opportunities for group discussion, self-assessment, reflection on learning and peer review. 'Facilitutors' were then able to contribute timely feedback using efficient templates for reviewing and annotating student work.

Students (360) originally worked in groups of 3-6 with a computer in 1999, but now groups of 3 are preferred after student surveys and evaluation of group dynamics showed that large groups had significant problems in sharing workloads. The classes of 40 are repeated several times each week, in a collaborative learning laboratory with 15 computers. Although the project is cross-platform, we chose iMacs because of their reliability and ease of use in delivering computer assisted learning classes.

Students worked on their semester projects in the last 30 minutes of the 2 hours of scheduled weekly collaborative computer assisted learning sessions, described in Kemm et al, 2000a It was not an optional activity and counted towards student's final assessment in the respective semester long courses. Assessment was based in participation, collaboration and effective use of the processes and less on the quality of the final submission.

Appearance to the students:
Student groups organised their own members and registered themselves on the project Web site. Each week, activities presented on the different Web pages posted corresponding records to the OCCA database for that group. Web pages could contain interactive objects and references to stored records that were dynamically updated on delivery. Each student group was provided with one of four real-world problems to work on.
Problems in Semester 1 were introductory, dealing with simple concept analysis.
Problems in Semester 2 used the same process on a shorter time scale, but with more complex and topical issues. (e.g. "What are the physiological effects of human growth hormone and why would Olympic organisors consider its administration to be performance enhancing?)

Students' activities involve preparation of material in their workbook combined with progressively submitting their work on Web pages.

The first week task: was performed individually by students reading around the topic to see what were perceived as the crucial issues. They submitted this by email to their 'facilitutor' and also had it available to share with the other members of the group in the following week.

The second week tasks illustrate activities that students might expect to undertake in the project over several weeks.

- ?? Brainstorm around the issues and write and submit several sentences that covered what the group thought was important. They could progressively review their work and add sentences, but once submitted they could not be modified.
- ?? Identify what they thought were the key phrases (or keywords) using their first writings which were made available on a new web page
- ?? Prioritise these key phrases by dragging them up and down their list.
- ?? Report on the level of consensus in their group decisions
- ?? Classify whether each of the listed items was of major or minor importance
- ?? Indicate how confident they were that their efforts addressed the problem.

The essence of the subsequent weeks' activities was for students to:

- ?? Learn to appreciate and interpret physiological information and to communicate effectively within a collaborative peer learning environment.
- ?? Use web-based interactive help that progressively revealed issues for consideration that students could consider in their later drafts.
- ?? Reflect and review their own work using guidelines provided. This was important to stress the importance of the various processes they undertook if they were to be confident with the quality of their work to submit it for peer review by another group.
- ?? Review the work of peers using several suggested criteria and justifying each of their ratings.
- ?? Respond to their peer reviewers' comments, professionally and without emotion, and change their final submission if it was warranted.

The students work was progressively stored in their groups learning portfolio. Additionally, electronic communication was used to exchange information amongst student group members, 'facilitutors' and academics responsible for the project's development.

Appearance to Staff

Various Web page templates were used to give assessors appropriate views that:

- ?? Summarised each group's activities in a particular week
- ?? Showed a group's final submissions, the peer review, and their responses to the review
- ?? Provided views that compared different groups' approaches to specific tasks

'Facilitutors' could use entry boxes on these templates to provide simplified and timely feedback to students on their progression through the problem. Such feedback was saved as records in the database and made visible on appropriate pages accessed by the group. Thus relative assessment of group activities was continual and seamless within the scaffolding, being made easier by being able to scan all class responses for an issue on one template page. The summary templates were also crucial in the final assessment by supervising staff, who were able to bring together the students efforts, together with the 'facilitutors' reports and ranking of each group.

4. Approaches to Evaluation:

General Approach:

A number of evaluation strategies have been used to collect data in 1998, 1999 and 2000. These are part of our overall action research strategy for dealing with global learning outcomes from collaborative computer assisted learning and focussed evaluation of additional standalone learning modules.

We required human ethics approval for our surveys and logging of student activities in the computer tutorials, since we wanted to be able to correlate individual student's responses to several questionnaires, their exam results, as well as their 'facilitutors' comments and assessments. Such approval required a student's enrolment number to be replaced by a randomised 'research number', with original records identifying students stored in a secure location and only available under strict guidelines to researchers who were not examiners.

Student Questionnaires

Questionnaires specific to the CLE were used to survey students' attitudes to various aspects of the CAL tutorials and the CLE sessions, in consultation with our educational advisors. These instruments were developed in consultation with out educational advisors.

The student questionnaires had approximately 80 questions designed to reveal students' attitudes and use of the CLE, covering aspects such their pattern of work with the CLE, development of independent learning skills, relevance of the CLE to their learning compared with lectures, and their attitudes to group work. Approximately half the questions focussed on issues pertinent to the Group Project. Most questions required students to rank their responses on a 5-point scale, supplemented by several open-ended questions. In addition we investigated students' self-assessment of their approaches to learning. We used a modified study process questionnaire to extend the investigation of deep, achieving and surface learning-approaches (Biggs, 1987) so it included additional learner characteristics. Its use is discussed in application to one of standalone interactive tutorials (Kemm et al, 1997) and will be correlated here with other evaluations. We found that students cooperate well with questionnaires and interviews if they are fully informed about their purpose and that the results have been acted upon each year.

'Facilitutors' play a key role in the implementation of the program so their impressions of the course are most relevant to understanding student reactions. They made observations and kept records of students' work and participation in the CLE sessions. Formative evaluation continued throughout with regular formal meetings between the main developer and tutors, as well as many informal interactions amongst the students, tutors and the academic developers whose nearby location enabled and encouraged this latter process. In the recent semester, we provided additional training for tutors to be able to better facilitate group learning processes and make better judgements about students' contributions.

5. Results

The highlights of the questionnaire responses in Semester 2, 2000, with numerical data being on a scale of 5 - with 3 being a neutral response, are as follows: students rated ease of use and feedback on the OCCA-based web pages highly (>3.9). They were neutral/disagreed that the project was a waste or time (2.8). They rated group work as useful, enjoyable and an important part of their development (>3.5). They did not think that the group project increased their knowledge much, but this single exercise was not designed for that purpose. In open-ended questions, most important comments emphasised working with people and discussing problems, researching and clarifying issues. Many students (45%) thought that they should be left alone as they already had the required scientific reading and concise reporting skills, although a formative assessment assignment and exam answers show that they are misled about their own abilities.

As a formative assessment assignment, a written short one hour test for the students was individually given as an open book assignment that required them to transfer these skills to a separate task. It required students to follow exactly the same format as they had undertaken collectively in their group. Only those students who went through the same process they learned in the group project were able to write concise answers. Many students wrote their answers directly and submitted answers that were either too long or made the tight word limit by writing generalities with little scientific content.

As an initial summative evaluation approach, we compared the examination outcomes for second year Science Physiology across 4 semesters. The "Exam result" excludes all collaborative computer aided learning assessments and is proportioned as 60% toward written answers and 40% multiple choice questions (MCQ). The student cohort was divided into high-achieving students (First year Faculty score ? 75), low-achieving students (First year Faculty score ?60), and those in between (61-74). Each group was further divided into whether students made an effort or not at their collaborative learning (? 7.0). Analysis of the data showed that collaborative learning assists students achieve significantly higher examination outcomes in the written component, but did not change the MCQ component. These results were markedly higher for all groups but the low achievers (eg 70 vs 63 for high achievers group). However, this improvement cannot be ascribed to any particular attribute of the collaborative learning environment that provides many learning opportunities.

We then analysed student results, investigating if any of our collaborative learning (CL) approaches correlated with the results of students who markedly improved their result over first year. Students were divided into *improvers*, *disappointers* and *remainder* groups. Data showed that *improvers* obtained a better CL mark. *Improvers* student cohort primarily improved their scores in questions requiring writing responses. (43 vs 34 for questions requiring written responses for the *improvers* group compared with the total student cohort).

The improved writing ability of the *improvers group* correlated only with a high score (>3.5/5) in the group project. Students performing well in the group project also did marginally better in the MCQ component of the assessment. Data indicate that those students who undertook the group project and did well, may obtain improved examination outcomes, especially to written answer questions. A good group project result however did not guarantee an improvement, but certainly the very large majority of the *disappointers* group did poorly in their written answers and they also performed poorly in the group project.

6. Discussion

The use of a customisable learning environment based on OCCA has given us significant advantages in producing some of our desired learning outcomes compared with our previous efforts to use a high level learning framework that had restricted flexibility. Generating structured collaborative exercises adds value to any high level framework, such as WebCT, while allowing academics to produce effective student-centred learning environments without specialist programmers.

The process of reasoning that has been introduced in this group project work is a first step in developing the training of critical thinking science graduates (with skills in analysis, criticism, aware of different views and with skills to manage those differences – both personally and as a consensus document). There remain some concerns that students have not been able to transfer these skills to other contexts. This issue will be addressed in 2001.

Once our collaborative learning environment is fully implemented, with strengthening of students' ability to extract and understand physiological concepts by group projects, it is envisaged that more factual material would be taught in a structured student-centred collaborative self-paced learning environment with less emphasis on lecture material..

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Online Assessment Criteria in Action: Task Design in Contrasting Tertiary Education Contexts

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Abstract: Our previous research provided a theoretical basis for a proposed set of practical design criteria for online assessment tasks. This work has been motivated by our recognition of the importance of not simply transferring face-to-face or distance learning assessment techniques to the online environment. We work largely in a constructivist framework and the key components of our design criteria include using a variety of qualitative and quantitative assessment activities, designing authentic tasks, using collaboration and interaction, providing appropriate feedback mechanisms, utilising online resources, and encouraging student responsibility for and control of the learning process. In this paper two case studies are used to illustrate the application of these criteria, and their effectiveness as online assessment tasks is evaluated. The first case study involves an online portfolio assessment in an Indigenous Australian literature unit, while the second looks at the adaptation of the modified essay question to the online environment in a medical education context. The results of our analysis will inform both the refinement of our design criteria and the development of future assessment tasks.

Introduction

When designing new assessment tasks or evaluating the effectiveness of existing tasks, it is essential that these processes reflect a sound pedagogical base and appropriate instructional design principles. Ten criteria for designing and selecting online assessment tasks was devised as a set of guidelines for appropriate online assessment tasks (Northcote & Kendle, 2000). The criteria are based within a theoretical framework combining the principles of situated learning and constructivism, and were created with the intention of promoting the use of both quantitative and qualitative assessment tasks. Instead of recommending a simple transformation of face-to-face or distance education assessment tasks to the online context, the criteria give practical suggestions of specific characteristics that are suited to online assessment tasks such as the use of online resources.

Major Questions and Motivation

Two major questions are addressed in this paper: firstly, the relevance and composition of the ten online assessment design criteria and, secondly, their applicability to other educational contexts. It is hoped that consideration of such questions will result in answering a more general question: what are appropriate and effective methods of assessment in the online environment?

The motivation for our current work was to evaluate the effectiveness and validity of our previously proposed assessment criteria in two different environments. This micro-application is expected to act as a trial for future macro-application of the criteria. We intentionally applied the assessment criteria in two educational contexts that were contrasting in as many ways as possible, enabling us to test their applicability and transferability across a wide range of tasks, students, discipline areas, courses and institutions.

Conceptual Framework for Online Assessment Design Criteria

The theories of constructivism and situated learning form an appropriate basis for designing assessment strategies for online learning environments which go beyond the mere reproduction of knowledge and encourage students to rise to the challenge of deep learning. Constructivism places a focus on the student in the learning process and aims to assist students' progress from their prior level of experience to construction of further knowledge and understanding. Several characteristics of online learning environments allow assessment strategies to pass control to the learner in a constructivist fashion. For example, valuable metacognitive skills are developed as a result of the independent nature of online study, and its flexibility allows students to choose their own style of learning to suit individual goals and abilities. Similarly, convenient online access to a variety of resources encourages learning patterns which more directly reflect the process of knowledge construction than knowledge delivery.

Situated learning builds on aspects of constructivism, and follows the premise that effective learning occurs when content is embedded or situated in life-like, authentic contexts. A replica of the appropriate environment, or a contextual anchor which reflects the conventions of the environment, can constitute a situated learning environment (McLellan, 1994), and should include the following characteristics:

- ensures meaningful, active participation of the student, while acknowledging relevant social and motivational factors
- offers opportunities for collaboration
- allows students to articulate new knowledge and concepts
- promotes student reflection
- offers meaningful learning outcomes with obvious uses in an authentic, real-life context
- offers authentic learning activities, including those which improve the problem solving abilities of students
- provides multiple viewpoints on knowledge and concepts
- allows for coaching and scaffolding where necessary
- offers flexibility of approach for students and teachers
- provides integrated and authentic assessment activities

(Herrington & Oliver, 1997 and Wilson, Jonassen & Cole, 1993).

Assessment tasks for online environments are often able to incorporate many of these characteristics. For example, the nature of online communications encourages collaboration between students, and can allow students to complete authentic collaborative tasks or reflect on their learning and compare it to the experiences of other learners.

This conceptual framework formed the basis for our initial development of design criteria for qualitative assessment tasks (Northcote & Kendle, 2000) and our subsequent criteria for incorporating appropriate qualitative *and* quantitative online assessment tasks (Kendle & Northcote, 2000). In order to evaluate two online assessment tasks from different contexts, we have combined our work on design criteria to develop the checklist below. Our evaluation asks whether the task:

- necessitates quantitative and qualitative responses?
- has a clear purpose and outcome?
- models an authentic situation?
- emphasises process over product?
- ensures collaborative communication?
- gives students choices?
- links to unit learning outcomes?
- includes feedback mechanisms?
- encourages the appropriate, discriminatory use of online resources?
- enables students to examine and present many viewpoints?

Application of Design Criteria to Two Case Studies

To test our evaluation checklist of design criteria, we chose to apply it to two varied online assessment tasks. The first was a component of a unit delivered wholly online, whereas the second assessed an otherwise face-to-face course. The detailed context of the tasks and the results of the evaluation serve to examine the usefulness of our set of criteria.

Case study 1

In the first case, the online assessment criteria were applied to a unit of study within a pre-tertiary bridging course for Indigenous Australian adult learners. The unit centred around the processes adopted by Aboriginal authors to create works of fiction and showcased 23 Aboriginal authors from across Australia. The assessment component was linked to the three modules of the unit and allowed students to construct their own learning pathway based on their choices of learning activities, thus catering for students' varied learning preferences (Groome, 1995). The main assessment task for the unit is a portfolio comprising three sets of learning activities reflecting the three modules of the unit. The portfolio components were either submitted separately throughout the semester or altogether at the end of the semester. In two of the three modules, the students were presented with a number of activities from which to choose.

Evaluation question	**Result**
Does the Portfolio …	
necessitate quantitative and qualitative responses?	Plenty of qualitative responses but few tasks which required quantitative thought.
have a clear purpose and outcome?	The purpose of each assessment task was usually stated at the outset. Could be worded more specifically in terms of learning outcomes.
model an authentic situation?	Many of the tasks implied links to authentic situations but few were directly connected to authentic contexts.
emphasise process over product?	This was a strength of the assessment, especially as it related to the topic of the unit (that is, the writing process).
ensure collaborative communication?	Some scope for community-student liaison. Required more structured examples of student-student contact.
give students choices?	Perhaps too many choices were given here: choice of activities, choice of topics within activities, choice of submission formats and timeframes.
link to unit learning outcomes?	Learning outcomes of unit were frequently referred to in actual explanation of assessment tasks.
include feedback mechanisms?	Few feedback-to-student mechanisms were provided, perhaps due to the qualitative nature of the tasks. However, feedback could be provided through model responses. Feedback to teaching staff from students was enabled through one of the initial tasks which asked students to comment on their initial impressions of the website.
encourage the appropriate, discriminatory use of online resources?	A wide variety of online resources were utilised in this assessment task. Assessment task structure could be improved by integrating some exercises which encourage critical evaluation of such resources.
enable students to examine and present many viewpoints?	Students were encouraged to consider their own views, explore the views of the writers featured in the unit and, on some occasions, were even suggested to investigate the views of their local community.

Table 1: Evaluation of Portfolio Assessment Task

Overall, many of the online assessment criteria were met in this example which was particularly suited to the students for whom it was designed. The online environment wasn't especially well exploited in the design of this tasks did not fully expand on the idea of building relationships between ideas, a concept central to Indigenous ways of learning (Hall, 1987).

Case study 2

The second case concerns an online assessment task for fifth year medicine students, who learn through a combination of problem-based learning (PBL) tutorials and clinical experience in hospital wards. A modified essay question (MEQ) format was chosen to assess students' diagnostic reasoning and patient management skills in an authentic way (Feletti & Engel, 1980), mimicking the learning pattern occurring through PBL. An MEQ uses a series of questions based on case information and additional triggers to build a scenario. Commonly, in paper-based MEQ tests, students are not allowed to turn backwards or look ahead in their paper, as subsequent questions may reveal key information for answering earlier questions. The emphasis is on the real-life scenarios which students will encounter, when immediate action is often required. Feedback from implementation of MEQs in paper-based format is that students admit to cheating by turning forwards or backwards.

The online environment was clearly very suitable for this type of test, as it was easy to restrict students from accessing previous or forthcoming parts of the question. Apart from the improved administration of the test, other advantages were perceived, such as the ease of marking typed answers over handwritten, the possibility of initial marking to be automated using keyword searches and highlighting, and the opportunity to provide qualitative feedback to the students in computer-based form immediately after the test had been completed.

Evaluation question	**Result**
Does the Online MEQ ...	
necessitate quantitative and qualitative responses?	Some questions required objective, quantitative answers while others focused on short answer articulations
have a clear purpose and outcome?	The task closely modelled the diagnosis and management process students would face as doctors
model an authentic situation?	Questions were modelled on real-life cases
emphasise process over product?	The task attempted to focus on the process of diagnosis and management rather than the final result
ensure collaborative communication?	No scope for collaboration; but future iterations could include peer-assessment and hence allow some collaborative communication
give students choices?	Students were not given any choices
link to unit learning outcomes?	Learning outcomes were consistent with the assessment task
include feedback mechanisms?	Model answers were supplied as feedback to students Students were also able to fill in an online evaluation form to give feedback to teaching staff about the effectiveness of the task
encourage the appropriate, discriminatory use of online resources?	Access to other online resources was not permitted, but future iterations could include access to resources while answering questions, mimicking more closely the real-life situation
enable students to examine and present many viewpoints?	Students were asked to present varying opinions on diagnosis and management but multiple perspectives (for example, cultural views) were not emphasised, despite being a key component of the curriculum

Table 2: Evaluation of Online Modified Essay Questions (MEQs)

Although this assessment task was primarily trialled online in order to solve the problem of cheating, in the design phase a number of other opportunities were identified and carried out successfully, for example, providing students with feedback in the form of model answers alongside their own answers after the deadline for completing the test had passed. By its nature, the task was also authentic and clearly relevant. It also allowed for some quantitative responses (e.g., dosages), as well as qualitative paragraphs (e.g., describe what you would talk to this patient about now). The evaluation criteria revealed a number of ways in which the task could be improved, for example, allowing access to other online resources, recognised as a useful adjunct for medical problem-solving tasks (Schuwirth, et al., 1999), and allowing communication and collaboration.

Summary of results and further implications

The results and suggestions for change arising from the evaluation of the two case studies show that the application of the criteria can highlight key issues such as the balance of qualitative and quantitative tasks and the promotion of aspects such as choice and variety. If these criteria were constantly referred to during the design stages, it would appear that a substantially higher quality of assessment task would result.

This application of criteria was also carried out in order to attempt to refine the criteria, and a finding common to both case studies was the concept of feedback being both teacher-to-student and student-to-teacher, although our previous definition of feedback had been intended only in the sense of observations on the performance of students. However, providing students with an opportunity to evaluate the assessment task has proven valuable in our case studies and is more widely recognised as beneficial (Naidu, 1994), and we will pursue this use of feedback through its incorporation into our design criteria.

Overall, the success of applying these criteria in two contrasting settings with very useful results suggests that they may have wider applicability for evaluating the effectiveness of online assessment tasks. In fact, ascertaining the quality of online learning environments in general may be achievable with the use of a similar set of criteria and it is this area of research that we intend to pursue in the near future.

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Computer-based cognitive tools: Description and design

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Abstract: With computers, tangible tools are represented by the hardware (e.g., the central processing unit, scanners, and video display unit), while intangible tools are represented by software. There is a special category of computer-based software tools (CBSTs) that have the potential to mediate cognitive processes—computer-based cognitive tools (CBCTs). Only a limited number of CBSTs have been designed specifically for educational purposes. It is the design of the educational environment, specifically the educational intent, that transforms student interactions with a CBST to that of a CBCT. Two examples of CBCTs are described. The Interactive Graphing Tool (IGT) facilitates on-screen sketching of graphs. Students receive qualitative feedback, may revise their articulation of graphical knowledge any number of times, and ultimately, have access to expert answers for comparison and self-evaluation. The Text Analysis Object (TAO) also facilitates an iterative approach to knowledge construction. The TAO allows a student to type extended answers to questions, receive qualitative and limited summative feedback, and access to both expert and 'good student answers' for comparison and self-evaluation.

Tools, tangible and intangible

Traditionally, tools have been seen to be manifestations of human technology in the form of some physical object—an inclined plane (screw or wedge), pulleys (cranes), or cogs and gears (gear mechanisms on a bicycle), for example. The purpose of these tools was to enhance human physical power, strength and human capabilities. Examples of physical tools that support learning include the humble pen-and-paper or an abacus. In educational settings we must also consider intangible tools (e.g., language, or mathematical symbols) that support human learning and cognition.

Vygotsky (1978) proposed that learning required two mediational means—tangible tools (technical tools) and intangible tools or signs (semiotic tools). At Vygotsky's time of writing, technical tools were actual physical entities (as above), whereas semiotic tools were (and still are) the means by which cognitive functions are mediated. Examples include language, numbers, algebraic notation, mnemonic techniques, graphs and diagrams—most of which may be expressed in the form of media elements that are easily stored, retrieved, and manipulated by computers. With the advent of new technologies the definitions of tools and signs in modern times, has blurred—that is, computers have the ability to mediate cognitive processes. (Duffy & Cunningham, 1996, p. 180).

Computer-based software tools (CBSTs)

Computers combine aspects of physical tools (the hardware) and intangible tools (software). Computers are a means of storing, retrieving, displaying, and manipulating signs (e.g., language, graphs, and mathematical notation). In Figure 1 the distinction between tangible and intangible tools is represented, with particular reference to computer-based tools.

Figure 2 illustrates that CBSTs (e.g., word processors, spreadsheets, concept mapping software, authoring software, and computer programming languages) that facilitate interaction between the learner and various media elements (e.g., text, graphs, video, audio) in an appropriate educational context may also be used to support cognition. That is, some of these computer-based software tools may also function as computer-based cognitive tools.

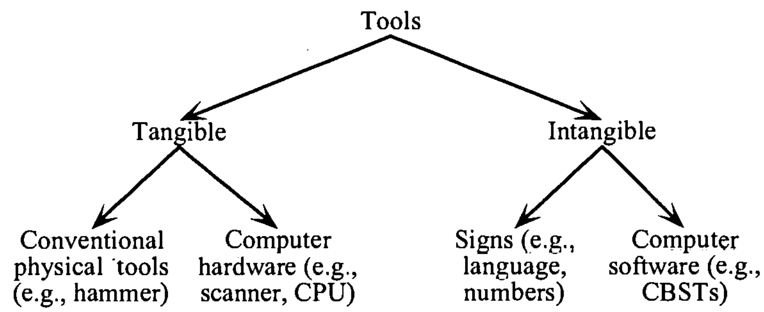

Figure 1: Tangible and intangible tools

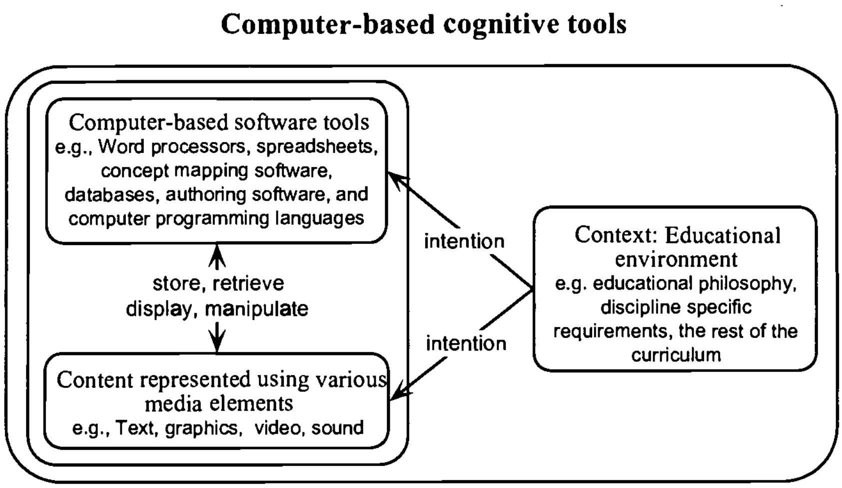

Figure 2: Computer-based cognitive tools

Computer-based cognitive tools (CBCTs)

What is a computer-based cognitive tool? In order to address this seemingly simple question, a number of interrelated issues need to be addressed including the:

- functional aspects of a CBCT;
- development of CBCTs (how do the pedagogical and functional issues influence their construction); and
- utilisation of CBCTs to the best effect.

The functional aspect concerns how students use CBCTs to mediate learning—are there any generalisable criteria (e.g., particular media elements or specific CBSTs)? The developmental perspective examines the software authoring tools used to create CBCTs—are some software authoring tools better for developing CBCTs, and/or integrating into courseware? The effective utilisation of CBCTs involves the concept of 'educational intention' or 'intent'.

A student who uses any cognitive tool effectively must necessarily engage (actively), think (deeply), and articulate their knowledge (Jonassen, 1994). In order to mediate cognition, a computer-based cognitive tool should:

- engage the student actively;
- support a deep approach to learning (thinking and reflection);
- provide support for a student to articulate her or his knowledge; and
- be embedded in an educational environment or context with a particular educational intent.

The key difference between a computer-based software tool and a computer-based cognitive tool is the educational intent or educational context. Thus, CBCTs are learning tools with which students communicate, articulate their thought processes, solve problems, engage in collaborative processes and think. CBCTs are also charged with instructional intent—the intent of the educational, or courseware designer. The computer is the storage, presentation, manipulation and creation device for various types of media—the technology that facilitates the use and function of a CBCT, and a part of the learning environment. The utilisation of the computer, CBCTs and media elements in order to achieve a particular set of student learning outcomes is influenced by the perspective of teaching and learning held by the educational designer. A CBCT may be thought of one component in the learning environment that requires computer-based media elements in order to support and enhance student learning.

The student constructs meaning by using the CBSTs in an educational context, by manipulating media elements from a particular content domain. Many CBSTs that by intent and educational context are utilised by a student as CBCTs may be described as generic tools. Examples of CBSTs that have become CBCTs by inclusion in a particular learning environment/ context are provided in Table 1.

Table 1: Examples of CBSTs in educational contexts as CBCTs

CBSTs as CBCTs	Educational context
databases	Used by students to develop case-studies and build clinical reasoning skills in veterinary microbiology (McNaught, Whithear & Browning, 1994).
spreadsheets	As part of a course teaching statistics to engineering students (Spedding, 1998).
concept mapping tools	Students and academics use a concept mapping software (Helfgott, Shankland, Stafford & Samson, 1997) tool to organise, plan, and display concepts in chemistry (Kennedy & McNaught, 1997).
software tools for developing semantic relationships	The use of Nud*ist for qualitative analysis of transcription (interview) data in educational evaluation (Gahan & Hannibal, 1998).
computer programming languages	The computer programming language, Logo has been used widely in primary schools to support a wide range of student learning styles by the creation of personal media (Papert, 1993).

The focus of this paper is not about the cognitive or metacognitive strategies intrinsic to the learner—but the external tools that extend and enhance their thinking processes. People do not learn from computers any more than they learn from a CBCT. The potential is there for people to learn *with* a CBCT. An example is a calculator. It is only using the calculator software (a CBST) in an appropriate context, with intent (motivation) that understanding can be arrived at. A student may use a calculator to find the logarithm of a number with little understanding of what a logarithm represents. However, the use of the same CBST in a chemistry class to explore the effects of small changes in the value of pH in a solution (the acidity or concentration of the hydrogen ions in a solution is defined as $-\log_{10}[H^+]$) is using the calculator software as a cognitive tool.

Computer-based cognitive tools can facilitate problem-solving by providing tools to access, manipulate and structure data from large, customisable, subject databases (Whithear, Browning, Brightling & McNaught, 1994). Carefully designed CBCTs can scaffold learning by modelling complex environments or expert problem-solving strategies. Computer-based cognitive tools can also provide relevant context-sensitive feedback by requiring a student to externalise (articulate, report, discuss, think-aloud) what are very often, internal processes (Collins, Brown & Newman, 1989).

Many examples of computer-facilitated learning environments have a variety of CBCTs integrated within the software. *Exploring the Nardoo* (an award-winning CD-Rom) has been developed using a synthesis of the ideas from 'constructivist learning environments, situated learning and problem-based learning in rich information landscapes to form the basis for effective design' (Harper & Hedberg, 1997, p. 14). The Nardoo provides an interface with access to number of very detailed databases of content. The databases contain plant and animal descriptions, pre-determined values of measures of water quality (e.g., nitrogen, oxygen, phosphorous, water turbidity), procedural knowledge, a number of presentation genres for knowledge construction and presentation—accessed by the student using a variety of CBCTs and supported by access to multiple forms of media. There are a number of CBCTs embedded in, and fundamental to, the Nardoo software. They include:

- three student-controlled simulators;

- a number of genre writing templates for students to structure their notes and presentations of findings; and
- a 'text tablet'.

Principles of successful use of CBCTs

CBCTs must be incorporated into a well-structured CFL environment that does not impose high cognitive demands by virtue of a complex user interface. Students will then be better able to engage in higher order thinking processes involving reflection, synthesis and analysis.

Computer-based cognitive tools are software constructions that:
- are simple for students to use;
- function best in a constructivist learning environment;
- provide the opportunity for students to address meaningful questions in a realistic context and receive appropriate and timely feedback;
- encourage students to 'take on' the ownership of their own learning;
- off-load basic cognitive demands while the learner focuses on higher level processes;
- facilitate the development of deeper and richer knowledge structures;
- facilitate collaborative and negotiative learning experiences that provide opportunities for students to explore, test, and validate their conceptions; and
- are unintelligent tools (unlike those claimed by intelligent tutoring systems) that facilitate a dialogue between teachers and learners and feedback appropriate to the task.

(after Duffy & Cunningham, 1996, p. 187 & Jonassen & Reeves, 1996, p. 698)

In addition, CBCTs extend some of the characteristics above through their facility to offer intrinsically different representations or views of data and/or phenomena not possible through other means and hence provide new understandings (e.g., powerful user-controlled visual simulations to make abstract concepts more visible).

Computer-based cognitive tools are not intended to make the task easier, or reduce information processing (Jonassen, 1994). In the evaluation of the two CBCTs briefly described here students have (sometimes grudgingly) admitted that a CBCT (e.g., the interactive graphing tool) required them to work harder for the answer. The students also thought this was 'probably better' for them because they couldn't simply click on an answer provided by the lecturer. Using CBCTs requires a student to:
- analyse and compare different representations of content (which may be in different forms of media elements);
- construct, refine and represent mental models; and
- articulate her or his understanding in some meaningful way.

Using CBCTs is not a 'free ride', it is demanding, challenging, and basically hard work. The following two examples briefly illustrate the relationship between media elements, instructional intent, and computer-based cognitive tools. The references provide more complete descriptions.

Cognitive tools in action: Two examples

The Interactive Graphing Tool (IGT) is intended to overcome some of the criticisms of static or animated versions of graphical knowledge. Instead, the IGT requires students to sketch a graph on screen, using the mouse as a drawing tool, and can respond to a wide range of common graph types including logarithmic, exponentials, curves, and straight lines. The IGT facilitates an iterative approach to articulating and understanding graphical representations of knowledge by actively involving students in the construction of these representations, and providing customisable (by the academic) multiple responses for more appropriate feedback (Kennedy & Fritze, 1998). Students receive qualitative feedback, may revise their articulation of graphical knowledge any number of times, and ultimately, have access to expert answers for comparison and self-evaluation. Figure 3 shows both the steps required for teachers to use the IGT, and also how the IGT responds to student input. The IGT has been evaluated in the teaching of kinetics in chemistry.

Another CBCT is the Text Analysis Object (TAO). The TAO facilitates the development of text-based extended question-and-answer problems. The design of the TAO focused upon developing a learning tool that facilitates extended answer/ short answer questions. Using the TAO, a student is able to generate a more meaningful answer by articulating her or his understanding, rather than merely recognising the lecturer's representation of the knowledge, as in multiple-choice questions. The TAO has been designed to support an iterative approach to knowledge construction by requiring a student to type an answer to a question into a text field, submit the answer for checking by a software algorithm, and then receive meaningful feedback. The student then has the opportunity to refine her or his answer a number of times, each time receiving feedback. Feedback provided by

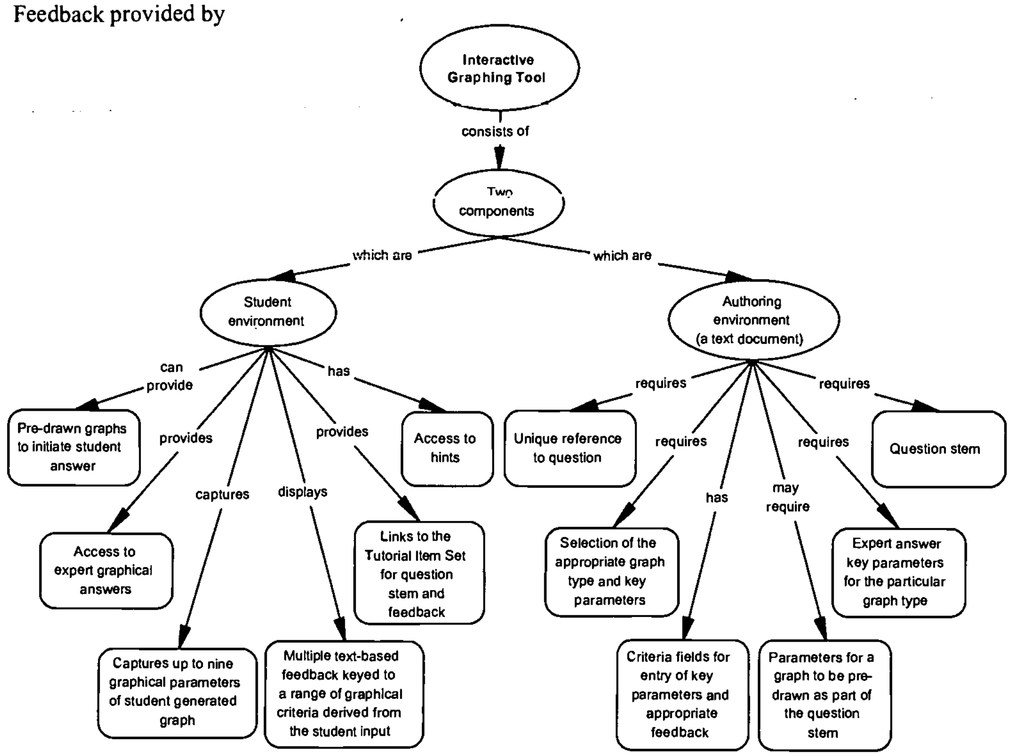

Figure 3: The functionality of the IGT

the TAO software engine to the student is determined by using a key word and key phrase search of the text entered by the student. The TAO software engine/ software algorithm has been designed to utilise a two-tiered, hierarchical feedback mechanism—distinguishing between concepts (major ideas or principles) and details (generally factual knowledge) in providing feedback to students (Kennedy, Ip, Adams & Eizenberg, 1999). Academic staff provide the information about concepts and details that the TAO engine uses in providing feedback to students. This is time consuming but valuable if the work is seen as a way of progressively building up effective learning resources. The TAO has been evaluated in the teaching of anatomy to medical students.

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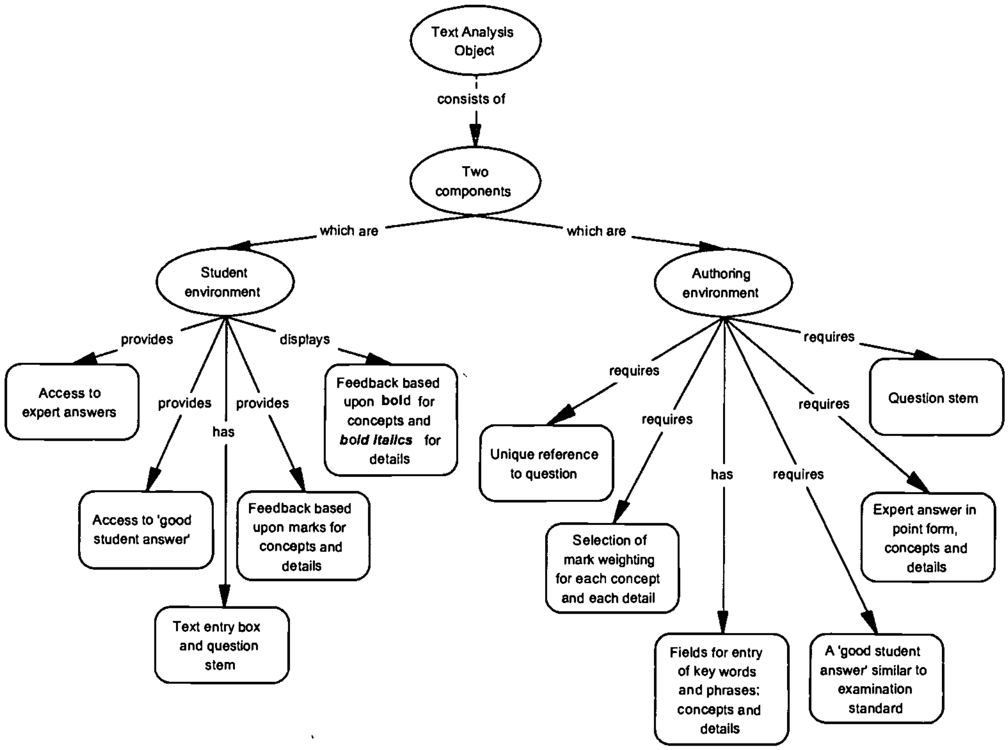

Figure 4: The functionality of the TAO

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DNAexplorer: Computer Facilitated Learning of Bioinformatics Using a Situated Model

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Abstract
This paper reports on the design of DNAexplorer, a computer facilitated learning package, which was developed to support the teaching and learning of bioinformatics. The instructional design of the package was broadly based on a model of situated cognition, with particular reference to the nine critical features of situated learning advocated by Herrington and Oliver (1995). The primary features of DNAexplorer's instructional design are described and discussed in relation to Herrington and Oliver's (1995) critical features.

The Teaching and Learning of Bioinformatics

Bioinformatics is an area of investigation which integrates the disciplines of biology, mathematics and computer science. Related activities include searching for, accessing and analysing biologically relevant information. The ability to access nucleotide and protein sequence databases is essential for scientists wishing to locate genes in genomic sequences, to predict gene function and to determine complex cellular interactions and evolutionary trends.

Teaching bioinformatics presents educators with a number of difficulties. The store of relevant bioinformatics information is increasing at a phenomenal rate which places constant demands on lecturers to provide their students with the most up to date data. In addition to the general increase in information, there has been an increase in the variety of approaches used to analyse nucleotide and protein sequences. An array of web- and PC-based analysis software has recently emerged. Even simple bioinformatics analysis tasks often require the use of many different software packages and databases which need to be applied in a coordinated sequence to ensure a reliable outcome. For example, to investigate the relatedness of microorganisms using nucleotide sequence data requires a number of different desktop applications and several web-based databases. Without intensive instruction or extensive experience, undergraduate biomedical students typically find it difficult to coordinate and integrate the use of these applications.

At the University of Melbourne, traditionally biomedical science students have been introduced to bioinformatics through lectures and practicals. Lectures are used to provide the theoretical background to bioinformatics and practicals are used to help students develop technical competence with sequence analysis databases and software. After delivering the course for a number of years the course coordinators decided that the practical component of the curriculum was problematic. Although practicals were successful in introducing students to the tools available for analysis of genetic data, the lack of a clear pathway between a number applications and web sites meant that the practicals were tutor intensive. Tutors spent much of their time in practicals explaining to students how to navigate between applications and web sites rather than helping students with more conceptual procedures and principles associated with bioinformatics. It became evident that a more effective and efficient method was required to assist students both with their understanding and use of sequence analysis databases and software and the principles and procedures associated with bioinformatics. Computer facilitated learning was an obvious solution to the difficulties encountered with the teaching and learning of bioinformatics as the discipline is fundamentally a computer based field of inquiry. Thus, a computer facilitated learning package, DNAexplorer, was developed to allow students to learn about principles and procedures associated with bioinformatics through the integrated use of applications and web sites associated with the discipline.

The Learning Design of DNAexplorer

The learning design of DNAexplorer is broadly based on a model of situated cognition which emphasises the need to place learners in real-life contexts. Brown, Collins and Duguid (1989), who were among the first advocates of situated cognition as a practical learning approach, argue that "useful learning" takes place when students are set authentic tasks or are placed in authentic contexts. They argue that "much school work is inauthentic (sic) and thus not fully productive of useful learning" (p. 34). Based on this and other work in the area of situated cognition, Herrington and Oliver (1995) developed nine critical characteristics of situated learning, comprising three overlapping domains (see Table 1) that, they argued, could be used to guide the instructional design of multimedia learning environments. They subsequently employed this framework to guide the design and development of an educational multimedia program on assessment strategies (Herrington & Oliver, 1997).

Interactive Multimedia Program
Provide an authentic context that reflects the way the knowledge will be used in real-life
Provide authentic activities
Provide access to expert performance and the modelling of processes
Provide multiple roles and perspectives
Implementation
Provide coaching and scaffolding at critical times
Provide for integrated assessment of learning within tasks.
Learner
Support collaboration and construction of knowledge
Promote reflection to enable abstractions to be formed
Promote articulation to enable tacit knowledge to be made explicit

Table 1: Herrington and Oliver's (1995) critical characteristics of situated learning.

Our approach, as designers and developers, was to create a multimedia learning environment based broadly on a model of situated cognition paying particular attention to Herrington and Oliver's (1995) framework. Through this approach we hoped to improve students' understanding of bioinformatics principles and procedures and encourage the application of what has been learned. We employed a number of strategies to create an authentic learning environment within DNAexplorer. First, we developed four case-based research scenarios which were based on practicals conducted in the Department of Microbiology and Immunology at the University of Melbourne, over a number of years. The cases present students with realistic microbiological problems—problems they could conceivably encounter as research scientists. For example, in the second of the four cases, students are presented with the task of conducting bioinformatic analysis of *Plasmodium falciparum*, a protozoan parasite that is the most common cause of malaria in humans. When certain mutations occur in this parasite it may become resistant to antimalarial drugs such as sulfadioxine. In the case, the lab that the student is working in has been sent an sample of *Plasmodium falciparum* from an Australian volunteer who was diagnosed with malaria while working in Papua New Guinea. The students' task is to determine whether the sample is sensitive or resistant to sulfadioxine. In order to resolve this problem and complete the case, they are required to perform analyses of nucleotide and protein sequences using a range of bioinformatics applications and databases.

In addition to basing students' learning around real-life cases or scenarios, we employed a number of strategies to create a realistic environment for students. We designed a primary interface that simulates a typical bioinformatics research environment (i.e. a virtual laboratory and office) which is similar to Herrington and Oliver's (1995) virtual classroom. The laboratory houses equipment that students would encounter if they were working as a research scientist in the area of bioinformatics. Students can rollover these pieces of equipment to see how they work and to access brief explanations of their features. The office environment acts as the home page for the package. Students access the four case-based scenarios from here via the manilla folders on the desk and can preview the content of the cases before opening the folder to begin their investigation. Once students have selected a case, the folder and file metaphor is continued as the interface for each case is set out as a research file (Figure 2). Students progress through the case by turning the file's pages and use a system of "tabs" to between different sections of the file.

Figure 1: The virtual laboratory and the virtual office

The Navigational Structure of DNAexplorer

The navigational structure of DNAexplorer combines linear and referential organisational structures (Herrington & Oliver, 1997). Each case in DNAexplorer forms the backbone to students' investigation. Students are presented with background material relevant to their investigation and a variety of interactive tasks. Due to the complexity of the content area, students are guided through each case in a fairly linear way, however, they are able to diverge from the primary linear organisational structure by using a system of "tabs" (located throughout their research file) and/or through the use of two support tools: the "NavFinder" and the "InfoFinder".

The Tabs System

Three types of colour coded tabs are employed in DNAexplorer. Red tabs denote learning loops for students. Students enter these sections of the case to access supplementary conceptual information. For example, students may be told about a class of drugs commonly used to treat malaria in the body of the case. To investigate this family of drugs more extensively, students are able to enter a learning loop before returning to the main body of the case. Students can enter and exit these learning loops at any time. Blue tabs allow students to view extended animations of bioinformatics procedures. As mentioned above, bioinformatics procedures often require students to coordinate a number of software applications. Rather than present this information solely in textual form, we thought it beneficial to allow students to view an animation of these, often complex, procedures. Finally, once students have completed a case, grey tabs allow them to access an interactive site map that has jump-off points to major sections of the case, including learning loops and extended animations. This navigational structure gives students the flexibility to move easily between sections of the case to clarify or revise concepts and procedures.

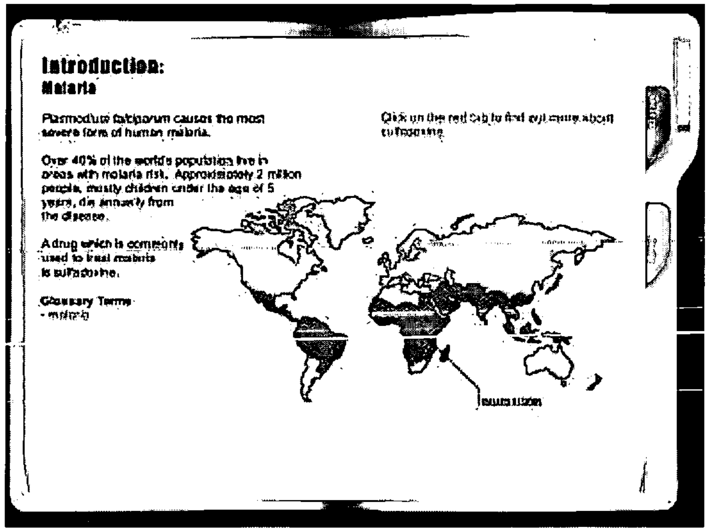

Figure 2: The "research file" interface for cases in DNAexplorer

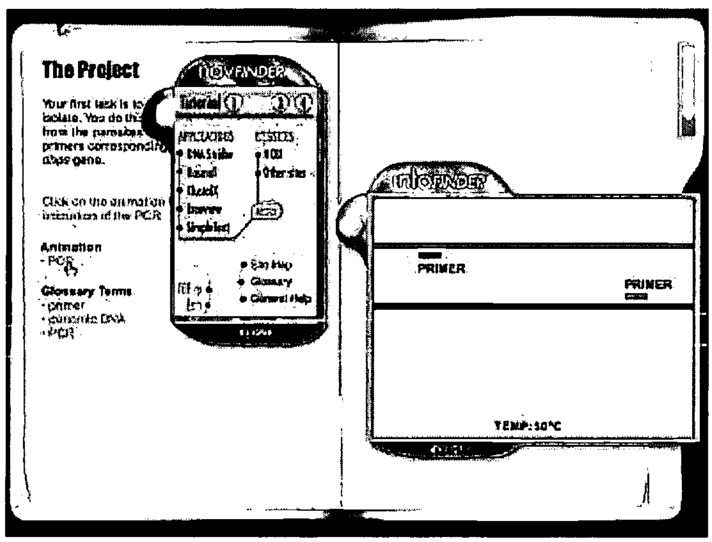

Figure 3: Interface showing the NavFinder and the InfoFinder as floating windows

NavFinder and InfoFinder

Students have access to two support tools while they navigate their way through cases: the "NavFinder" and the "InfoFinder" (Figure 3). The NavFinder, was developed out of the need to integrate and coordinate applications and webs sites associated with bioinformatics. The NavFinder is a separate, dragable, floating window that can be maximised or minimised depending on the students' needs. The NavFinder fulfils two primary purposes. First, it allows students to navigate easily between the case itself, the office, the lab, web sites and desktop applications. All the applications and web sites students require for their investigation are listed on the NavFinder and are a simple mouse-click away. The NavFinder obviates the need for students to search for applications on the hard disk or search for bookmarked web sites in their browser, thereby simplifying their navigation between applications and web sites. The second purpose of the NavFinder is to provide students with text based instructions about bioinformatics procedures associated with their case. At critical points in their investigation, students are directed to the NavFinder which contains an additional scrollable window of instructions. It is important to note that the NavFinder provides students with steps associated with performing procedures but neither gives students the "answer" nor highlights the implications of performing such procedures. Students are simply provided with a scaffold associated with complex bioinformatics procedures critical to the investigation of their case.

The InfoFinder is used within cases to present supplementary information and tasks to students and has four roles:

- presenting quiz questions for formative assessment
- displaying short animations of biological principles or concepts
- presenting DNA and protein sequences to be used in subsequent bioinformatics analysis and
- displaying definitions of terms used in the case (glossary).

These four components of DNAexplorer's navigational system (pages of case content, the tab system, the InfoFinder and the NavFinder) are used together to support students in their investigation of bioinformatics principles and in their application of complex bioinformatics procedures. For example, a typical use of the components of the navigation system may be to:

- enter the virtual office and select a case for investigation
- turn pages in the research file to review the background material of the case
- use a red tab to review supplementary information as required
- use the NavFinder to return to the lab to review the function of a PCR machine
- use the NavFinder to return to the case
- use the InfoFinder to copy a nucleotide sequence
- use a blue tab to review an animation of a complex bioinformatics procedure
- use the NavFinder to launch the DNA Strider (desktop application)
- perform sequence analysis using DNA Strider and using supporting text in the NavFinder
- use the NavFinder to launch the NCBI web site
- compare the outcome of DNA Strider analysis with the NCBI database
- use the NavFinder to return to the case
- use the InfoFinder to answer a formative assessment question on their analysis.

Critical Characteristics of Situated Learning

We believe that DNAexplorer satisfies many of the nine critical characteristics of situated learning proposed by Herrington and Oliver (1995). The design adheres to these characteristics particularly in the "interactive multimedia" domain (Table 1). We have attempted to place learners in an authentic learning context by using a case-based approach and by creating an interface which simulates an actual work environment. We have designed a package that allows students to explore bioinformatics concepts and principles by completing realistic bioinformatics activities and we have used animation to show students how an expert would complete particular bioinformatics procedures. While each case deals with a unique situation requiring students to complete specific bioinformatics procedures, through the provision of four cases (and potentially more) we have provided students with multiple perspectives. Hopefully, students will come to fully understand bioinformatics concepts and principles through their investigation of different problems and scenarios that require similar bioinformatics applications and procedures.

In the domain of "implementation we also feel that, to a certain extent, we have successfully met the criteria proposed by Herrington and Oliver (1995). We have provided scaffolding and coaching to the learner especially with regards to complex bioinformatics procedures through the use of the NavFinder. However, we are also relying on the context in which DNAexplorer is used to provide further support for students. DNAexplorer is designed to be used in a computer laboratory with the aid of a tutor. Given this learning environment, students should be able to draw on tutor support when they require it. The second criteria in the "implementation" domain, integrated assessment, has also been incorporated within the learning design of the package. Through the use of the InfoFinder, students are assessed on both products and processes associated with bioinformatics. However, it should be noted that this assessment is only formative in nature and Herrington and Oliver's (1995) discussion related more to summative assessment. Again, however, we are relying on the greater educational context to meet this criterion. Students will be provided with integrated assessment as part of their study of bioinformatics which, like the formative assessment, should deal with both learning products and processes.

The domain in which we had most difficulty was that of the "learner". It was difficult to incorporate the elements of collaboration, reflection and articulation in the design of the DNAexplorer. It should be noted that in developing their own educational multimedia program, Herrington and Oliver (1997) admitted similar difficulties, stating that "many aspects of the model could not be incorporated into the software per se" (p. 128). The learning context can again play a role in promoting these aspects of the situated learning environment. Students who have used DNAexplorer to date have been encouraged to use it in pairs, which may promote collaboration and articulation. Through online collaboration this aspect of situated learning could be further promoted via group tasks or problem solving. While review and reflection is encouraged in an implicit way through the provision of an interactive site map and through the use of formative assessment questions, promoting reflection more explicitly is an area where the package could be improved.

Conclusion

It is hoped that the careful attention given to the instructional design of DNAexplorer will be reflected in benefits in terms of students' understanding of bioinformatics principles and procedures. By taking a situated learning approach, it is also envisaged that students will find it easier to apply their knowledge in real life contexts. The package should enable students to develop the highly demanding skills of gathering, organising and analysing molecular and biological information. Through the use of DNAexplorer students should also show greater confidence in using web- and PC-based resources to analyse molecular and biological information. The package's case-based structure and navigational support tools give developers the flexibility to accommodate advances in bioinformatics, which is critical in this fast growing area of inquiry, teaching and learning.

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Supporting Students' Learning with *The Personal Learning Planner*

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Abstract
This paper describes a computer based, learning support tool called the *Personal Learning Planner* (PLP). The educational context is described and we point to three interrelated demands on students in problem based and self-directed learning contexts. These demands form the basis for the rationale behind the development of the PLP. An overview of the program is provided before an outline of the functionality of each of the developed sections is presented. Future development directions are discussed.

Educational Context and Rationale

In 1999 the School of Medicine at the University of Melbourne introduced a new medical curriculum incorporating problem based-learning (PBL) and self-directed learning (SDL). Space does not allow a full description of the curriculum here (see Kelly, Martin, Larkins & Elliott, 1998; Keppell, Elliott & Harris, 1998) however it centres on a weekly clinical problem or "problem of the week". Each week students are presented with a problem in a small group tutorial. Through group discussion and with the help of a tutor/facilitator, students generate hypotheses about the potential causes of the clinical problem. The group then considers the mechanisms that might underlie these hypotheses. This process allows students to identify aspects of the problem they think require further investigation over the week and these become the students' "learning issues" for the week. Students are then required to undertake SDL where they investigate the problem using the learning issues they have generated. A variety of resources are made available to students to support them in their SDL. Resources include more traditional modes of instruction (such as lectures and practicals) and electronic and paper based resources (including text books, journal articles, web pages and computer facilitated learning modules). Students use these resources to investigate their learning issues over the week, before returning to their second PBL tutorial where, as a group, they identify and discuss the critical mechanisms that underlie the problem. Through discussion and with the guidance of the tutor/facilitator, students work towards a resolution of the problem.

The introduction of the new curriculum represented a fundamental shift in pedagogical focus for the school, reflecting a move from a teacher-centred to a student-centred curriculum. This shift made more salient a number of interrelated demands on students. These demands include a greater emphasis on individual research skills and management of learning and less explicit information for students with regards to what constitutes the core syllabus. Each of these challenges for students is covered in more detail below.

Individual Research Skills

In PBL curricula, typically students are not explicitly directed to course related information or resources. In the context of PBL in medicine, Koshmann, Kelson, Feltovich and Barrows (1996) note that students must "identify and utilize resources--person, print and electronic--outside the [tutorial] group that can provide additional knowledge for understanding and managing the patient's problem" (p. 98). The ability to identify and use appropriate resources represents a complex set of research skills. Students must become adept at determining the focus of their inquiry, searching for information, evaluating information returned from their search in light of their goals and ultimately retrieve resources of interest to them (Fink, 1989).

Students must, therefore, develop specific skills related to searching for information. These may include determining appropriate resource catalogues to interrogate (either in the library or online), devising appropriate keywords, applying boolean logic when carrying out an inquiry and modifying their searching techniques when either too much or too little information is returned. Searching for information also requires students to become skilled in gauging the appropriateness and relevance of information given their research goals, often on the basis of limited summary information. Thus, in PBL curricula, the independent research skills of seeking, finding and evaluating information are critical parts of students' learning experiences.

Self-Management of Learning and Planning Behaviour

PBL and SDL, as student-centred approaches to teaching and learning, are typically less directive and constrained and therefore place a greater onus on students to manage their own learning. With SDL particularly, learners must take control of their own learning processes and experiences. Learners "decide how, where and when to learn the content they have identified as important" (Hammond & Collins, 1991; p. 153). Given the freedom associated with student-centred approaches to learning, students may initially feel quite daunted by SDL. As Hammond and Collins (1991) point out, "Learners accustomed to teacher directed learning may have no experience of self-management of learning so it may initially be intimidating." (p.154).

An important component of managing one's own learning is the ability to plan. Lawrence (1991) and Hammond and Collins (1991) suggest that planning is a useful—even necessary—pursuit for students, noting the problems students traditionally have with planning and managing their own learning. Lawrence (1991) argues that, generally, planning is required because some tasks "require attention, effort and organisation, because they are either complex, novel, or both complex and novel..." (p. 85). Students in the new medical curriculum need to perform tasks that are both complex and novel. Tasks are complex because students are presented with ill-defined problems and are provided with an array of resources to investigate them. The content being investigated is, in many instances, also novel for students, while the situation itself is novel with many students being more familiar with teacher-centred learning environments, where the role of planning and management is traditionally fulfilled by teachers and a timetable.

Planning behaviour is often seen as goal dependent and part of either a general or specific problem-solving process (Polya, 1957; Lawson, 1991; Lawrence 1991). A concept of planning behaviour that is contingent on problem solving and goal directed behaviour is consistent with the educational context in the School of Medicine. Students' planning takes place in the context of a "problem of the week" and is seen as part of ing processes. The general goal in this context is to arrive at an adequate resolution of the problem, while specific sub-goals are to investigate learning issues that facilitate this general goal.

According to De Lisi (1987, p.53), the term plan can refer to both "a drawing or diagram such as a map of a town's roads or and architect's blueprint for a building" and "a method of doing something or a procedure, or a detailed program of action". If we apply these definitions to planning behaviour in a SDL context, then we can recognise two distinct activities: "conceptual" planning, where students determine the interrelationships between concepts of interest to them, and "action" planning, where students devise a course of action for their learning.

Information on the core syllabus

Compared to the 'old' curriculum, students in the 'new' curriculum may also find it difficult to determine the degree to which they are covering the syllabus. In the old curriculum students' learning activities were largely constrained by the timetable which prescribed classes and provided little, if any, opportunity for students to consider their own educational goals or to set their own learning priorities. Teachers would often instruct students and tell them what topics they were required to 'learn'. In the new curriculum, timetable guidance is reduced and students are encouraged to construct their own learning pathways by generating their own learning issues. In the problem-based curriculum, determining the required material may also be difficult for students because of the integration of biomedical and clinical disciplines within a problem.

An evaluation after the first year of the new curriculum showed that many students were unsure of the degree to which they were covering the syllabus (Dodds & Sood, 2000). Many students were unsure of the goals in a number of key areas of study, needed more feedback on their progress and were unsure what constituted essential information. Furthermore, while they were generally very positive about PBL, they often mentioned that they were unsure what was required of them. It seems, therefore, that some mechanism is necessary to provide students with feedback regarding their progression towards the course objectives in this PBL curriculum.

The Personal Learning Planner

The *Personal Leaning Planner* (PLP) was developed to address the three needs outlined above, namely

- to help students develop independent research skills
- to assist students to take greater responsibility for the planning and management of their own learning
- to provide feedback to students on the degree to which they are covering the syllabus.

The PLP is a computer based, learning support tool and has three primary phases (searching, planning and reviewing). The planning phase is divided into two further sections (conceptual planning and action planning). The program interfaces with two databases: a resources' database and a profiles' database. The resources' database consists of a series of descriptions of resources identified by the Faculty as relevant to the medical curriculum and available to students within the University through its various libraries, resource centres, computer laboratories or online. The profiles' database contains individual, historical records of each student's activities within, and use of, the PLP over time.

The PLP will include a short tutorial to introduce students to research skills and the self-management of learning as study skills, however the overarching goal of the project was to produce a program which would achieve its goals by helping students work on their actual course content. That is, rather than instructing students explicitly about "research skills" or "self-management of learning", the PLP was designed to be embedded into curricula thereby implicitly educating students about the value of these skills. A schema of the components of the PLP is presented in Figure 1. While the review phase and the tutorial are still under development the remaining components of the PLP have been developed as a working prototype.

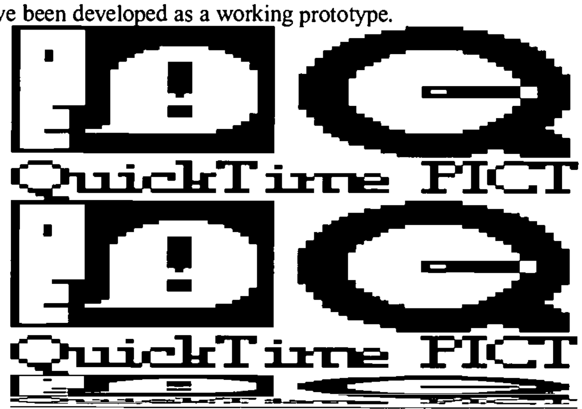

Figure 1: The structure of the Personal Learning Planner.
~~[THIS DIAGRAM NEEDS TO BE CHANGED - EITHER REMOVE THE BOXED AREA OR INCLUDE THE PROILE DAATBASE IN WHAT HAS BEEN DEVELOPED]~~

The PLP prototype was developed using a Macintosh-based Rapid Application Development (RAD) tool. The decision to use a RAD tool as opposed to a more traditional programming language (e.g. C++, Java) was made to provide maximum flexibility during the development process, enabling us to implement and evaluate alternative functionality of both the planning and searching phases of the PLP within a tight development schedule. Once the PLP's functionality is finalised it is envisaged that a robust, scalable, cross-platform product will be developed. The functionality of the prototype PLP's working components is explained in detail below.

Searching

The searching phase of the PLP allows students to query the resources' database and identify resources with which to investigate the problem of the week. Initially students are asked to enter their learning issues for a particular problem or investigation into the fields provided (see Figure 2). For each learning issue, students then generate keywords with which to interrogate the database of resources. Students can begin investigating the problem by searching for relevant resources using their learning issues and associated keywords. For each search the PLP displays all resources associated with a particular keyword. For each resource, students are able to call up summary information. The summary provides students with the title, author, type of resource (eg. computer facilitated learning modules, textbooks, journal articles and web sites) and an abstract. Students should be able to determine the relevancy of each resource to their own investigation on the basis of this information. Students can select resources that are of interest to them and can view a list of the resources they have selected at any time.

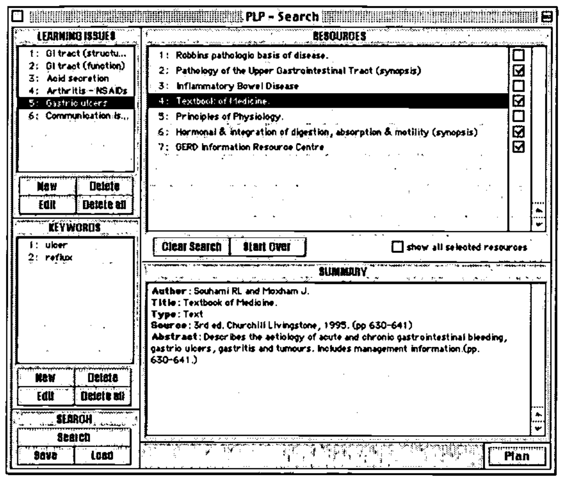

Figure 2: An example searching screen from the PLP.

Conceptual and Action Planning

The development team decided that both types of planning (conceptual and action) should be manifest in the planning phase of the PLP. That is, students should have the ability to map out the conceptual relationships between their learning issues and resources (conceptual planning) and also be able to organise a specific course of action with regards to the investigation of the problem using these learning issues and resources (action planning). In the conceptual planning section the team attempted to promote students' engagement by asking them to actively construct a concept map. A variety of tools were made available to students so that they could be creative in the construction of their maps and to give them the flexibility to plan in an individual way. Students can create a concept map of the relationships between their learning issues and resources which have been carried over from the searching phase. Students can place "tiles" of their learning issues and resources into an on-screen workspace (see Figure 3). The workspace is dynamic and students can drag tiles to any location and draw links between them. The summary information for each resource is available on a pop-up field so that students can use this information to inform the construction of their concept map. Students are also able to annotate their maps or the links between tiles and may also group sections of the map using different colours and shapes. Different visual backdrops are available to students as another means of prioritising or grouping sections of their concept map.

After completing their conceptual planning, students are able to organise a specific course of action using the action plan. The action planning section of the PLP consists of a dynamic two-way table which has the students' learning issues on one axis and their resources on another (see Figure 4). Each cell of the table represents a potential link between a learning issue and a resource. The links or associations students have made in the previous two sections of the PLP (searching and conceptual planning) are shown as coloured cells for students when they enter the action planning section. Different colours are used to represent the different phases and sections of the PLP where students have made associations between learning issues and resources (i.e. searching vs. planning, conceptual planning vs. action planning). Students can create or delete links by clicking on the cells of the table. They are also able to prioritise their learning issues and resources by reordering the rows and columns of the table. To assist with this process, students can review a snapshot of their conceptual plan and the summary information associated with each resource. By completing this process students are able to create a concrete guide for their study activities over the week.

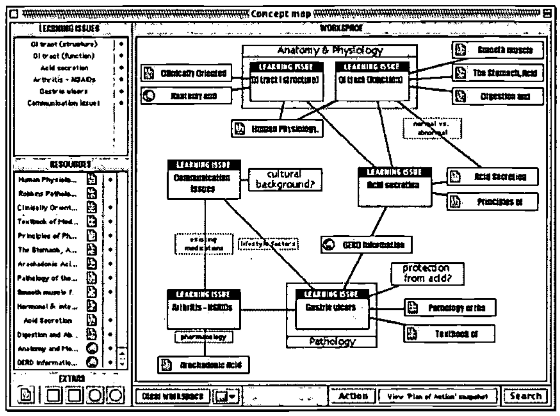

Figure 3: An example conceptual planning screen from the PLP.

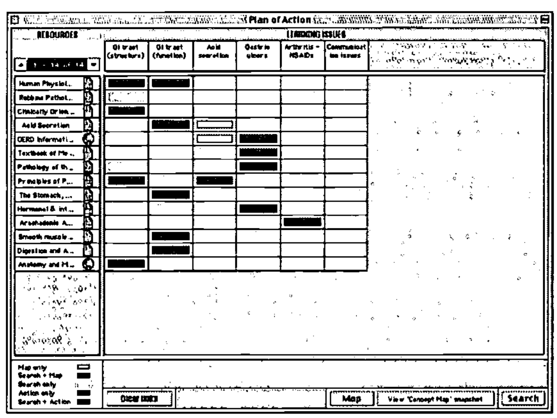

Figure 4: An example action planning screen from the PLP.

Resources and Profiles Databases

The prototype utilises a flat-file resources' database that is accessed locally. Each record in the database comprises (where appropriate) a title, author details, publication details, resource type (e.g. books, computer facilitated learning modules, web site etc.), keywords (for searching the database), and a short abstract. The database is scalable and records can be readily added or removed in response to changes or additions to the curriculum. The profiles' database, which is networked, stores a detailed history of students' searching and planning activities including their learning issues, keywords, selected resources, concept maps and action plans for each problem.

Conclusions and Future Directions

Extensive formative evaluations have been completed on the PLP prototype and these have been used to inform its ongoing development. However, several outstanding issues need to be addressed before the PLP is implemented within the new medical curriculum. The primary development issue at this stage is the functionality of the review phase. Records in the profiles database will form the basis of this phase's functionality and currently it is envisaged that students will be able to review their own learning issues, keywords and selected resources for each week of the curriculum and compare this to Faculty sanctioned learning objectives and resources. This should provide students with an opportunity to evaluate the degree to which they are covering the syllabus. In addition to this information, students will be provided with summary statistics of the learning issues, keywords and resources that their cohort identified to investigate each problem. It is hoped this will encourage students to review, evaluate and reflect on their own planning which is seen as a critical component of planning and problem solving behaviour (Polya, 1957; Lawson, 1991; Lawrence 1991).

It is envisaged that the PLP may also be applied in other curricula which incorporate inquiry based learning (case, problem or project based learning) and SDL. The database of resources would be the only major change in moving from one educational context to another, as resources would clearly need to be curriculum specific. In these educational contexts the PLP would support students in their SDL while allowing them the freedom and flexibility to maintain their learning independence.

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Flexible Audit Trailing in Interactive Courseware

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Abstract
This paper reports on the development and implementation of a flexible audit trail system comprising a library of auditing functions that can be embedded into interactive courseware and customised to the requirements of researchers and developers. It presents a case study involving the pilot implementation of the system within a piece of medical courseware. The results of this study demonstrate the general utility of evaluation based on audit trails. They also provided the courseware's developers with valuable information on how students used the courseware generally and, more specifically, on how they completed one particular interactive task.

Audit Trails: One Component of Electronic Evaluation

We are currently developing a system of electronic evaluation that addresses three distinct types of evaluation: (i) students' activities and movements within individual pieces of courseware (ii) students' use of and movements between pieces of courseware, and (iii) students' perceptions of pieces of courseware. The first of these components, based on audit trails, provides developers, evaluators and researchers in the area of educational technology with an invaluable mechanism to record and analyse students' activities within a variety of electronic environments. Misanchuk and Schwier (1992) define and ascribe four primary roles to audit trails:

- Formative evaluation of instructional design; that is, evaluation aimed at optimising the performance of a piece of courseware.
- Basic research in instructional design; for example, investigating how different users interact with a piece of courseware.
- Usage audits for unstructured or public environments; that is, determining which paths or components of a piece of courseware are most visited by users.
- Counselling and advising; that is, supporting the user's decision making within a piece of courseware.

With these four roles in mind we devised a series of essential criteria that we considered critical to the development of a robust, flexible audit trail system. The six criteria we established were:

- Flexibility - the system should be capable of fulfilling all of the roles of audit trails outlined by Misanchuk and Schwier (1992). It should be able to store a range of data types.
- Efficiency - the system should manage data efficiently. It should only record and deliver information specifically requested by the developer/researcher and any information collected should be clearly associated with a specific user action or activity.
- Scalability - the system should be capable of handling an unlimited number of records and of dynamically adding or deleting records.
- Portability - the system should adopt an architecture that can be implemented across a range of authoring environments/software.
- Retrospective compatibility – the system should be easily fitted to existing courseware.
- Ease of use - the system should be easily implemented and require minimal programming effort by developers/researchers.

The first two of these criteria are general and address the various roles of audit trails and the need to provide a robust yet flexible framework and to avoid indiscriminate data collection. The third and fourth criteria are essentially technical requirements that speak to the need to develop a robust yet generic audit trail system. The final two criteria are concerned with adoption and implementation; ensuring the system is both useful to and useable by the developer/researcher.

We subsequently designed an audit trail system that sought to address each of the above criteria. As most of the courseware produced within our unit is created using Macromedia Director® we elected to initially develop our system in and for that authoring environment. However, in keeping with our fourth design criteria – portability – we ensured that the system's architecture was structured in such a way so as to be readily adapted to a range of other scriptable multimedia authoring systems.

The resulting system is built around a library of functions that read and write individual records of user activities to a master record (the audit trail) within the target courseware. These functions interact with the other components of the system, which include client- and server-side administrative applications for transmitting and storing the audit trail data for later analysis. The library consists of a range of functions including timers, counters, item selection and data/text entry from which developers and researchers select according to their needs. Individual functions are attached to or associated with each of the objects to be audited within a piece of courseware and, when activated, these functions report to and dynamically update the audit trail record. The audit trail record can be exported at any time, although this process typically occurs when the user quits the courseware.

As a pilot test of the system, we embedded it into a piece of biomedical courseware called Medical Genetix. The remainder of this paper describes the structure and use of the Medical Genetix courseware, our implementation of the audit trail system within it, and the various findings that emerged from this implementation.

The Structure and Use of Medical Genetix

Medical Genetix is used by medical students at the University of Melbourne to investigate biomedical and clinical aspects of genetic disorders such as cystic fibrosis and thallasaemia. Specifically, it is used as a self-directed learning resource to support students' investigation of particular medical problems or 'problems of the week' (Keppell, Elliott, & Harris, 1998; Keppell, Kennedy & Harris, 2000). Medical Genetix is available for students' use in the faculty's main computer labs as well as in tutorial rooms.

Medical Genetix consists of a number of sections and levels that students can easily move between. For example, material on the disorder cystic fibrosis is divided into three primary sections: Clinical Diagnosis, Laboratory Diagnosis and, Counselling and Ethics. The Clinical Diagnosis section is further broken down into Clinical Features, Family Histories and Pedigrees, and Molecular Pathogenesis. Each of these subsections has a series of screens comprising content and interactive tasks that allow students to review material, perform construction tasks, test their knowledge and understanding, or access further information as they require (Metcalfe, Williamson & Bonollo, 1999).

Medical Genetix was made available to second-year medical students to support their investigation of a problem of the week on cystic fibrosis. In the Family Histories and Pedigrees section of the courseware, students can access an interactive task involving the construction of a pedigree on the basis of a supplied family history. The family history details the relationship between family members and their status with regard to the genetic disorder cystic fibrosis (that is, whether family members were carriers, a proband, or had the disorder). The interactive pedigree is completed by dragging "tiles" designating these various states into the correct position in the pedigree on the basis of the supplied family history. Six types of tiles are available for students to use and there are a total of twenty positions to be filled in the pedigree (see Figure 1). If a student places a tile correctly in the pedigree it remains in its position and the name of the individual is displayed whereas incorrectly placed tiles are rejected and returned to their original position.

Figure 1: The interactive pedigree task illustrating the six types of tiles and a partially completed pedigree.

We embedded a selection of audit trail functions into the Family Histories and Pedigrees section of the Medical Genetix courseware, placing particular emphasis on the interactive pedigree task. The audit included which screens within the section were visited and, for the interactive pedigree task, the amount of time students spent on the task, a detailed record of which tiles were dragged, where and in what sequence they were placed, and the number of times students consulted the history and help screens.

Results

A total of 78 students accessed Medical Genetix during the week it was designated as a resource for the medical curriculum. Of these, 49 entered the Family History and Pedigree section; indicating that 29 students bypassed this section altogether. Of those 49 students, 42 arrived at the interactive pedigree. Eight of the 42 students who arrived at the interactive pedigree did not attempt the task. The remaining 34 students, who attempted the task, form the basis of the analyses below.

Activity	Mean	Minimum	Maximum
Total time on interactive pedigree†	257.86^	162.30	576.40
Number of correct drags	15.62	11	20
Number of incorrect drags	5.91	1	13
Number of incomplete drags	.09	0	1
Total time on history†	125.46	37.50	322.00
Average time on each history†	8.63	3.39	22.95
Number of times accessed history	15.44	5	27
Total time on help	8.11	2.80	24.00
Average time on each help	7.58	2.80	24.00
Number of times accessed help	.21	0	2

†two cases of the 34 were not included in this analysis because of incomplete data.
^all times are recorded in seconds.

Table 1: Summary statistics of students' use of the Interactive Pedigree derived from audit trail data.

Summary statistics of students' activities while completing the interactive pedigree are presented in Table 1. On average, students spent around four and a half minutes on the task, made a little over fifteen correct tile placements and made around six mistakes while attempting the task. They spent a little over two minutes on the history screen and most accessed it regularly (over 85% of the sample accessed it more than ten times). However, students did not access the help screen regularly or for any great length of time. Eighty-two percent of students did not access the help at all.

We were particularly interested in determining how students were attempting the interactive pedigree task. As a result we focussed our attention on the number of correct and incorrect tile placements (or "drags") that students completed. Table 2 presents frequency counts and percentages of students' correct and incorrect drags. It can be seen from this table that all students completed over half the task (ie. completed over 10 drags correctly) but only one student successfully completed the entire task (ie. completed 20 drags correctly). The average number of tiles correctly placed before students left the task was between 15 and 16 and this seems to be a critical point in the task in terms of students interest or persistence (see Table 1).

Correct Drags	Freq	%
11	1	2.9
12	1	2.9
13	3	8.8
14	4	11.8
15	8	23.5
16	6	17.6
17	5	14.7
18	3	8.8
19	2	5.9
20	1	2.9
Total	34	100

Incorrect Drags	Freq	%
1	2	5.9
2	2	5.9
3	6	17.6
4	6	17.6
5	3	8.8
6	2	5.9
7	2	5.9
8	3	8.8
9	3	8.8
10	1	2.9
11	0	0
12	1	2.9
13	3	8.8
Total	34	100

Table 2: Number of correct and incorrect tile placements ("drags") made by students

The fact that only one student fully completed the interactive pedigree task raises questions as to why the students were not completing the entire exercise. Was the task too difficult or did the students simply lose interest? We attempted to address this question by considering the proportion of correct tile placements made by students. The number of correct tile placements made by students was divided by the total number of tiles placed by students (ie correct and incorrect drags). The results of this analysis (Table 3) reveal that students had a high degree of success with their tile placements with two thirds of students returning a 70% or better success rate.

Proportion of Correct Drags	Freq	%
< 50%	1	2.9
51 - 60%	3	8.8
61 – 70%	7	20.6
71 – 80%	11	32.4
81 – 90%	10	29.4
91 - 100%	2	5.9
Total	34	100

Table 3: Proportion of correct tile placements made by students.

In addition to overall success rate, we analysed the final three tiles placed by students in the pedigree (regardless of how many tiles they placed in total). By assessing whether students were leaving the task after correctly or incorrectly placing tiles we sought an indication of whether students were losing interest in the task or found the task too difficult. An analysis of the last three tile placements is presented in Table 4.

These results indicate the overwhelming majority of students were leaving the task after performing well. Not one student placed all of the last three tiles incorrectly and 26 (76.5%) students placed their last three tiles correctly. Only one student left the task with an incorrect final drag, indicating that 33 (97.1%) students left the task with a correct final drag. This suggests that it was not the difficulty of the task that prevented students from completing it. Rather, given that students were successfully progressing within the task, their failure to complete it suggests that after a certain time they lost interest or had understood the point of the exercise. Further assessment is required to test this hypothesis further.

Status of the last three tiles placed by students	Freq	%
0 of last 3 tiles correct (0/3)	0	0
1 of last 3 tiles correct (1/3)	1	2.9
2 of last 3 tiles correct (2/3)	7	20.6
3 of last 3 tiles correct (3/3)	26	76.5
Total	34	100

Table 4: Analysis of the last three tiles placed by students

Discussion and Conclusions

The results of this pilot study demonstrate the utility of audit trails for gathering evaluation data for the purposes of usage audits and formative evaluation of instructional design. Audit trails provided valuable information on the degree to which Medical Genetix was being used by students as a resource to investigate the problem of the week (78 of 184 students (42.4%) used the courseware over one week) as well as detailed information about which sections of the courseware were being. The audit trail system is clearly able to provide course coordinators with critical and accurate information about the integration of courseware into their curriculum. This is particularly pertinent in student-centred curricula such as the medical degree at the University of Melbourne, which emphasises self-directed learning. Common evaluation techniques, such as self-report questionnaires and observation, struggle to adequately gather information on the resources students use as part of their self-directed learning due to inherent variation in the times and locations that students access resources. Using the audit trail system we developed, data can be gathered easily while maintaining flexibility and freedom of student access.

The audit trail system was used to formatively evaluate a specific interactive task (an interactive pedigree), and provided useful descriptive information. For example, of those students who attempted the task, all relied heavily on the provided history to complete the task but there was substantial variation in both the amount of time individual students spent on the history and the number of times they accessed it. The fact that the majority of students (82.4%) did not access a task specific help screen suggests the task was intuitive and well designed.

Undoubtedly, the most interesting result from this component of the study was that all but one student failed to complete the interactive pedigree task. This, coupled with evidence that students were, in general, successfully progressing within the task indicates the task was not too difficult. There are a number of possible explanations for this finding. Students may have simply found the task too long and lost interest in the exercise. Alternatively, they may have understood the "point" or message of the exercise part way through the task, removing the incentive to complete it. It is also possible that students had completed the pedigree on a previous occasion when using Medical Genetix as a resource in a earlier problem of the week.

The findings with regards to the interactive pedigree have implications for the instructional design of Medical Genetix as well as interactive tasks more generally. They suggest that attention should be given to length of interactive tasks and whether they are able to sustain students' interest. This is especially relevant if students are directed to different parts of the courseware on the basis of whether they complete a task or not. While decisions about the instructional design of interactive tasks should always be made with the target audience in mind (students' previous experience and prior knowledge), it is clear that audit trail data can inform the design of these tasks.

The success of this pilot implementation of the audit trail system validates our development of a generic yet flexible method of creating audit trails. By restricting the amount of information gathered using the systems' inbuilt functions (see Judd & Kennedy, 2001) and by focussing on a specific interactive task, we were not overwhelmed by data and were able to gather meaningful and useful information. Care should be taken not to over-interpret the data garnered from audit trails and additional data collection techniques should be used in conjunction with audit data to assist in the analysis and interpretation of results. This not withstanding, the judicious implementation of the audit trail component of our electronic evaluation system clearly has the capacity to inform and assist both developers and evaluators. The two further roles of audit trails outlined by Misanchuk and Schwier (1992) (research in instructional design and counselling and advising) are also possible with the audit trail system we have developed (Judd & Kennedy, 2001) and will be investigated in subsequent implementations of the system.

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A Multimedia Business Simulation Game: Making Decisions That Count

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Abstract: Good communication in a business context requires a student to select the most appropriate mode of communication (e.g., email, meeting, telephone or fax) and construct an appropriate message. The student has to make decisions regarding content, style of communication, and when to use a particular mode—the student is then faced with the consequences of their actions. This paper presents an innovative approach to addressing these three issues in an interactive CD-Rom environment and preliminary formative evaluation undertaken as part of the development of the software.

Introduction

The Gippsland School of Computing and Information Technology (GSCIT) of Monash University offers a number of undergraduate computing subjects on campus and for distance learning students. One subject, Human Communications, is offered as a distance education subject to students within Australia and overseas. The students in both groups have difficulty learning the nuances of good business communication, particularly those students that do not have English as a first language. This paper discusses the development of an innovative approach to communication problems encountered by a business/computing student—how to decide what mode of communication is the most appropriate to use in a given situation (e.g., email, fax, call a meeting, telephone, memo or letter) and how to construct a message with the appropriate style and content. The result is the Multimedia Business Game, an interactive CD-Rom that engages students actively in the decision making process. The software is a simulated business environment, where students are required to develop a tender document for a company (Blue Sky). The use of simulated environments is well supported by the literature on constructivist models of teaching and learning (Hedberg & Harper, 1995). The design of the software relies upon the concept of situated learning to support educational design parameters. Games have also been advocated for the creation of more engaging, challenging, enjoyable and meaningful software for learning (Amory, Naicker, Vincent & Adams, 1998). Like most games, the business simulation has rewards and penalties.

Developing a more realistic context for the simulation

Three key issues were addressed by the developers. The first was the requirement for the simulation to behave in a realistic manner once students completed a communication task. For example, in the real world email messages cannot be retrieved, and success or failure to complete the task incurs rewards and penalties, respectively. Unlike many other examples of simulation software (cf., Jonassen, 1998; Phillips, 1997), the business game does not permit students to backtrack and change a message. The student is required to make a definitive decision at a series of decision points (nodes), and having made that decision accept the consequences. The software has only one path, with numerous decision nodes. Figure 1 [Fig. 1] provides a schematic of the design. The arrows represent a one way path for the student. While there are multiple paths, and multiple opportunities for message construction and feedback, once a task has been completed the student is committed to that decision. This is in contrast to many other computer facilitated learning (CFL) materials that facilitate a more flexible approach for students (Harper & Hedberg, 1997; Kennedy & McNaught, 1997; Wilson, 1997). The second requirement was to provide students with some understanding of the effect of message formality on communication outcomes. In the module, the student can construct formal and informal messages, or a mixture of both. Students are required to self-evaluate their perception of the formality of each message prior to sending it. Feedback on discrepancies between message formality and the user's estimation of formality (identified on a sliding bar) is presented immediately to allow the user to adjust their approach in subsequent selections. The third issue related to potential differences in communication styles between messages that passed internally within the fictitious company, and messages exchanged with external organisations.

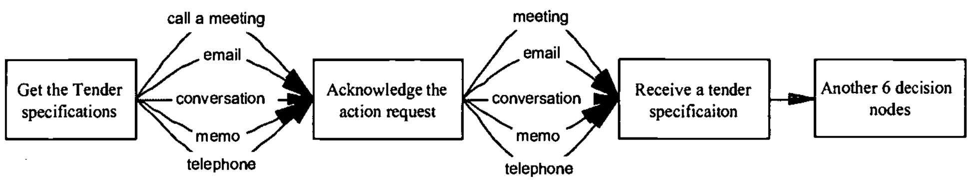

Figure 1: Outline of the decision nodes in the multimedia business game

Each message has an opening sentence, a middle component, and a conclusion and signoff. Once the message is constructed it is sent, and the student's choices are analysed in order to provide feedback. The score is then adjusted, either positively or negatively. All scores are cumulative and contribute to a final score for the module. In addition, students also incur time penalties (shown by a simulated calendar on a virtual desktop). For example, if a student decides to call a meeting as a starting point for the task instead of obtaining the tender documents first, two virtual days will be lost (the entire game requires 14 virtual days). At the conclusion of all eight nodes, students are informed of their overall success or failure to complete the task on time and with good communication decisions by a series of outcomes. For example, good decisions result in a company bonus, represented by a congratulatory message and virtual air tickets to a luxury travel destination.

Formative evaluation

Formative evaluation has been undertaken using a prototype of the first node as part of the design and development process. Five students with prior experience in the subject were observed using the software, and completed a questionnaire with both open and closed questions. A peer review process was also undertaken. The results indicate that the students find the software more engaging and more interesting than the conventional study materials. The formative evaluation has modified the interface, and refined the feedback mechanism.

Conclusions

The programming of the business simulation game is currently in the process of being completed. The formative evaluation has provided information that guided the final form of the software. It is expected that the software will be completed by June 2001.

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Coaching Medical Academics in Multimedia and On-line Teaching and Learning Principles

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Abstract: The following paper addresses the implementation of a professional development program in the Faculty of Medicine, Dentistry and Health Sciences at the University of Melbourne. It examines the rationale, approach, evaluation and implications of this training and its effect in transforming traditional academic ideas about teaching and learning. A systems-based approach enhances teaching and learning by utilising the most appropriate and relevant methods as opposed to advocating multimedia and on-line learning as a panacea for higher education.

Medical Course

The medical course at the University of Melbourne incorporates elements of Problem-Based Learning (PBL) and Self-Directed Learning (SDL). The use of Information Technology (IT) is an important feature of the new curriculum. TopClass is utilised to deliver the web-based medical content and multimedia stand-alone modules have been designed and developed to complement clinical cases. This paper will not address the nature of the curricular change and the utilisation of IT for the medical course. This has been examined elsewhere and details are provided in (Keppell, Elliott, & Harris, 1998; Keppell, Kennedy, Harris, 2000). However, with this change there is a need for academics to become familiar with the possibilities of new media for teaching and learning purposes. Medical academics need to see the relevance, viability and usefulness of new media. As part of an initiative to assist in addressing these issues the position of Multimedia Training Coordinator was developed.

Professional Development Approach

The task of addressing multimedia training in the Faculty of Medicine, Dentistry and Health Sciences began by defining "multimedia training" in order to determine "what it means to be trained in multimedia". For the purposes of creating a common definition, multimedia refers to highly interactive CD-ROM or web-based educational modules that utilise varying levels of text, graphics, photographs, video, animations, audio and discussion groups. The purpose of the multimedia module is to complement other forms of teaching and learning strategies. Multimedia should engage the learner and provide interactivity and innovation that generally cannot be created in any other format (eg. lecture, tutorials, print, video, etc). Training refers to both informal and formal instruction. Informal instruction includes coaching of grant writers and grant holders on an "as needed basis" and 'showcases' of projects. Formal instruction includes the Level 1 and 2 Workshops and the TopClass Tutorial.

The aim of the training model is to provide a flexible and responsive approach to academic staff. The approach considers the level of multimedia experience, available time and purpose as different academics require different approaches. For example, an annual symposium provides a forum for sharing ideas within the Faculty. It focuses on discussion about the 'story' behind the design and development of the project so that other staff can learn from these experiences. Informal training occurs through a consultative basis with staff within the Biomedical Multimedia Unit (BMU) http://www.medfac.unimelb.edu.au/bmu/ who provide advice and guidance in curriculum and learning theory, instructional design, graphic design, software and hardware, evaluation and project management. The BMU provide consultative advice at the pre-grant, project and post-project phases. The formal aspects of the multimedia training model centre on three workshops. The main theme throughout all the workshops is that academic staff should focus on their strength (content expertise) and complement this strength with designers and developers (instructional designers, graphic designers, multimedia developers, programmers, evaluators, project managers, videographers, photographers).

The aim of the Level 1: 2 hour Familiarisation workshop is to provide an overview of multimedia. The workshop focuses on: What is multimedia? Why use multimedia? When is multimedia useful? How is multimedia produced? As an academic what is my role in multimedia design and development? The target audience for this workshop are academic staff who want to know "about" multimedia rather than the specifics of how to design and develop a multimedia project. The aim of the Level 2: 16 hour workshop is to provide a comprehensive design and development workshop addressing curriculum, instructional design, graphic design, authoring, project management and evaluation. This workshop aims to empower the participant with the ability to create a quality educational multimedia module (of limited size) in conjunction with a design and development team.

Evaluation

Five academics participated in the initial design and development workshop in 1999. They were a blend of academics who had received priming grants which allowed them to undertake a modest project or proof of concept in conjunction with the BMU. The participants were asked to rate each of the topics/sessions on a five point likert scale in terms of 'interest' and 'usefulness'. They were also asked to rate project management, curriculum and learning theory, instructional design, graphic design, software and hardware and evaluation on the same scale. Of top interest was graphic design followed by project management, instructional design, evaluation, software and hardware and then curriculum and learning theory. Of top usefulness was evaluation, followed by project management, instructional design and graphic design, software and hardware and then curriculum and learning theory.

Implications

This paper has discussed a professional development program for multimedia and on-line learning. The approach focuses on blending informal and formal methods which is responsive to the needs of the academics within the Faculty. 2000 has seen further work in assisting some fifteen grant writers; the coaching of thirty academics currently involved in projects and the teaching of the level 2 workshop for 10 academics. The level 1 workshop has been undertaken with approximately 30 academics. A CD-ROM for the level 1 workshop is also being developed. The response to the training approach has been positive with other schools outside the faculty enlisting our services in multimedia training. Further work is continuing to refine the training approach.

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TeleQACE: A Dynamic Web-based Knowledge Network of Health Professionals

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Abstract: TeleQACE (Quality Assurance and Continuing Education) is a web-based learning environment that allows medical general practitioners (GPs) to participate in interactive learning at times that suit them. The design addresses the balance between richness of content and bandwidth to reach geographically dispersed regions. The guiding philosophy is shared knowledge and interaction based around actual experience and cases developed by practising academic GPs in consultation with specialists. This paper examines the educational rationale and the design and development of this module.

Educational Rationale

Real-world learning experiences, often called authentic learning experiences, are "those which are problem- or case-based, that immerse the learner in the situation requiring him or her to acquire skills or knowledge in order to solve the problem or manipulate the situation" (Jonassen, Mayes, & McAleese, 1993, p.235). The context of the actual learning situation and the goals of learning can influence the acquisition of conceptual knowledge and the ability of the learner to apply this knowledge. In fact, "the potential usefulness of knowledge is a function of the congruency between the conditions of knowledge acquisition and the conditions of knowledge application" (Koschmann, Kelson, Feltovich & Barrows, 1996, p.92). Authentic learning situations attempt to emphasize this congruency by utilizing real-world problems in their learning context. Situated cognition suggests that learning should be "organized around real world problems in order to induce orientations to learning that are congruent with subsequent knowledge use" (Koschmann, Kelson, Feltovich & Barrows, 1996, p.93; Brown, Collins, & Duguid, 1989). The TeleQACE modules attempt to apply authentic learning principles by examining real-world problems in anaesthetics, gynaecology and snakebite.

Critical reflection is a central approach which is utilised by the GP in their day to day work. Reflection is a metacognitive activity, which refers to a process that involves thinking about thinking. Boud, Keogh & Walker (1985) define reflection as a "generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and applications" (p.19). Schon (1983) suggested that there are two types of reflective practice. He referred to these as reflection IN action and reflection ON action. Reflection in action refers to "thinking on one's feet" or during the event. Expert reflective practitioners generally have the ability to adjust their thinking during the event to solve a professional problem. Reflection *on* practice involves "turning back thought" on learning or professional practice (Boud, Keogh & Walker, 1985). The TeleQACE modules encourage practitioners to reflect on their own professional practice and share this knowledge in online discussion groups.

Design and Development

The TeleQACE modules http://www.medfac.unimelb.edu.au/teleQACE provide an opportunity for clinicians to share professional information in a secure virtual environment which should assist in reinforcing best practice during episodes of patient care. The aims of the program are to provide an internet site for supporting rural General Practitioners to enhance quality health care. In particular we have developed a learning framework suitable for providing access to health information, continuing educational programs and communication with other health professionals. Rural GPs are provided with practical and relevant information that is useful for the practising GP in rural and remote areas. The primary means of achieving these aims focuses on collaborative discussion groups which allow rural GPs to discuss crisis management and specific events with other geographically dispersed GPs.

As a web-based learning environment TeleQACE allows GPs to participate in interactive learning at times that suit them. A basic case elicits knowledge gaps and suggestions from participants, which are shared through on-line discussion. This discussion guides the construction or development of the 'basic case' into its 'advanced' equivalent. This 'advanced case' is re-presented to the participants, accompanied by relevant reference material, for reflection and interaction. Finally, the outcomes of this process are consolidated, packaged as a 'model case' and archived for ongoing reference by the group. Participation in each module will be an extended and deep learning experience. The initial modules have a rural focus and include snakebite, gynaecology, and anaesthetics. These were selected as a result of the needs expressed by rural clinicians.

The snake bite module allows the participant to reinforce understanding of the signs and symptoms of evenomation and a systematic approach to the initial and ongoing treatment of snakebites. The use of antivenenes and monitoring are emphasised in the management. The gynaecology module allows the participant to reinforce understanding of the diagnosis and management of gynaecological (pelvic and abdominal) pain. The base case leads the participant through history, assessment and management of a common, but difficult clinical scenario. The anaesthetics module allows the participant to interact with it to reinforce understanding of monitoring and troubleshooting in general anaesthesia. It presents participants with a non-specific, but potentially serious scenario and leads them through the decision-making processes necessary to manage the problem.

Conclusion

The gynaecology module is currently being trialled with eighty GPs recruited from across Australia. An evaluation is being undertaken on all aspects of the module which will inform the design and development of subsequent modules. Future modules include obstetrics, aged care, prostate problems and complex cardiovascular problems.

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xClass - Extensible Virtual Classroom: Mobile communication possibilities in teaching

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Abstract: This paper describes a project, which aim is to develop and test different types of mobile (and some wired) learning environment solutions. In this project, the learning environment is seen as a technology based extension of classroom, where technology makes different types of communications possible. Learning itself is done by human to human –communication. Some parts of solutions are separately in use, but the whole system would be under testing in spring 2001. First test results would be published during year 2001. This kind of classroom extension may contain some additional value to learning process or motivation.

Introduction

At the Pori School of Technology and Economics (Finland) started a research and development project about wireless communication's capabilities in elementary education. The starting points of the study are the following:
1) Wirelessness. Like WWW, also WAP is studied as one piece of learning environments. However, the WAP - techniques are still quite undeveloped and they cannot yet be fully utilized. Also, the costs of data transfer are still quite high. The disadvantages of wireless PC-techniques include the quite limited operational range and the fairly large size of the mobile computers. However, the costs of data transfer are minor and the performances of the devices can be adjusted to sufficient level for the requirements of a learning environment.
2) Teaching/instruction. As a starting point for instruction is the use of wireless communication in situations where some additional value is to be achieved from it to the teaching. The technology is not used just for itself (technological imperative), but it is tried to be used to support problem-based and/or cooperative learning. (Hakkarainen, Lonka & Lipponen, 1999).
3) Communication. In this study communication is restricted to interpersonal communication. Thus, technology is regarded only as a tool with which a mobile learning environment applying to and effectively maintaining social knowledge construction is made possible. (Bereiter & Scardamalia, 1993; Bereiter, 1999).
The purpose of the learning environment of this study is to emphasize Vygotsky's idea about children learning from each others. A portable mobile learning environment makes possible many different forms of communication with which the children can discuss learning problems or tasks even without seeing each others.

The communication may be delivered for instance as traditional phone calls, image calls, literal text -messages, on-line chat boards or off-line message boards. All these forms can be carried out between two or more partners. It is also possible to arrange for each learner a personal working area where the others can send messages and the learner can respond to them in a way he/she prefers. The traditional teacher -centered instruction is also possible in the mobile learning environment of this study, but it is assumed that the learning will be self-directed to social inter-studential knowledge construction.

Technical background

The xClass server software is now in develop process. Some parts of it are separately in use and the whole system would be ready in spring 2001. is scaleable so, that different types of terminals (work stations) can have access to information delivered by server. Possible types of terminals are LAN –workstations, wireless LAN –workstations (laptops), WAP –phones, PDA –terminals and mobilephone integrated WWW-terminals. The server software finds out, which type of terminal are in use, and communicates with terminal by required language. All data, stored in server is meta-data labelled, and so there is only one type of stored documents which is translated into requested form.

In spring 2001 the main researc field is in GPRS –network usage because its accessibility, though WLAN –networks in school use would be more cost effective. WLAN –network is also under research, but because the limited range of WLAN it is not examined as an all around solution in wireless learning systems.

Visions

The xClass shoud give added value for example problem-based learning exercises. Often, when complex exercises are done outside the classroom, teachers work becomes quite hard: the teacher must instruct and control every pupil, but when pupils are around the schoolyard, it comes almost impossible. Also, when doing outclass exercises, the need of instructions arises heavily. Often for having advises children have to run after the teacher or the teacher have to run after children to control them. It is also common, that completed exercises don't reach the aims of the planned exercise because of the lack of the instruction.

With succh technological environment, teacher need no more use time to find pupils. Teacher can just connect pupils with their environment tool - a PC, mobile or PDA – and give instructions by text, speech or video interface. Pupils can also contact other pupils, which are doing the same exercise, and get advices from them. In such case the environment supports Vygotsky's social learning theories. There are also a group mangement point of view: If there is a connection between the server and the workstation, the teacher knows, that pupil (or at least the machine) is in the schoolyard. In the future the location services can be added to xClass. Before that, the line between guidance and control must be well discussed.

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Interaction and learning: Learning results in multimedia geometry -game

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Abstract: The aim of this study was to develop learning materials with computer supported user observation. The results of this study showed a clear connection between the usage of the learning material and the learning results. Those most explanative variables were 1) time between two user events, named as interaction. 2) Relative error, which was calculated by dividing the number of incorrect answers by the total number of events. According to these results, fast interaction with few mistakes achieves no learning effect, because of too easy learning material. On the other hand, when interaction is very slow and there are lots of mistakes, the learning material seems to be too difficult. In generally the learning material should be difficult enough to effect thinking. Thinking could be achieved either as a inner process, when interaction between material was slow, or with fast interaction, when amount of mistakes increases.

Introduction

According to constructivism, people construct their own knowledge. This means that construction process is active in the nature and students' understanding is tied up with his or her previous experience. Thus, learning is a constructive process, where students actively construct their knowledge through interaction with the environment and through reorganization of their mental structures (Chi & Bassok, 1989). The learners are builders of knowledge structures rather than the recorders of information (Mayer, 1992). The high level of student's activity in comparison with traditional learning situation is the main argument for the using information technology in education. Multimedia, which is based on learning theory (Moreno & Mayer, 1999), computer quid building environments like LEGO/Logo (Resnick, 1996) and intra- or internet based social knowledge building computer tools like CSILE (Bereiter & Scardamalia, 1993), are all examples of good attempts to increase the quality of students learning. From the constructive point of view, the interaction between computer and user is the most important issue in computer supported learning materials.

Www gives also promises to be very rich environment for educational research, many powerful data collection algorithms can easily be added to www -based learning materials. In this study, the data about interaction and mistakes was collected with such data collecting algorithm (Ketamo & Suomala, 2000)

Research questions and method

Research contains three groups of six years old children: experiment group 1 (n=21), experiment group 2 (n=20) and control group (n=30). All groups were pre- and post tested considering their geometric skills. Measures of the study are done during April 2000.

Two different www -based learning materials about geometry, polygons exactly, were written for this study. These learning materials contain sections with active input and also sections with passive input. Experiment group 1 got learning effect with learning material that requires active input. Experiment group 2 got learning effect with learning material that requires both, active and passive input. The control group did not get any educational effect.

The research questions of the study can be summarized as follows: 1) What kind of general learning results has been achieved? 2) What kind of differences, in use of different learning materials, between children with good geometric skills, average geometric skills and poor geometric skills can be found? 3) Can learning results be explained by use of the learning material?

Results

When considering the learning effect of testing within the control group through different skill groups, we can find an interesting difference. The average skilled pupils in geometry have learned most from the test (improvement ~10%). Low skilled pupils have learned a little less from the testing than average skilled (improvement ~7,5%). High skilled pupils has learned from the testing only about a half that the other groups (improvement ~4,5%).

Because the strong learning effect of testing, it is more interesting to focus on the real learning effects of the learning materials. Real learning effect can be estimated by subtracting the learning effect of the test from the improvement percents, differently in each skill group.

Only low skilled pupils have had real learning results from the learning materials (table 1). When considering experiment group 1 we ca find a statistically significant difference in real learning results between low skilled pupils and high skilled pupils ($t=2,215$ $p=0,044$). Because results in both experiment groups are quite like the same, we consider added experiment groups in different skill groups. With this combination we can see, that there are statistically significant differences between low skilled and average skilled groups (t =2,090 p=0,042) and between low skilled and high skilled groups (t=3,028369 p=0,005). According to this result, we can say, that low skilled pupils have had significantly more benefit from these learning materials than other groups.

Test group	Skill group	real learning effect %
experiment group 1	low / average / high skilled pupils	11,4 / 2,1 / -1,3
experiment group 2	low / average / high skilled pupils	11,5 / 0,3 / -3,9
exp 1 + exp 2 (added)	low / average / high skilled pupils	11,4 / 1,2 / -2,4

Table 1. Improvement percents and real learning effect in experiment groups.

Interaction in different skill groups within use of different learning materials differs significantly (table 2/top). In experiment group 1. The interaction in low skilled group was significantly slower than in average skilled (p=0,030) or high skilled group (p = 0,048). In experiment group 2 the situation is opposite. The low skilled group uses little faster interaction in learning material use than the other groups, but there are no statistical significant differences between groups.

	interaction (s/event) in exp. 1	interaction (s/event) in exp. 2
low / average / high skilled pupils	14,1 / 9,7 / 9,3	5,9 / 9,4 / 7,8
	mistake % in exp. 1	mistake % in exp. 2
low / average / high skilled pupils	8,7 / 8,9 / 7,6	18,1 / 8,4 / 7,7

Table 2. Mistake percents in different skill groups.

In the bottom of table 2 the mistake percents are considered in different skill groups. In experiment group 1 all skill groups have done approximately as much mistakes. In experiment group 2 the low skilled pupils have done much more mistakes than other groups. Although there seems to be quite a difference, the variance in single cases was so big that no statistical significant difference can be found.

Conclusions

Combination of these result seems to be interesting: Only the low skilled group have had real leaning effect from the learning materials, which alone is not a surprise according to former studies. The surprise is in use of the learning materials. When low skilled pupils in experiment group 1 have had a longer interactions, but as much mistakes than others in experiment group 1, the low skilled in experiment group 2 used faster interaction and make much more mistakes than others in experiment group 2. After all, average skill and high skill pupils did not get real learning effect from the learning material, but they used material approximately like same, not depending on learning material in any way.

Those average and high skilled group in both experiment groups gives us a good viewpoint to learning effect: In experiment group 1, where the learning material was requiring active input, the learners was forced to think if they did not want to make mistakes. It seems that they were thinking more than others, because interaction was slower, but there were no more mistakes than others. In experiment group 2 learners was first used just clicking the elements and that style continues through whole game. This naturally affects more rethinking of the incorrect answers. In generally, it seems that for learning it is not important how the thinking effect is achieved, most important is that material is so difficult that it requires thinking. For the average and high skilled pupils of this study, the learning material does not offer challenges, so it does not work.

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NESTOR-Integrated Tools for Active Navigation and Constructive Learning

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In order to involve learners in the meaningful cognitive processing of the delivered information, we need cognitive tools such as knowledge- based navigational aids. We present NESTOR Navigator, a graphical web browser, which allows constructive navigation with the help of a visual map and supports collaborative learning. NESTOR's approach is to provide an interactive environment where users construct themselves their knowledge. One of the main objectives of NESTOR, beyond engaging learners in constructive browsing, is to support the asynchronous and synchronous exchange of browsing experience among a group of learners.

DO WE HAVE A CASE FOR NOTEBOOK COMPUTING?

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Abstract: A vision for learning...

A DAY IN THE LIFE OF A 16-YEAR OLD
Woke up this morning at about 11am. After a quick wash, I logged onto to my personal webportal. A pop-up box reminded me that I've completed downloading my fav MP3 clips... and a few video clips which I need for a project presentation for Mr Wong's class. My online calendar reminded me of the appointment with Peter and the guys at 12pm at Starbucks. We need to discuss our group's project assignment. Mrs Chew needs us to hand in a proposal by tomorrow. Did a quick check to see if I had any emails. A few. Not too important ones. Except for one from Dr Pawas asking me to send him the link of a new really cool e-comm website which I discovered yesterday. Did a quick reply to the email. OK, done. Now I'm ready to meet the guys... no need for any notes or books... just need my notebook. And mobile... hmm.... take my advice... don't leave home without them...

A DAY IN THE LIFE OF A 40-SOMETHING-YEAR OLD
Sent the kids off to school and I'm back home. It's 8am. A cup of hot coffee in one hand, the other on my trusty notebook. Let's check the news... hmm...this looks interesting. Let me send the link to Wong... it should be useful for what he's teaching. OK, let's check online calendar and email. Right, 10am meeting with Jerry's group at Coffee Club to discuss some problems they're having... 2pm meeting faculty visitors from Indonesia in campus... 4pm meeting with faculty staff to discuss new open book exam regulations... that reminds me, it'll probably be helpful to check what others have done on this issue... OK... search ERIC... open book exams... Right, let's save these articles and get them printed out later... Hmm...there's some time left before the 10am meeting. Let's check the discussion forum on the course which I'm facilitating... well... looks like the kids are really getting into the debate. OK, but let's try and get them to focus on the real issue... let me post this message on the forum. OK, that's done. Now let's check on the web development course I've enrolled in...

These scenarios are not quite science fiction. They are becoming a reality for more and more people. Formal education is happening outside the confines of the physical classroom. Computers and in particular, the Internet have created new learning scenarios for both the student as well as the teacher. Portable computers and mobile devices that are connected to each other through network and telecommunication technologies have created yet another set of scenarios. These blur the lines between home, classroom/campus and external community. They also blur the line between work/study and play. The availability of information at the fingertips and on demand as well as communication channels which are open 24 hours a day is making lifelong learning less a rhetoric and more a reality.

One of the paradigm shifts from old to new economy is from perfecting the known to imperfectly seizing the unknown (Productivity Digest, 2000). It was with this in mind that NgeeAnn Polytechnic embarked on an initiative to equip all students with notebook computers operating in a network-enabled campus environment. This is termed the Mobile Computing (MC) Initiative. This paper will present three key arguments based on the Access-Cost-Quality model to support this initiative.

Background

NgeeAnn Polytechnic first introduced the use of notebook computers in early 1997. A pilot group was formed to test out this initiative. The survey results indicated that students favoured the use of this approach despite the initial technical problems which they had to contend with. Students' responses strongly indicated that the use of notebook computers encouraged independent learning and facilitated communication.

On the external front, the pressure for schools to adopt the use of technology was evident. Computer literacy was seen as a critical skill set to prepare students for the new digital economy. The government had prepared an IT masterplan which served as a blueprint for the implementation of IT infrastructure and initiatives to "create new national competitive advantages and enhance the quality of life in Singapore". Education was key to ensure the realisation of this goal to develop the nation state into an intelligent island (IT2000 Report, 1992). Subsequently the government formulated the IT2000 and Infocomm 21 Masterplan.

In 1999, NgeeAnn announced that it would equip all its first year students with notebook computers by 2005. There would be a phased implementation of this initiative starting with the first batch of 450 first year students from the Accountancy Department. At the same time, the institution had begun installing network points in classrooms and canteens. In July 1999, wireless access points were installed at the Library and other public access areas in campus. Thus, mobility afforded through wireless technology became a key element of the MC Initiative.

Why Mobile Computing?

Sir John Daniel, Vice Chancellor of the UK Open University, in his keynote address at the TechEd99 convention referred to the "eternal triangle" of forces and tensions affecting educational institutions (Refer Figure 1. Daniel, 2000). Cost, access and quality are forces which appear to pull institutions in different ways. The introduction of technology has amplified this tension. Cost is a major consideration for any institution wanting to implement its technology plans. Not only do institutions need to plan for an initial up-front capital cost investment, it needs to also consider the recurrent cost components as well. Technology appears to provide greater access to learning opportunities for the masses. Seen from the perspective of the digital divide, the gap between the haves and have-nots, however, it appears to limit real access to those who are in control of the technology. Quality, as seen from the perspective of technology enhancing learning effectiveness, has always been a topic of debate amongst educators – does technology improve students' learning?

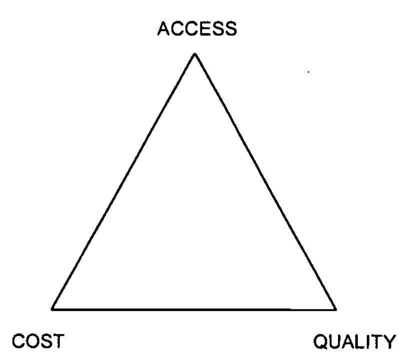

Figure 1: Cost-Access-Quality Triangle

There are three arguments to consider when planning for a mobile computing initiative. These relate to the three factors of cost, access and quality. The assumption is that the adoption of technology in education is a given. The question is what form should the technology take? Do we have a case for notebook computing?

1. The Cost Argument

Consider the conventional model used by most educational institutions where computers are purchased and set up in laboratories for student usage. Cost is borne entirely by the institution. This includes purchase of software, network cabling and equipment, and furnishing. Rooms need to be dedicated as computer laboratories. Technicians need to be hired to maintain the systems. Administrators need to be employed to manage the booking procedures. After the normal school hours, the computer systems are left unused. If required to work after the laboratories are closed, some students would have their own computers to work from home.

Now consider the model where students own their portable computers. They can use them at home and they can bring them to school when required. They purchase their own software which they maintain themselves. They are taught to take care of their own computer systems. The cost to the institution is thus limited to the provision of network infrastructure in campus and if need be, to provide for dial-in utilities and services from outside of campus for students to access the campus network facilities.

In this regard there are substantial savings for the institution. One may argue however, that this cost has merely been passed on to the student. The issue becomes one of perceived value to the student (and to his/her parents who sponsors the investment) as well as one of affordability for those who genuinely cannot afford the associated costs. The issue of perceived value is related to the next two arguments on access and quality. The issue of affordability can be addressed through financial assistance schemes.

2. The Access Argument

In the conventional model, there is always limited access for student usage unless there is a one to one ratio of computer to student, as in the case of the MC model. Personal ownership and mobility of the computer equipment makes learning anytime, anywhere (using the computer) possible. In a computer laboratory, rules and regulations exist to control what the student can do and what he/she can access. This is not the case when the student owns his/her own notebook computer. Every classroom can become an instant computer laboratory when students with notebooks gather together. Public spaces in the campus become spaces for students to use their computers to work or to play. One may argue that students could be spending more time playing than doing serious work with their computers. But does it matter? From the point of view of measurement of utility of any hardware as an investment indicator, then one argues that it is better that the equipment is being used than not at all. A more important outcome of students using the computer more frequently is that they become increasingly computer literate – the very skill set which we want our students to have in order to compete in the digital economy.

Personal ownership is a very powerful learning motivator. Consider the growth of the internet when internet became accessible to the masses and browsers became something which users own and can customise. Consider the growth in the popularity of software language when the coding was made freely accessible for programmers to use. Consider the increase in use of mobile phones (or handphones) when the device became a personal asset item. The value of a student owning his/her own computer allows the change in lifestyle which now assimilates the use of the technology and making it increasingly ubiquitous in nature.

3. The Quality Argument

Does technology improve students' learning? Many educators have debated this. Arguments and counter-arguments abound between staff from the pro-technology camp and the "traditionalists" who quote the many research papers which point to a "no significant difference" phenomenon in comparing the use of technology against conventional classroom teaching approaches (Russell, 1999). The argument perhaps is less about the adoption of technology per se but *how* the technology is being used to advance students' learning. The constructivist approach to learning has gained significant acceptance amongst educators who favour this approach to teaching over traditional instructivist approaches. Reeves in describing the role of technology as a continuum between "surrogate instructor" at one end and "cognitive tool" at the other, advocated the use of technology as a cognitive tool when used in a constructivist manner (Reeves, 1999). Biggs contrasted between two teaching strategies, one, on what the student does and the other, on what the teacher does and proposed that the former is more effective for learning than the latter (Biggs, 1999). He quoted from Shuell:

> It is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does.

It is argued therefore that because students own their computers, there are greater opportunities and reasons for teachers to design learning activities that require their students to use the computers to construct their learning. And because students have access to their own computers and have personal ownership over them, there are greater opportunities for them to create their own learning outside of teacher-driven activities.

Conclusion

Since the MC Initiative was launched, many concerns were voiced by faculty particularly in areas related to teaching and learning. Changes had to be made not only to classroom management and practice but also curriculum design. These concerns provided opportunities for management staff and faculty to rationalise the benefits of the initiative. Healthy skepticism serves to moderate unreasonable assumptions associated with use of technology. Technology is afterall merely a tool. It is what we make of it that will determine its value for our stakeholders. Through the MC Initiative, our students have become an active investment partner in the use of technology to advance learning. So, what do you think? Do we have a case for notebook computing?

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Virtual Reality Simulations in Physics Education

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Abstract: A virtual reality physics simulation (VRPS) is educational system using virtual reality interface, which brings together a 3D model of some real apparatus and a virtual visualization of some physical situations with interactive manner. VRPS enhances students' understanding by providing a degree of reality unattainable in traditional two-dimensional interface, and supports the creation of sensory rich interactive learning environments. In this paper, we will present the recent development of a computer-based virtual reality simulation, which will permit students to learn physics concepts such as wave propagation, ray optics, relative velocity, electric machines, etc. in the level of high school physics or college.

Introduction

Virtual reality(VR) technology may offer strong benefits in science education not only by facilitation of constructivist learning activities but also by the potential to provide alternative forms of learning that can support different types of learners such as visually oriented learners. VR, a new communication medium, is usually identified by a collection of technological hardware including computers, head-mounted display(HMD), eye phones, and motion-sensing data gloves. Virtual reality is defined as a highly interactive, computer-based, multimedia environment in which the user becomes the participant with computer generated virtual world. A key feature of VR is real-time interactivity in that the computer is able to detect user inputs and instantaneously feed back to modify the virtual world. VR world can also be used to circumvent the physical, safety, and cost constraints that limit schools in the environments of learning-by-doing they cannot provide. For example, it would be impractical to allow students studying nuclear physics to go into the nuclear reactor unless VR program provides the 3D reactor with HMD and data gloves. This type of activity can be performed in a virtual world.

Distance learning is now popularized in recent years because of fast development of computer system and spreading Internet connectivity. One of major restriction in the science and engineering education for distance learners is difficulty of laboratory activities. An alternative way to overcome such difficulty is using the simulation programs running on Web browser instead of hands-on experiments. But, most of such programs are displayed in 2D which is lack of reality.

The virtual reality simulation program is one of solution for hand-on experimentation with full of reality. Furthermore, physical phenomena, which are neither easy to perceive nor to be measured in usual experiments, can be scientifically visualized in a virtual world and can be viewed in many different ways traveling over VR laboratory. In addition, the dangerous experiments, high cost experiments, and complicated experiments can be realized in VR system for distance learners.

In this paper, we will present the recent development of a computer-based virtual reality simulation, which will permit students to learn physics concepts such as wave propagation, ray optics, relative velocity, and electric machines, etc. in the level of high school physics or college. Development of the simulation programs involves following steps; instructional design, 3D modeling, experimental set up constructed by 3D objects, keys to control, and 3D animation control program for visualization of the 3D model.

VR simulation programs in physics education

We have used the 3D Webmaster software for authoring VRPS programs. 3D Webmaster is one of powerful windows application for creating interactive 3D Web Page. 3D Webmaster is the browser platform that lets you display, move around, and interact with worlds that you creating virtual world. It lets you adjust viewpoints, display options, and device configurations, to add the final touches to your world. The worlds you create can be displayed on the fully interactive environments in 2D HTML pages. You can add URLs to objects so that you can link directly from your virtual world to any other 2D or 3D page on the WWW, or interaction between the world and your HTML. In order to create realistic worlds you can use script language (Supercape Control Language, SCL) to control behaviors to objects in the world, perform complex actions, and modify your worlds based on user's actions in your HTML documents.

The VRPS sample programs developed in this study are described below.

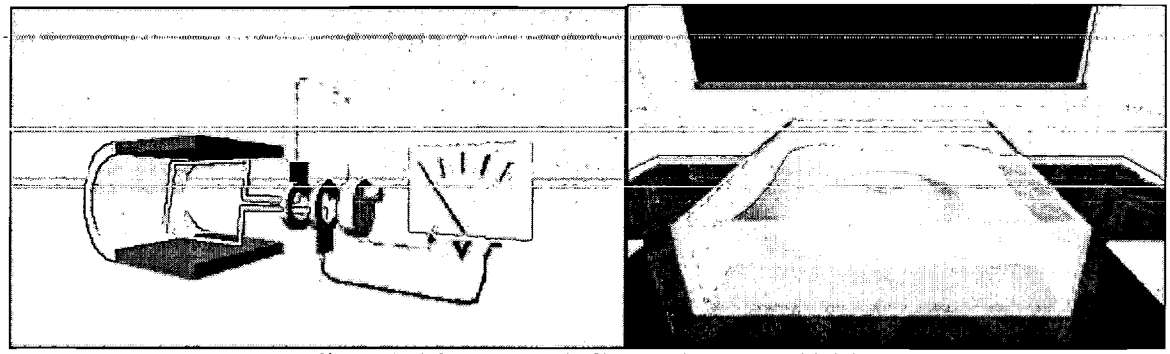

Figure 1. AC generator (left) and Water wave (right)

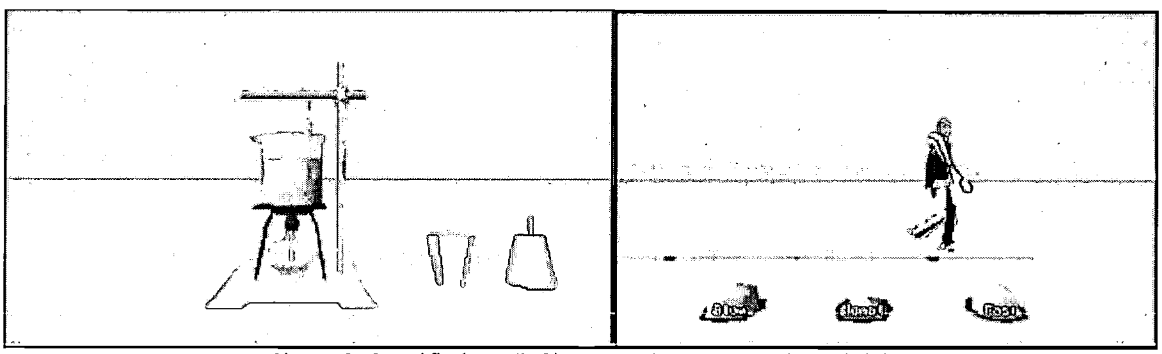

Figure 2. Specific heat (left) and Action and reaction (right)

Figure 1 shows the principle of AC generator where student navigates and controls the generator by dragging and clicking the mouse, and the propagation of water wave. Figure 2 shows the experiment of specific heat where student learns by doing step by step, and experience of action and reaction where student walks virtually on a thick board located in frictionless floor. We have developed many other VRPS program such as wave propagation, ray optics, relative velocity, electric machines, etc. in the level of high school physics or college.

Conclusions

There is a need to develop new VRPS programs for distance education as well as regular class room. The VRPS program is useful for teaching materials as a hand-on experimentation with full of reality, visualization of invisible physical quantities, replacement of dangerous, high cost, and complicated experiments.

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OMETZ: Virtual Learnig Civil Community

Booki Kimchi, Center for Educational Technology(CET), Israel; Irit Lifshitz, Center for Educational Technology(CET), Israel

The OMETZ program came about as a result of cooperation between the Movement for the Quality of Government in Israel and The Center for Educational Technology (CET). OMETZ: Hebrew acronym for Citizenship and Social Involvement; The word meaning in Hebrew is: courage.

OMETZ is a unique civic education program that integrates active study of democracy and social involvement with a specially designed virtual learning environment on the Internet- OMETZ Website. The program promotes democratic values; enables youth to be involved; to practice basic democratic rights and obligations; and encourage social awareness and involvement among school-age children. OMETZ program bring together secular and religious Jewish children and Israeli Arabs children, ages 13-17, that learning in separate systems schools, into a virtual, dynamic learning civil community, that allow them, to study together, to talk, to share ideas, dreams, problems, conflicts, information and knowledge. OMETZ Website, designed especially as a civic education center. We develop special training courses for teachers, for political science students, for mentors and moderators. All of them become also active members of the learning community. One of the general issues we focus on is: how can we wisely use, Web-based educational programs, such as OMETZ, for confrontations with the reality we are facing in Israel and in other conflict aria in the world?

A Framework based Approach for Intelligent Multimedia in Education

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Abstract: This paper describes an approach for multimedia representation within the intelligent educational systems to facilitate better domain competence acquisition by the learners. The implementation of the approach is dependent on the educational framework, which is adopted in the educational system. In this presentation, it is discussed for the systems providing domain competence using Exploration Space Control framework to support learning-by-exploration. The presentation will demonstrate the application of the approach in the design of TILE environment, which is a multimedia based educational delivery system with intelligent student support.

Introduction

This presentation demonstrates the application of a Multiple Representation (MR) approach to multimedia technology. The MR approach makes use of the underlying educational framework within intelligent educational systems. The approach attempts to arrange the individual multimedia objects (such as audio, pictures, animations) into a multimedia interface world where the relationships of the objects to the world are governed by the educational framework. Learners are provided with various forms of interactivity to suit the pedagogical goals of the intelligent educational systems. For this purpose, various multimedia objects are identified with respect to various tasks required for domain competence. This approach ensures the suitable presentation of domain content to the learner by guiding the selection of multimedia objects, navigational objects selection, and integration of multimedia objects to suit different learner competence levels. The approach does not try to replace the well-established interface design guidelines. The attempt here is to assist the educational system's designer from learner's point of view. A vast literature is available covering the subject of use of multimedia in education, but one cannot find any guidelines within this flooding amount of information that show how to proceed from original idea to the definitive multimedia based systems (Lara & Perez-Luque, 1996).

The implementation of MR approach is dependent on the educational framework adopted in the intelligent educational systems. In this presentation, it is discussed for the systems providing domain competence by using Exploration Space Control framework (Kashihara et al., 2000) to support learning-by-exploration. The MR approach is being applied in the TILE environment, which aims to provide integrated system for the management, authoring, delivery and monitoring of distance education.

Motivation and Context

The success of the learning process in an intelligent educational system depends on how the system presents the domain knowledge to the learner and changes its presentation in terms of complexity and granularity according to learner's progress. Tutoring strategies are the major source of taking decisions regarding domain knowledge presentation. Adequate educational framework gives a way to create effective and efficient tutoring strategies for a given domain. Many researchers have emphasised the need of suitable educational framework in the use of multimedia technology in educational systems, with some researchers particularly considering intelligent educational systems.

Pham (1997) pointed out that many multimedia based educational systems in current existence have placed too much emphasis on the affective and psychomotor aspects and lured the learner by using spectacular effects provided by images, animations, video and sound. In such systems, the emphasis has shifted from adequate learning outcomes and cognitive development, and the goal of knowledge acquisition seems to have diluted. Palmiter et al.

(1991) warned that it should not be assumed simply because a visual component is present, that the instructions will be coded into long term memory.

Rogers et al. (1995) suggested that the solid foundation of intelligent tutoring systems should be utilised as a platform for a more sophisticated control of multimedia objects in a learning environment. Nicol (1990) argued that the interfaces for learning should be designed considering the same principles that good teachers use. Pham (1997) concerned that little considerations have been given to the cognitive, pedagogical and psychological aspects of learning while designing multimedia based educational systems. He emphasised that a good educational multimedia system must not forget educational objectives while taking advantages of advance technology.

Multimedia technology can contribute to the success of learning only if it can adequately represent the tasks and concepts of domain. Rheingold (1990) recommended that the multimedia presentation should also be capable of supporting the goals of the system. The Multiple Representation (MR) approach is predominantly dependent on the educational framework in which it is being applied. This research work is focused on learning-by exploration. Exploration Space Control is a framework to support such learning process. The application of MR approach in TILE environment within Exploration Space Control framework will be demonstrated in this presentation.

Discussion

There has not been much consideration of use of multimedia technology in the educational systems with the view of educational theories. This paper suggested one such consideration in the form of Multiple Representation approach for domain competence acquisition. An implementation of the approach using Exploration Space Control framework was also discussed with the description of a system built using the approach.

There are many areas in which the research demands further consideration. Currently the Multiple Representation approach is applied to the disciplines with focus on exploratory learning. The requirements of other learning processes also need to be considered. Research is also required to extend the approach on student's learning styles or some other established user classification.

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Authoring Techniques for Educational Video Data

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Abstract: Due to the requirement for new forms of multimedia enriched lecture in various online and virtual education services, a growing demand for recording and authoring of different educational or informational events, e. g. lectures, seminars or conference talks, has to be considered. Such recordings can only be authored efficiently, if content-based accelerators for accessing recorded video streams are established. This article introduces techniques for the (semi-)automatic production of comprehensive and intuitive visual summaries for video sequences that can be used for efficient, content-based authoring of video recordings in many areas of multimedia enriched education.

1.Introduction

Efficient authoring of video recordings from discussions, lectures, seminars or conference talks often fails because of the lack of compact and intuitive visual summaries. Therefore the video author has to view video sequentially without semantic navigation support, thus wasting a lot of time. Current research prototypes (e. g. CueVideo from IBM[1], Srinivasan et al., 1999) implement some extended video navigation support features (e. g. increasing playback rate), nevertheless this decreases video viewing time only by a small percentage (see Gupta et al., 2000). In order to achieve better performance through richer semantic navigation possibilities, we have to think about new and better ways for (semi-) automatic creation of visual summaries for video recordings.

Such new visualizations depend mainly upon content of the recorded video sequences. Following this article presents a technique for creating semantically rich visual representations through preparation, online support during recording and interactive refinement of recorded sessions.

2.Techniques for the creation of visual summaries

Fully automatic techniques for creating visual summaries for video sequences are already known but mostly they deploy heuristic algorithms (see *mBase and VideoManga*[2], Uchihashi et al., 1999) depending on calculation of importance descriptors from neighbouring images in video sequences: great changes between neighbouring images indicate important positions, no or small changes indicate sequences of less importance (see Maybury, 1997). Sections of great importance according to this algorithm are summarized by calculation of clusters and selection of one "representative" keyframe for each cluster. In Fig. 1 keyframes are indicated by a small blue triangle beneath the timeline.

Figure 1: *mBase* visualization technique from Parc Xerox 2

One big advantage of this technique for generation of visual summaries is the fact that different and robust algorithms for keyframe extraction are available and the process is fully automatic. This qualifies this technique for processing big video archives and a great range of different video material. On the other hand generated video summaries may consist of arbitrary and strongly varying quality because no knowledge at all about video

[1][1]IBM CueVideo project, http://www.almaden.ibm.com/cs/cuevideo/, February 2001.
[2][2]Parc Xerox mBase/VideoManga project, http://www.fxpal.xerox.com/smartspaces/index.htm, February 2001.

content has been applied in the process of keyframe generation and the assumption that strongly differing frames indicate sections of great importance will barely be proofable.

Other techniques try to summarize video content through application of formal icon languages (see Davis, 1993, 1995). Icons for different abstract spatial and temporal relations and objects are designed and attached to sections of the video sequence (e. g. arrows for description of moving directions or icons for different abstract geometric shapes). Multiple icons in different semantic hierarchies can be attached to the same section or to overlapping sections which can interactively be switched in between by the user. One major drawback of this approach is the fact that such systems have to rely on a comprehensive set of icons universally enough for different appliances. New icons can only be produced by graphically skilled persons, therefore extension of expressing capabilities is expensive and complicated. Furthermore quality of visual summaries depends strongly on intuitive design and correct assignment in different abstract description hierarchies of icons.

Different approaches also exist for representation of more technically motivated descriptions of video sequences. These techniques often determine different automatically calculated information, e. g. brightness, colour histogram, camera movement, and produce visual, timeline-based representations of video sections for supplementary presentation together with the described video sequence (see Tonomura et al., 1993, Ueda et al., 1993). Such representations do not include semantic information and can therefore be neglected for the following considerations.

3.A structured approach to video modeling

Systems may generate substantially better summaries, if they can rely on manually or (semi-)automatically provided structuring information. This information can be used for comparison with important events in the video stream thus inducing a structure on the video sequences. Such a process is naturally strongly dependant upon the type of the recorded video streams but nevertheless it is a feasible way for recordings of lectures or discussions which are of primary interest for the scope of this article. Here such important events may consist in recording the timestamps of slide changes or of sections with different speakers during a discussion.

For the structuring information needed a priori one can think about e. g. taking the prepared outline of the lecturer or agenda of the discussion leader. With this structuring information one can identify different, coarse grained semantic blocks by the end of the recording.

This section wants to give guidelines and algorithms for generating visually rich and intuitive summaries of video sequences which can be refined interactively by the multimedia author and improved by linking additional material to the visual representation.

a.Automatic vs. pragmatic approach

Ideally we would like to have comprehensive and robust algorithms for scene and video object detection in order to construct semantically correct summaries. For example if the lecturer shows a physical object we would like to have algorithms which detect this event and - even better - which also categorizes the shown object based on an existing domain ontology. Furthermore reliable speech recognition and speaker detection would help a lot in automatic construction of video summaries. Unfortunately systems partly implementing such features solely exist as research prototypes. Nevertheless some automatic detection and recognition techniques are now robust enough for utilization in automatic video summarization applications (e. g. algorithms for keyword spotting in recorded sequences, see Srinivasan et al., 1999).

b.Visualization of structured video data

An often used metaphor for visualization of video sequences is the "film strip", a concatenation of small images captured at different positions from the corresponding video stream (see Fig. 2). For longer sequences there are normally fewer images captured per time unit or there are means for interactively choosing the presented resolution and time interval (e. g. by scrolling the film strip along time axis). This visualization method has the disadvantage that video sequences can not be presented as detailed as necessary when we need to have a global view onto the visualization at the same time. Indeed video strips can be cut and hierarchically arranged in different temporal resolutions but this approach makes it difficult to intuitively understand global relations between video sections. Furthermore this visualization will definitely be difficult to overlook if additional materials with relations to other sections of the video have to be visualized.

Figure 2: Film strip visualization metaphor

i.3D visualizations for video sequences

In the following section this article wants to introduce techniques for intuitive visualizations of video sequences in 3D virtual environments. One advantage of this kind of visualization can clearly be found in the greater information area compared to conventional 2D approaches. Thus more accompanying additional information can be made available and temporal and causal relations can be understood more easily. But navigation in such 3D virtual environments can be quite complicated with normal input devices (e. g. mouse, keyboard), so great importance has to be given to the support of extended navigation mechanisms.

ii.Navigation and information support

Supporting interaction and information mechanisms may consist in intelligent navigation support based on the knowledge of what is presented in the video stream. Therefore we can develop methods which support

1. navigation in virtual space through absolute, relative and content-based time specifications (e. g. "go to the first discussion");
2. navigation through interaction with presented video strips and automatic "moving" of the viewing platform to well-suited places.

Therefore navigation support methods have to determine the right positions in virtual space for arbitrary time specifications and additionally have to compute well-suited, context dependant viewing directions and angles into the 3D scene.

iii.Visualization metaphors

Visualizations of complex structures are heavily dependant upon intuitive visualization metaphors. Consequently they contribute a big part to usability of the selected visualization, together with the definition of the meaning of available dimensions in the virtual environment.

1.Dimensions and arrangement in 3D video spaces

For representation of video sequences in 3D virtual spaces this article suggests the following arrangement of semantic objects: Video strips of sequences in different temporal resolutions are computed (this can be done during recording time or interactively on demand) and scaled to fit the selected temporal resolution of time. These video strips can then be arranged in virtual space according to the following criteria:

- The X axis of the visualization is interpreted as time dimension.
- The Y axis is used for video strips in different temporal resolutions which are arranged in hierarchical ordering. In order to maintain temporal continuity, video strips are turned by an individual factor (depending upon their length) into Z axis direction. Therefore temporal refined video strips of specific sections are not aligned in parallel to the main video strip.
- The Z axis is dedicated to visualizations of additional material (e. g. slides) or semantic relations which are pointing out of the context of the currently authored video sequence.

In order to keep this arrangement easy to survey the recorded sequence is split into several sections which are visualized side-by-side as semantic spheres. Relations and interdependencies between those spheres are shown as labeled, directed arcs which are connecting corresponding semantic spheres.

This approach can be an exceptional advantage if sequences with strong interdependencies are visualized. By choosing from different metrics for positioning of video sequences in virtual space, dependencies between visualized segments and importance of those segments may be emphasized as needed (see Frécon & Smith, 1998).

2.Variation of presented level of detail

Selection of different temporal resolutions for video strips allows a context dependant variation of presented detail information. Assumptions about importance of sequences based on the presented level of detail may be stated: the more detailed a sequence is presented, the more important it is for the visualized video stream. Furthermore the extend of presented information may be adapted by variation of the viewing angle onto the virtual scene.

More detailed visualizations of certain segments may be calculated on demand if the author wants to zoom further into the scene. This concept is normally referred to as a semantic magnifying lens (see Gupta et al., 2000) which allows to present arbitrary levels of detail depending upon user interaction.

3.Principle of locality

The position of the virtual viewing platform in the 3D universe can be changed context dependantly in order to present relevant information in the foreground or in short distance of it. Selection of a temporal or semantically defined position in the presented visualization implicitly determines position of the viewing platform as well as viewing direction into the scene.

4.Cyclic refinement of semantic information

Up to now no statements about the problem how different video sequences may be identified for visualization have been made. Following we suggest a model of cyclic refinement of structure information based on a suitable domain ontology. We assume that an intuitive visualization easily allows to detect deficits in attribution and categorization of presented video sequences. Such sequences can then be attributed in more detail by interaction with the video author. Necessary information about meta data is acquired through usage of a shared and cooperatively extendable domain ontology for teaching and presentation resources.

a.General process model

The proposed model may be seen as a continuous balancing of structured attribution of a recorded event represented by a directed graph with its corresponding 3D visualization. Temporal sections in the video stream are compared to semantically defined segments induced from the directed graph representation, based on timestamps of easily identifiable events acquired during recording. This brings together two different modeling techniques:

1.Semantic modeling of content based on directed graphs.

2.Modeling of temporal sequences based on timestamps of easily identifiable events.

Combination of these modeling approaches gives us a visualization of temporal media that may be refined interactively. The general process model reflects ideas from the waterfall model of software development (see Fig. 3).

b.Preparation of recording

Process model presumes that the recording is planed and subdivided into - at least – a coarse grained structure. For recordings of lectures and seminars this can be done e. g. by specifying chapters and relating slides which are to be presented. For discussions normally an agenda will be prepared and made available with additional material for each participant.

Once the structure is conceptionally planned it must be designed by using a description language capable of expressing hierarchical decomposition and attribution and which can enforce structural and perhaps semantical integrity. Well suited for this purpose are models based on notations from the *Resource Description Framework (RDF)* specification[3] and the *RDF Schema (RDFS)* recommendation[4] of the *W3* consortium. The XML-based notation specifies notions of objects, concepts and relations for semantic description of documents. Furthermore construction of different concept hierarchies is supported by subclassing of objects and relations. By specifying a semantical validating RDF schema for the structure description, syntax as well as semantics of the designed

[3][3]Resource Description Framework (RDF) Model and Syntax Specification, `http://www.w3c.org/TR/REC-rdf-syntax/`, February 1999.

[4][4]Resource Description Framework (RDF) Schema Specification 1.0, `http://www.w3c.org/TR/rdf-schema/`, March 2000.

description can be checked.

The result of the initial structure specification consists of a RDF description of the recording. Temporal relations (see Allen, 1983) between identified sections and concepts are implicitly specified due to the hierarchical decomposition.

Figure 3: Waterfall model of semantic attribution

c.Realization of recording

Basic information for the dynamic model is acquired during realization of the recording. This may partly be done automatically (e. g. recording of timestamps for slide changes of computer-based presentations), but manual approaches are reasonable as well if suitable support systems for the manual recording of timestamps for interesting events are available. Such support systems must be capable of establishing relations based on coarse grained structuring information from the preparation stage, between events and content. Systems also must be able to record efficiently and flexibly additional unplanned activities and events.

The more detailed the recording of the dynamic model is done "online", the more precise and intuitive visualizations can be calculated. This means better performance for technical implementations, because visualizations of sections which sematically belong together may be already calculated during recording.

d.Authoring

After the end of the recording enough information has been collected for a first structured visualization of the video stream (for instructions how to do this cf. section *Visualization of structured video data*). Essentially three different tasks based on this visualization have to be performed:

5.Interactive refinement of attribution.

6.Definition of temporal and semantical relations.

7.Attribution of unplanned sections.

In order to support the author in accomplishing these tasks, the system should create and manage a bi-directional linking between video player and visualization: changes of the time position of the video player are reflected by transformations of position and viewing direction in the visualization. Navigation in the 3D environment modifies time position of the video player respectively. Navigation support methods for identifying video sequences by absolute and relative time specifications must be provided in order to assist users in working with the 3D visualization.

For the process of refinement of attribution temporal and spatial areas have to be specified in the video player as well as in the visualization. In the visual summary this can be achieved by marking a specific region of 3D environment which corresponds to a sequence of interest in the video stream. This capability is also needed for creation and management of temporal and semantical relations which can be divided into relations between different sections of the same video summary and relations to/from other video summaries. Furthermore references to additional multimedia materials are also linked to temporal and/or spatial sections of video sequences.

8.Realization of a prototype

In order to proof the proposed ideas a prototype for the 3D visualization is currently implemented in *Java*, using optional APIs like *Java Media Framework* (*JMF*[5]) for support of playback and recording of video streams, and *Java 3D*[6] for realization of the 3D virtual environment for video strips. The prototype includes views for visualization of the hierarchical structure of XML files, a 3D virtual video world for visualization of video sequences as video strips and a row for multiple video players (for each visualized recording there exists one separate video player). Calculation of the visualization of video strips is done according to specifications found

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[5][5]Java Media Framework Specification, `http://java.sun.com/products/java-media/jmf/`, June 2000.

[6][6]Java 3D API Specification, `http://java.sun.com/products/java-media/3D/`, March 2000.

in the input XML files. Interaction with the video strip can be done by selecting a video strip in the 3D visualization: the corresponding video player then jumps to the specified position in the video sequence and plays it.

Prototypes of support systems for preparation and structuring of the recording have also been implemented. Work is going on for an import of structure and data of a *Microsoft Powerpoint* presentation (e. g. slides as images, slide topics). Recording of slide change events and camera movements is done by embedding Powerpoint as a COM server into an event recording application.

With improved implementations of those prototypes we are planning to start recording of a computer science lecture in mid 2001 for a period of two semesters. Results of the processing will be presented to attending students of the lecture who are supposed to use the visualizations for preparation of examinations or as an additional source for information.

9.Summary

This article has introduced an approach for a structured, semantic visualization of recordings of lectures, conference talks or discussions and similar kinds of video recordings. It suggests to integrate preparation phase tightly with the final visualization by defining a semantic structure and match it with timestamps from the dynamic model of the recording. The computed visualization is interactively refined in order to match the imagination of the video author.

For visualization of video sequences a 3D virtual video world is suggested. Video sequences are represented as video strips which are arranged appropriately according to a presented algorithm. This approach leads to a comprehensive and intuitive visualization of video sequences.

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A Multimedia Repository for Online Educational Content

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Abstract: We propose an architecture of a multimedia repository for online educational content, that helps to manage the continuously growing amount of electronic learning material. The multimedia repository can be embedded in educational learning environments or in Content Management Systems. It is designed to manage a large amount of interactive multimedia and hypermedia learning material, provides a centralized access to all stored content, preserves the physical quality of the learning material and offers functions for content based searching, browsing and retrieval in different qualities, depending on the users environment and location.

Introduction

As more and more educational content becomes digital and will be delivered and presented electronically some questions arise such as how to administer the continuously growing amount of electronic content or how to manage the large variety of electronic presentation techniques and storage formats. Each author and provider of electronic learning content will be forced to build up a smaller or larger archive, in which the whole electronic learning content will be stored. The main purpose for this need is the wish to preserve the technical quality of the content, to keep an overview of all content available and of course to reuse already created content in new productions. But how can such a content management be done? In order to find an answer, we divide the problem how the management of electronic content can be realized into a few smaller problems such as:

- How to document content it in the right form, so that something can be searched for by using this documentation
- How to store content in the right way, so that it can be found again
- How to store content in the right format, so that some parts of it or the whole content can be retrieved and reused
- Where to store content, so it can be accessed instantaneously for retrieval or reuse

To solve this storage management problem, a general management of content storage has to be introduced. One proposed solution can be realized as a part of a Content Management System (cf. Kleinberger, Müller 2000.1 and Kleinberger, Müller 2000.2), which is responsible for the management of digital assets, the storage of digital media, the access to stored media and the support of retrieval, reuse and production processes

How does the content now look in modern education? New learning material will be built up more and more of multimedia and hypermedia content (cf. Steinmetz 2000 and Holzinger 2000). We deal with texts, pictures and graphics, with hypertexts, multimedia and hypermedia but also with active objects like applets, servlets and scripts because learning is still mostly an interactive process. All these objects, media types and their combination can be summarized in the term "essence", while all descriptive and administrative data about essen
accordingly are the "metadata" (see definition of content, essence and metadata in Kleinberger, Müller 2000.2). content is according to this definition the sum of essence and metadata.

Typically the metadata is carried together with the essence to provide easier searching and access to the essence. Especially in the case of multimedia or hypermedia objects, these objects are coded in a way which is difficult to be indexed or to be searched for. Often there are logical relationships between the essence and the metadata such as timecode references. For example, an abstract may relate to a particular time span in a video material, and a usage restriction will usually also apply to a particular time span in a video material. As a result the content now not only consists of only one object, but is built up from a variety of essence and metadata objects.

In consequence a Content Management System has to provide a storage management as a core component which stores all the objects the content in eLearning is built up from: Essence (multimedia and hypermedia) and metadata (structure and presentation information). There have to be different storage areas according to different requirements for the objects stored in these areas. Metadata and essence objects have different characteristics such as access method, object size, access time etc. and therefore need different treatment.

We can summarize the requirements for a storage management for hypermedia and multimedia eLearning content in the following terms:

- Storage of multimedia eLearning content
  - Store content, consisting of different essence and metadata objects
  - Store multimedia documents consisting of multiple formats and multiple physical objects
  - Provide different storage areas with different access methods for different kinds of essence and metadata
  - Examples of content: audio, video, animations, text, pictures, hypertext, hypermedia
- Flexible access to the stored documents for retrieval and reuse
  - Allow proper documentation of essences in a generalized manner
  - Provide indexing mechanisms to extract metadata and semantic information automatically
  - Provide advanced search capabilities for essences using extracted metadata information
  - Offer filtering and scaling methods for retrieval according to available bandwidth or location
- Integration in teaching and learning environments
  - Decentralized implementation with transfer and replication mechanisms
  - Remote access facilities with broker mechanisms
  - Integration of rights management

In the following section, we describe one possible solution of a multimedia storage management for the application domain eLearning, which bases on a multimedia repository architecture.

Application domain eLearning: The L3 project

The L3 project (L3 stands for Life Long Learning (cf. L3)) is a project founded by the German government with the goal to create a technical and organizational infrastructure for a lifelong further education. The solution approach emphasizes two different points: On the one hand the creation of an educational infrastructure which uses new media efficiently and can be used by all interested people, independently of there education or social position. On the other hand the development of organizational structured and economic business models with which the developed infrastructure can be operated at a medium term.

The central component of the educational infrastructure is a multimedia repository which manages online educational content, especially multimedia content like audio and video. The educational multimedia content consists of learning objects which can be structured hierarchically in courses and lessons. The actual relationships between the learning objects are defined in a course structure definition which is represented in XML. Metadata for the learning objects is represented in a XML notation of the IMS metadata specification version 1.0 (cf. IMS) which is based on the IEEE LOM definition 3.5 (cf. LTSC) with some changes and extensions. We have extended the LOM definition ourselves with the structures necessary to store all metadata information not already included in LOM, i.e. the course structures. Media objects are references out of the metadata objects to physical media objects stored in the multimedia repository.

Repository Architecture

The proposed multimedia repository architecture in L3 takes care of all requirements for a multimedia storage management given above. It provides different interfaces to both end user applications and additionally to components of a Content Management System which is embedded in the learning environment. The basic features of the multimedia repository provided by its internal functions and interfaces are:

- The management of a large amount of interactive multimedia and hypermedia learning material
- The provision of a centralized access to all stored content
- The preservation of physical quality of the learning content
- The provision of functions for content based searching, content browsing, retrieval and reuse

To fulfill all requirements for a multimedia storage management, the internal structure of the multimedia repository has been separated into dedicated components, each of them realizing certain functions and providing special interfaces. A general classification into two component groups can be made due to the different load profiles the multimedia repository is faced with for metadata and essence.

On the one hand the multimedia repository has to do the work of a classical database system. It has to handle a great amount of user load and to answer a lot of user inquiries with adequate computing power. This can be compared with a typical database load profile. On the other hand a very performant storage system is required, providing capability of handling large multimedia objects, managing a large storage area (typically in a file system) and providing high data throughput over network and audio/video interfaces. This can be compared with a typical file server profile, here with auxiliary interfaces such as streaming servers and audio/video encoders and decoders

In classical information technology both load profiles, database and file servers, are handled by different system configurations and software solutions. For example database servers are typically well equipped with a huge main memory and computing power (e.g. multiprocessor) whereas file servers are well equipped with a performant hard disk system (e.g. Hardware-RAID-Controllers, FC-interfaces, HSM-Systems, Caches) and fast networking interfaces.

To realize a repository for multimedia objects, both load profiles have to be addressed. Hence the multimedia repository is internally organized into at least two different components according to the classification: a repository addressing the database load profiles and a media server addressing the file server load profiles. Figure 1 summarizes the basic features of the two components:

	Repository	Media Server
Load Profile	Many accesses, Computing intensive	Less accesses, High I/O Throughput
Software	Database, Fulltext Search Engine, Web Server	Video-, Audio- , Web-, File Server
Requirements	Computing Power, Memory	Performant Storage, High I/O Throughput

Figure 1: Requirements

Figure 2 shows the general separation of the two components repository and media server.

The multimedia repository stores all the metadata information about the educational multimedia content. This is the descriptive metadata for the educational content like author, theme and any other metadata information like special attributes for certain domains. Because an educational content object is mostly embedded in an environment, compound documents consisting of content objects can be structured into a course. The course structuring information is stored in the multimedia repository a metadata information, too. All metadata information can be queries by XQL or searched for with a fulltext search engine. The multimedia repository provides adequate services and interfaces for these functions.

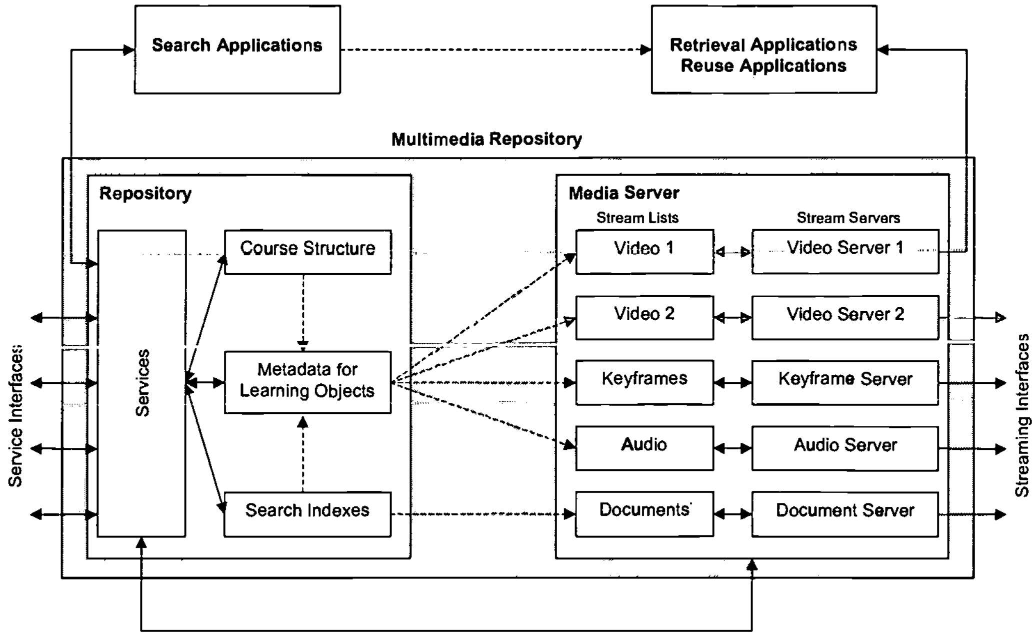

Figure 2: The L3 Multimedia Repository and Media Server

On the media servers side an essence manager is responsible for the management of the media objects the learning object refers to. The essence manager includes a metadata management which stores the technical metadata about the physical media objects. Since a media object can also consist of more than one physical media object (e.g. files), the essence manager furthermore manages containers, which aggregate physical media objects into material lists which are then referenced by media objects. Physical media object can be stored in different formats and different bandwidths, e.g. RealVideo, MPEG-1 or MPEG-2. Formats are distinguished in stream lists which point to the location of the physical media objects as files in a file system. Retrieval access to a physical media object can now be gained through a corresponding stream server. Figure 3 shows a more detailed view on the repository and media server, in which the media servers components stream server and essence manager are detailed.

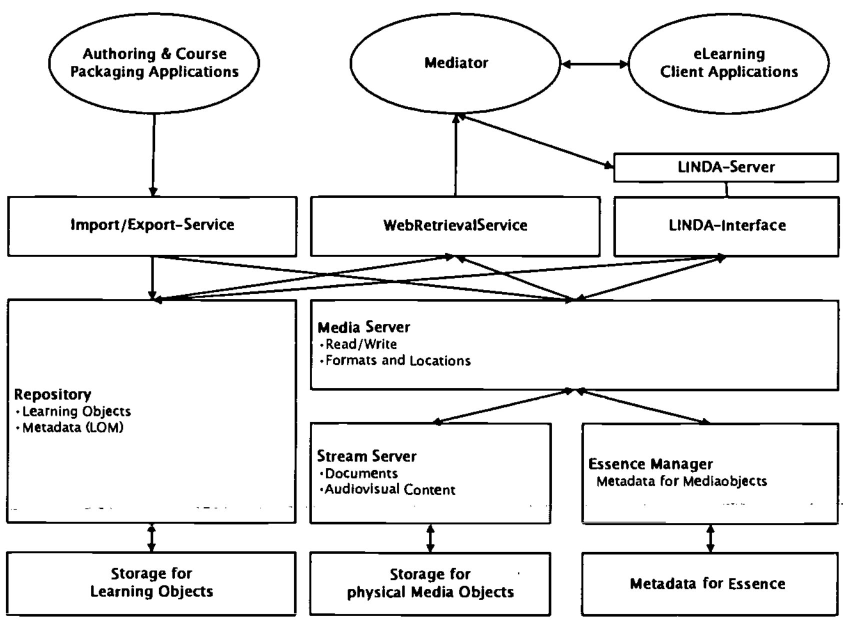

Figure 3: The L3 Repository and Media Server System Components

There are different stores for the learning objects, the media stores and the metadata for essences. Objects are stored in a database management system, file system, HSM-System or in a storage management system. Various services like import/export services (for importing and exporting complete packed learning objects (courses) including metadata and essences into and out of the multimedia repository), a web retrieval service (for retrieving media objects) and a Linda interface (cf. Schoenfeldinger 1998) (for accessing all administrative and metadata related functions) are provided to support authoring and course packaging tools, mediators (which support course navigation) and eLearning client applications

In a typical installation both components, repository and media server are installed on separate computers, each built up of the appropriate hardware components in computing power, main memory, hard disk storage and network interfaces depending on the load profile.

Logical structure of eLearning content in L3

In L3 the learning objects are structured hierarchically with a top course element. A course consists of several lessons. To each lesson a content and a test is assigned. Content and tests refer to media objects. The actual relationship between these objects is defined in a course structure, which is used by a mediator application to navigate in between the course.

Media objects can either be references to local physical media objects, which are stored in the media server storage, or external media objects. For local media objects the media server provides the suitable interfaces for accessing and retrieving. External media objects reside outside the multimedia repository. They are referenced by an URL. It is the responsibility of the mediator application to interpret this references correctly and to access the external objects via HTTP on an external web server or file system. The media objects point to one or more physical media objects, depending on the physical representation of the learning content. This can be any kind of object type including audio, video in different formats and qualities, keyframes, texts, web pages, etc. Figure 4 explains an exemplary structure of a L3 learning object and the allowed references to physical media objects:

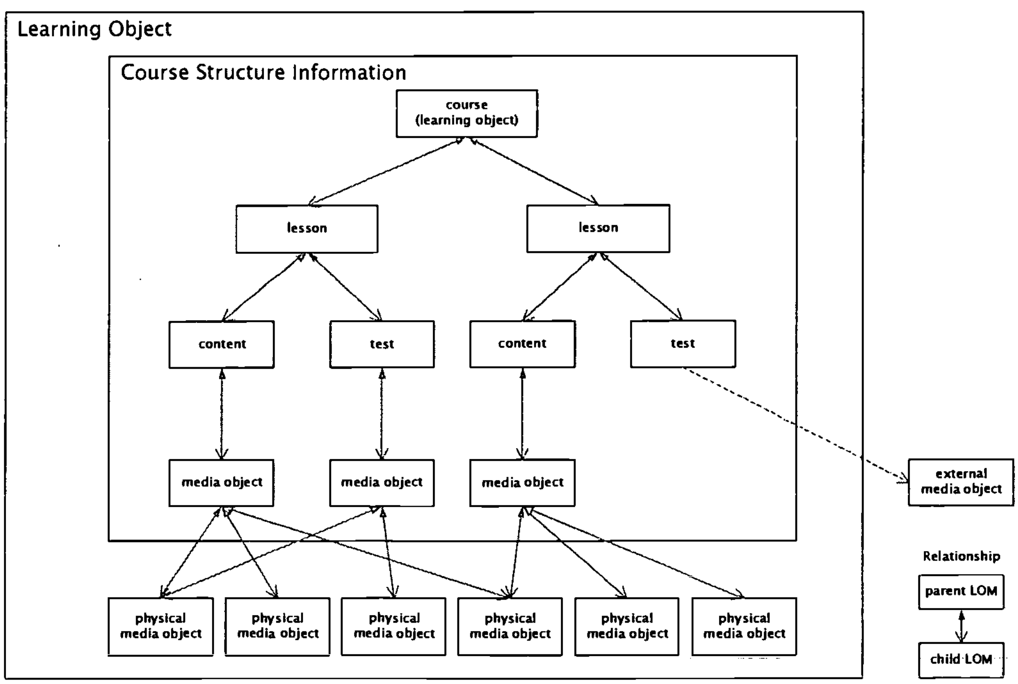

Figure 4: Course Structuring in L3

In the L3 object model all elements belonging to one course form one learning object. Every part of a learning object is assigned the corresponding metadata. All metadata information is represented in an XML mapping with appropriate Document Type Definitions and validating parsers, that check valid structures. Metadata objects are tagged with GUIDs (Global Unique Identifiers), which identify each object uniquely. Physical media objects are distinguished in type via mime-types and also identified via GUIDs

Conclusion

The multimedia repository can either be embedded in educational learning environments or in Content Management Systems. The general software design is developed in layered building blocks, in which each layer consists of a set of services offering CORBA-Interfaces to other services, system components or client applications (see Thomas 1999). This allows for a decentralized implementation, which is very important in learning environment where the users (learners) typically do not stay in the same place as the learning content is developed or stored. If there is to be a division in learning centers and service centers analogous to the L3-project (cf. L3) there have to be:

- Transfer and replication mechanisms for moving content between centers
- Remote access facilities with broker mechanisms for transparent access wherever the content lies
- Filtering and scaling methods for retrieval according to the available bandwidth between leaning centers and service centers
- Rights management for regulating access for learners but also for providers of content

Acknowledgement

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Answering Authentic Needs by Using the Internet: From an Instructional Setting to the Real World

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Abstract: Intcrnct based learning offers unique opportunities to expose teachers and pupils to authentic learning experiences at different levels of interactivity, and facilitates enquiry while emphasizing the practical implications for production. It also promotes the need for contact with the outside world and culture, and recognises the relevance of knowing how to operate new technologies. The act of using the Internet in teacher training and in school instruction assumes a model of education which is conducive to the construction of knowledge and which has relevance to what can be useful and productive in dealing with authentic needs. This presentation describes a model of an Open University in-service methodology course for teachers of English as a foreign language which teaches a content area and represents a model of instruction. While focusing on the content of the course, the participants are exposed to a delivery system which includes features they can easily adapt to their own teaching environment. The rationale is based on the construction of teachers' knowledge, an awareness of the importance of a teaching paradigm that models teaching and learning, and the development of the capacity to face the real world both within and outside the instructional setting.

We are in a period when strong efforts are being made to develop a new kind of professional community in education - one whose ethos is built around the continuous study and improvement of teaching and learning, and the direct application of knowledge to real life situations. Educators are attempting to design environments conducive to the construction of knowledge which have relevance to learners' authentic needs.

In such a constructivist view of education, we aim at developing a learning environment which facilitates the enquiry of learners but also emphasizes the practical implications for production, both in the immediate setting and in the long term. Within the general framework of constuctivism, knowledge is emerging rather than static, learning means seeking meaning within one's expanding frame of reference, building knowledge and checking it against the concepts of others, and connecting what is being learned in the instructional setting with real life demands (Richardson, 1997).

The theoretical underpinnings for such a view are that new concepts can have multidimenstional effects: They can change ways of organizing knowledge and can provide new material for associations and problem-solving (Ellis, 1993). Meaningful learning is also likely to go beyond the classroom and provide skills and strategies that will impact future actions. A further underlying assumption is that the design of a useful instructional model must incorporate a computer environment of some kind, since we strongly believe in the increasing importance of computer literacy for functioning in the real world. Indeed, one of the ways of bridging the gap between the instructional environment and life outside the classroom is knowing how to function with the technology.

Rationale: The rationale behind the design of this Open University in-service methodology course for teachers of English as a foreign language is based on the construction of teachers' knowledge, an awareness of the importance of a teaching paradigm that models teaching and learning, and the development of the capacity to face the real world both within and outside of the instructional setting. We have created a course based on a task-based syllabus (Long & Crookes, 1992). which is teacher-directed in its conception but highly learned-centered in its actualization (White & Weight, 2000).

A salient feature of teaching is that it requires continuous adaptation and demands new learning in order to solve the problems of each moment and situation. Therefore the process of knowing how to transfer pedagogical skills and strategies from one context to another is essential to help teachers solve problems and reach their students more effectively. Horizontal transfer refers to the conditions in which a skill can be shifted directly from the training situation. When the work and training settings are very similar, a skill can usually be transferred "as is" with little additional alteration and learning. On the other hand, if the two contexts are very different, vertical transfer is needed. Vertical transfer refers to conditions in which the new skill cannot be used unless it is adapted to fit the new conditions wherein an extension of learning is required before the skill can be applied. Such transfer is more likely when there is a greater gap between the context of training and the conditions of the new situation: the newly learned skill being different and thus not easily fitting into the new situation. The distinction between horizontal and vertical transfer refers to the amount of adaptation and reinterpretation that is necessary if the skill is to be effective in the new situation. Familiarity is the key. The greater the degree to which a new skill fits into already familiar patterns, the less adjustment will be needed.

Because English is the subject that our experienced teacher trainees teach, we have been able to take advantage of the globalization of English and the fact that it has become the main medium for international communication and technology (Kern, 2001). English provides us with a window to the real world as well as with additional opportunities for accessing information. As a result, we have created a framework which links pedagogical perspectives on teaching and learning to elements of Internet input in order to achieve our particular desired educational outcomes.

Design of the Course: The 15-week course is transmitted via the Internet. It consists of weekly readings from selected professional journals provided to the teachers in a printed anthology, and of questions related to these readings delivered through the Internet. Some of the questions focus on the theoretical principles discussed in the articles while others are application tasks which the trainees are required to think about, plan and implement in their own teaching context. The trainees' reflections and reports about the practical tasks, the presentation of individual and of collaborative projects among participants, the discussions, as well as all other interactions are asynchronous and occur on-line. Depending on the nature and the purpose of the communications, some involve the trainees only while others include the trainees and the instructor.

The participants are responsible for finding and sharing Internet sites and articles which are topically related to the subject matter at hand and which they feel will enhance their knowledge and increase their teaching repertoire. In addition, three areas which may be problematic for teachers are selected on the basis of negotiation with the trainees. Each chosen area serves as a topic for on-line discussions for a period of four weeks, with the specific aim of finding appropriate solutions that will emerge from sharing ideas and drawing applicable conclusions. At the end of the course, trainees submit an individual portfolio which includes some of the above and a journal in which they are asked to reflect on their experience of the course and its practical relevance to their teaching context.

The design of the course is based on a Presentation, Practice and Production (PPP) model (Willis, 1996). Planning the presentation of the content, getting the participants to practice and execute the required tasks, and eventually take what has been learned beyond the framework of the immediate environment into a wider world seems to reflect a sensible definition of an educational mission. In other words, we take the view that one of the secrets of successful learning lies in the process of transfer – the effect of learning one topic or skill on another situation.

In this context, the teacher trainer presents the course content, encourages the teacher trainees to practice what is being learned within the framework of the course, and hopes that eventually some of the elements of the course, including the strategies and skills presented, will be utilized (in horizontal transfer) adapted and perhaps even reproduced (in vertical transfer) by the trainee in his/her professional world (as a teacher) and personal world (as an Internet user).

Similarly, the teacher prepares and presents materials in class, encourages the pupils to practice what is being learned in the school, and hopes that in the future some features of what has been taught and learned will be useful in the pupils' lives outside the classroom. The presentation and practice stages feature mostly in the school setting while the production stage is expected to first occur in the instructional environment, and eventually filter through beyond that environment into the pupil's big wide-world. In other words, pupils will operate first on the basis of horizontal transfer and then proceed to a vertical transfer of the skills and knowledge they have acquired.

How is this model of teacher training for a Methodology course for teachers different from others? The method of delivery via Internet not only teaches a content area – Methodology for teaching English as a foreign language – but it also represents a model of instruction for their own use in their classrooms. While focusing on the content of the course, the participants are exposed to a delivery system which consists of features they can easily adapt to their own teaching environment; at the same time they are expanding their personal horizons regarding the use and potential of the technology.

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Flexible Course Configuration based on a Modular Course Model and a New Reference Mechanism

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Abstract: This paper presents a new course model for IT-based flexible teaching and learning. In particular, the re-use of learning material and the configuration of goal-oriented and learner-adapted courses are addressed. IT-based courses should be no longer monolithic but a flexible traversal of course modules. The emphasis is on the introduction of learning modules dedicated to the characteristics of a learning process, and a new method to configure flexible courses on the basis of these learning objects. In order to fully support the re-use of learning material, meta data are added to the learning objects. Therefore, standardization activities like the Instructional Management System project, the European ARIADNE project and the IEEE Learning Objects Metadata are considered.
Keywords: IT-Based Learning, Learning Modules, Course Configuration, Meta Data

Introduction

High-quality electronic learning material has to be multimedia, based interactive, individual, and adaptable to the learner's knowledge, learning goals and learning progress. These demands cause high development costs and hinder a widespread usage of electronic learning environments. The production costs can be reduced by sharing them among a large user group. To fulfil the high quality on one side and the requirements of widespread use and re-use on the other side, electronic learning material has to be modular and courses have to be a flexible traversal of course modules. In the following, an object-oriented course model with a new highly flexible reference mechanism is introduced. At first, the basic concepts and the different kinds of learning modules are described. Then, a new method of referencing these learning modules by immediate, conditioned and indirect references is introduced. At least, a meta data model illustrates how meta data may support the re-use and in particular the dynamic use of learning modules.

The Basic Concepts of the Course Model

The basic structure of the course model is shown in Fig. 1. *Structure objects*, in a micro view, define a single course segment which is a well-defined composition of content, presentation and interaction. In a macro view they define the course structure and the combination of several course segments to larger course units. A structure object may point to any number of further structure objects. The method *nextSegment()* denotes the next course segment. Furthermore, structure objects may reference elementary learning objects, interactive learning objects, interaction objects, and presentation objects.

The class *elementary learning objects* describes the monomedial learning content: a concrete content is combined with a specific object. Elementary learning objects send messages to presentation objects to display the contents. The method *selectContent()* extracts the content that corresponds to the actual course configuration. The *presentation objects* typically display the content of elementary learning content in the learning-frontend. Therefore, the method *present()* is used. The *interaction objects* handle the interactions with the content and are used to control the course. Interaction objects may send messages to all other objects. These messages may have different

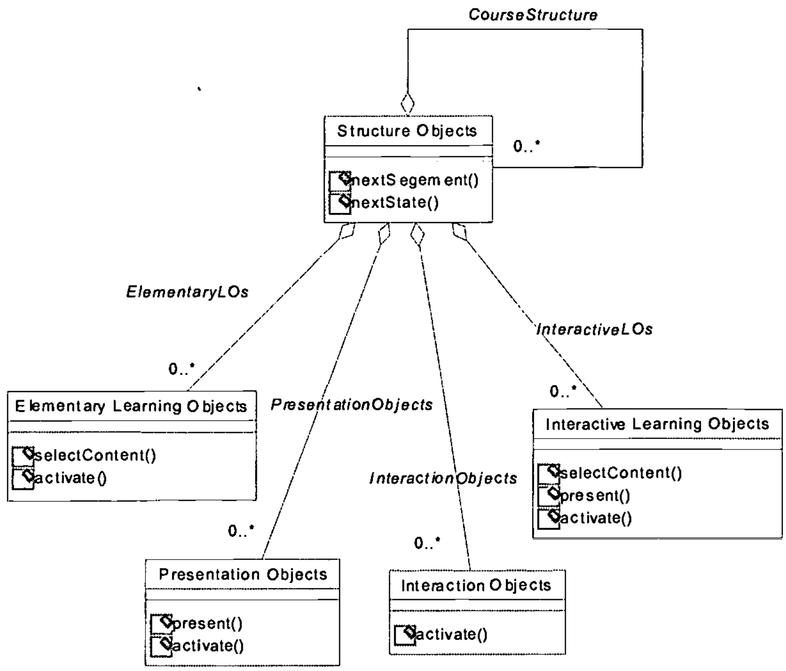


Figure 1: The Basic Structure of the Course Model

intentions, e.g., for an elementary learning object it may be a content selection and for an interactive learning object it may be its activation. Each message is also sent to the corresponding structure object in order to track the actual state of the course segment.

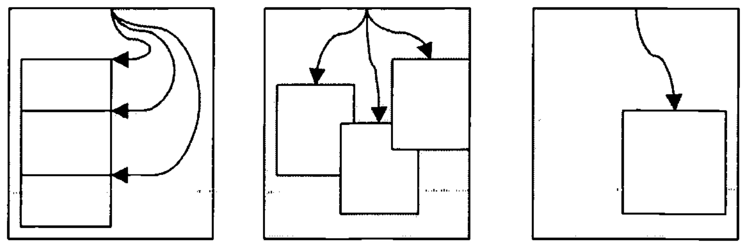
The *interactive learning objects* are an integrated combination of elementary learning contents, presentation and interaction objects. In particular, they are used with highly interactive learning content; the interactions with the learning contents have to be explicitly programmed. By building an adequate class hierarchy for the single course model elements, the specifics of the classes (text or graphic, button or slider) are first realized within the class itself. Thus, a functionally methodical interface can be created which hides from the implementation and platform details and from the properties of a special medium. Therefore, the interface is extensible, reduces the amount of interfaces and supports the author by his original task: producing content and configuring courses.

The Learning Modules

Elementary Learning Objects

The elementary learning objects contain the basic knowledge of the learning units. They are atomic, monomedial modules, e.g. text, graphics, audio or video modules, typically developed with standard editors (MS Word, Adobe Photoshop, etc.) and stored in standard or quasi-standard formats. In (Tritsch 1996), a reference model for tele media is suggested which may serve as a basis for describing and structuring the elementary learning contents; it is extended within this course model.

The new course model suggests a clustering of elementary learning objects and provides a so-called container object, that may contain several elementary learning objects for a well-defined topic, only differing concerning the target groups and the learning levels. A schematic realization of this mechanism is shown in Fig. 2. Within a textual content, different paragraphs can be extracted (1); for graphics, different pictures will be stored (2); and a video can serve all user groups (3). The container object provides for the content, whether it consists of a complete file (3), is extracted from a file (1), or is chosen from several files (2). The content selection is hidden



(1) (2) (3)

Figure 2: Different Instances of the Container Objects for Elementary Learning Content

and the display of the content is – as already mentioned – delegated to the corresponding presentation objects.

Interactive Learning Objects

In contrast to the elementary learning objects, interactive learning objects do not need external presentation objects and allow a direct manipulative interaction on the presentation area assigned to the learning content. Thus, these objects are especially appropriate to gain knowledge by explorations. The medium *computer* is much more used by these contents, while the combination of elementary learning content and presentation objects corresponds more to the traditional way of conveying learning content. Combining these two facilities in one common course model supports both: the classical way of conveying knowledge and the new possibilities supported by the medium *computer*.

Interactive learning objects offer the methods of the elementary learning objects, the presentation and the interaction objects, and are an aggregation of these three object types. Because of the inherent interactivity of the learning content, the content and the specific behavior of these objects have to be programmed by the learning material author. One possibility is the realization of these objects as Java applets; they can be used in several environments and are, in principal, platform independent.

Interaction Objects

Interaction objects are all the classical interaction elements as they are known from the user interfaces (buttons as the superimposed concept for push oder toggle buttons, sliders, etc.). Typically they are hardware-oriented and thus platform dependent. Solving the platform dependency is done by the learning-frontend which means that the concrete instance of an interaction element is realized when it is displayed. Interaction objects within the course model only represent the functionality and do not directly correspond to the interaction elements at runtime. They can be seen as virtual input devices.

Presentation Objects

The presentation objects provide the functionalities to present the elementary learning content. This can be realized in different ways, from plug-ins up to integrated and almost monolithic solutions whereby the presentation unit is part of the system. Therefore, a message channel is established between the elementary learning objects and the corresponding presentation object, and a method within the presentation object is addressed. The course model itself hides these realization aspects. Thus, the courses are portable to several IT-based learning environments and may follow different implementation paradigms. The presentation objects can be seen as virtual output devices.

Structure Objects

Structure objects are used to determine the course structure and the course control, i.e. the sequence of the learning content. Therefore, they contain three elements:

- references to the used objects (in particular elementary and interactive learning content),
- information concerning the layout and
- a state machine for the control.

A detailed discussion of the references follows below. The layout information for the visual positioning of each object is also contained in the structure object. The positions are transferred during the activation of the referenced object. A state machine is also part of the structure object. Within this state machine, the sequence of the course segment is anchored and it serves for the control and the monitoring of the learnflow.

The Reference Mechanism

So far, the basic concepts of the course model and five types of learning modules have been described. Within this chapter, a new mechanism to combine these learning modules in a flexible manner is introduced. Referencing learning modules in an object-oriented context means the establishment of relations between objects. If these objects are persistent, i.e., they are stored in a data base, the referencing can be done by referring to unique identifiers (Object Identifier - OID). The main problems of this "classical" kind of referencing are:

- Unidirectional relations
  Mostly, the references are unidirectional, which means that they point from the referencing object to the referenced objects. The objects do not know who references them (comparable to the hyperlinked documents in the WWW). If objects are deleted, it is hard to find and delete all links that point to them.
- Location dependent referencing
  Because the referencing object wants to reference a dedicated object, the object's location has to be known and may not change. Thus, a migration from one data base to another is not allowed.

These problems can be solved by so-called "indirect references". This means that objects are referenced by a description of the desired object based on unique qualifiers, e.g. the topic of the course, the context and the target group. The realization of indirect references is supported by meta data. Meta data know their objects (instances) and are able to resolve the requests without "visiting" the specific object. Thus, meta data have to be independent objects with an anchored semantic.

These independent meta data objects may be used in search requests to treat a specific learning content. For a structure object it should be hidden whether the referencing is performed directly or indirectly. Thus, a direct integration of the query into a structure object is not desired. Therefore, and also to handle direct references bidirectional, the references are modeled by an independent class, which is used by a structure object to build course structures. The advantage of this kind of referencing is the "best-in-class" approach, which means, that the best fitting object is found when the references are resolved. Thus, the possibly best knowledge conveyance is guaranteed. This approach may cause problems because reference resolving may start when a course segment is activated and thus runtime problems may occur. The effects can be decreased by suitable implementation methods and tools. Referencing an object within a structure object is done by the abstract super class *Reference*. For elementary and interactive learning objects as well as for structure objects this reference is resolved by an object of the classes *directReference* or *indirectReference*, and for presentation and interaction objects always by an instance of the class *directReference*. As shown in Fig. 3, the class *directReference is* further divided into the classes *immediateReference* and *conditionedReference*. While an immediate reference directly establishes the relation to the target object, a conditioned reference points to several alternative target objects. Theses are identified by a first order predicate logic and imitate the *case* construct. Thus, direct references may point to several target objects depending on conditions.

If the course author exactly knows which learning object he wants to integrate into the course, he typically uses an immediate reference and directly names the learning object. If he wants the learning objects to be dynamically chosen, e.g., in dependence on the test result, in dependence on the learner's preferences or in dependence on the learning environment's equipment, he uses conditioned references. Since the conditioned references are a sub class of the direct reference, the author has to specify the conditions and to name the learning objects.

The Meta Data Model

To support the re-use of electronic learning material, a modular learning material structure as developed before is not sufficient. Furthermore, a mechanism is needed that maximizes the goal-oriented usage of the available modules. Meta data are such a mechanism. Meta data are used within the introduced course model to describe the structural and content-specific properties and the behavior of an amount of objects satisfying a com-

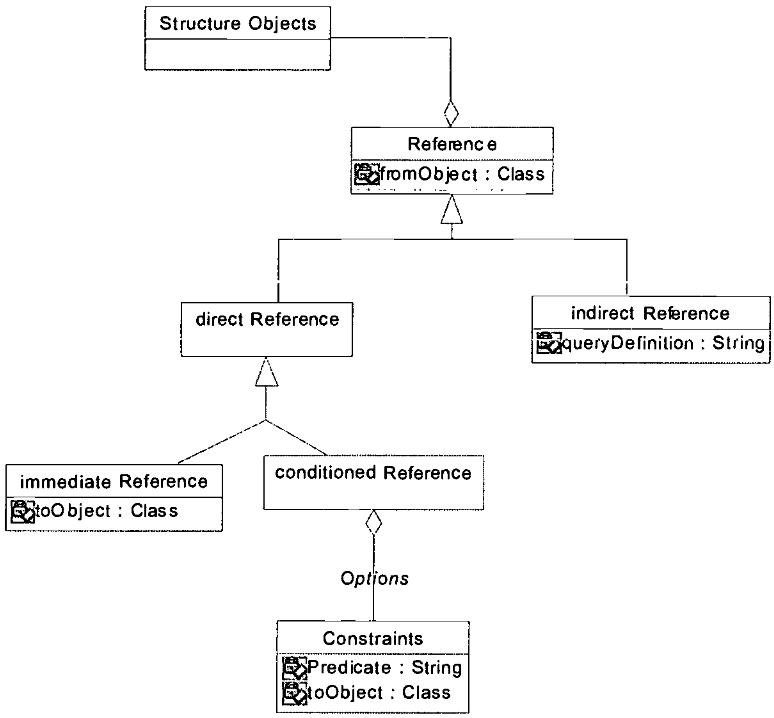


Figure 3: Class Hierarchy for the Reference Concept

mon structure. A single object receives its specific properties while values are given to its attributes. The meta data attributes, their categories and their value domain uses the standards draft proposed by the IEEE working group LOM (LOM 2000), the ARIADNE project (ARIADNE 2000) and the Instructional Management System (IMS) project (IMS 2000).

Meta data are also used for a content-related retrieval of learning objects and are given to each module class described above. Meta data are realized as independent objects and each meta data object points to all related learning objects derived from it. These relations between meta data objects and the related learning objects are illustrated in Fig. 4. The object's specifics, like its data base or its location are hidden, and in consequence, the data base requests can be formulated independent of the location. In addition to the structure descriptions, the meta data also contain control aspects concerning the learning material presentation. The presentation of learning material requires knowledge of the medium (e.g. the MIME-types within the WWW context) to identify the dedicated program that may display the file. To support context-specific restrictions of the learning modules and its suitability for different knowledge levels, more content information has to be provided. For example, video sequences could be limited to those sequences which are necessary to reach a certain learning goal. These additional properties differ from medium to medium and thus, a medium-adapted support is necessary.

Conclusions

A new reference mechanism to support a flexible and dynamic course configuration was introduced. The usage of immediate references enables course authors to directly address the learning modules they want to integrate into a course. Conditioned direct references also allow for direct addressing but additionally they allow for the dynamic selection of learning modules in dependence on several decisions possibly made during the course traversal, e.g. test results or to learner interactions. Indirect references contain most flexibility concerning the learning modules' selection but may terminate in uncertainty. To fully use the facilities such a highly flexible reference mechanism offers, it was shown, that courses have to be modular and that meta data may support the flex-

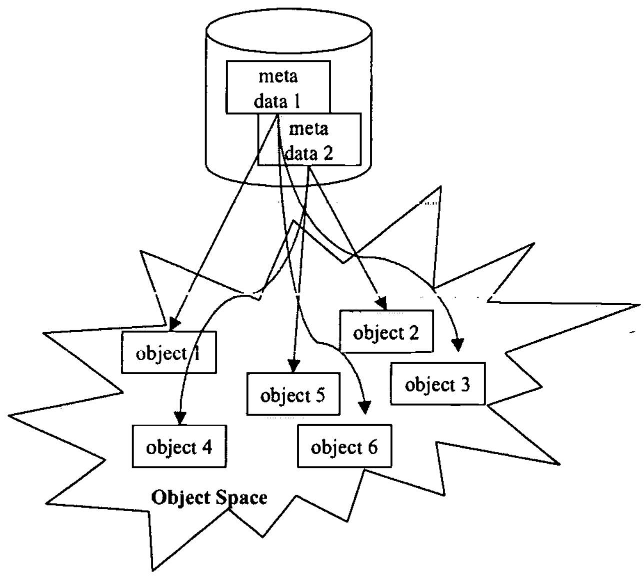


Figure 4: Relations between Meta Data and Objects

ible course configuration. This flexible course configuration is a key issue to re-use learning content in different courses and to serve learners with different knowledge and learning goals. The introduced course model may be the basis for the implementation of several IT-based learning systems. It has been partially realized within the DEDICATED Modular Training System (DEDICATED 1995) and the project IDEALS (Lindner 1997). Learning material designed according to the proposed concepts follows the intention of international activities: harmonization and standardization of learning content, learning services and learning technologies (LTSA 2000, PROMETEUS 2000).

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Programming-free Web-based Automatic Online Drill/Quiz Creator

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Abstract: This is to introduce an on-line drill/quiz making system that can be operated on a Web page. This system can easily and instantly create drill and quiz pages with scoring and log functions to be published on the Internet even by a novice. Drill pages made by the system have been used in our language classes to help the students improve their listening skills. The goal of our research is to make customized on-line exercise pages with an automatic grading function for classroom use, in any subject. Both multiple-choice and fill-in-the-blanks questions, either in English or Japanese, or in any other languages as long as necessary fonts are installed in the machine, can be created by the system. Both two types of questions can be put together on the same page. The number of questions is limited within ten on one page, but the number of such pages can be limitlessly created, and then several of them can be selectively bound together, also automatically, into one compound drill, which makes it possible to give on-line examinations.

Introduction

We have been engaged in developing systems by which we can make and conduct Web-based on-line examinations and drills. So far we have developed four systems, such as Saiten (meaning grading or scoring in Japanese), Nyushi (meaning entrance examination), Shiken (meaning examination) and New Shiken:

(1) The Saiten System in 1998 (http://koby.rikkyo.ac.jp/saiten/quest.html)
(2) The Nyushi System in 1999 (http://koby.rikkyo.ac.jp/final99)
(3) The Shiken System in June, 2000 (http://koby.rikkyo.ac.jp/classes/listening/2000s.html)
(4) The New Shiken System in September, 2000 (http:// www.rikkyo.ne.jp/~kobayasi/conf/sample/ samplemain.html)

The drills and examinations created on each of these systems have been actually used mainly in our English classes at Rikkyo University and Mie University. The new shiken system, the last one on the list above is being experimentally used in Kobayashi's English listening classes, to make supplementary review exercises to be given to the students each week, and to be modified into a stable and better system. Some examples can be tried at the following page: (http:// toby.rikkyo.ac.jp/ english/shiken/shiken.html)

Purpose of our project and research

The purpose of our project is three-fold.

(1) To make an archive of on-line drills and tests to be used on a Web browser.
(2) To make an archive of audio/video materials which can be shared and used on these drills and tests.
(3) To present an on-line drill/quiz creator for free use for anybody, particularly for teachers to easily make on-line drills and exam: We are trying to develop an ideal system by which on-line drills can be made with ease, hoping that teachers in any subject all over the world can make their own on-line drills so that they can share such Web pages of drills on the Internet.

The New Shiken System

1. Functions

Our newest system can be operated by going to a Web page on the Internet. It has functions as follow: (See the Web design below.)

(1) The list of all on-line drill/quiz pages
(2) The script (source code) of each page
(3) The answers to the questions of each page
(4) The creator's page to create a single page of drills/quizzes
(5) The creator's page to create a compound page of drills/quizzes
(6) The log page

Creator's page

Creator's name (4 letters) : tony

Password: ••••

Functions
◉ List of all the pages
○ Script of the page(Fill in the the box at the bottom, too with the name of the page.))
○ Answers to the questions (Fill in the the box at the bottom, too with the name of the page.))
○ To Create a Single Page Drill(Fill in the box at the bottom, too with the name of the page.))
○ To Create a Compound Page Drill(Fill in the the box at the bottom, too with the name of the page.))
○ Log Page

The name of the page (4 letters or numbers) : a001

[Next] Confirm the information above and click this botton.
Igonore a warning window or message and go on to the next page.

The best function of this system is the fourth one by which more than one single page scan be integrated into one compound drill page with the total score suited to it automatically incorporated to the newly made page. On this system, the learners can do the exercises on the pages created by the teacher and they immediately receive their results .The teacher can look at his/her students' results or scores on the log page. Even a novice can use the program by simply going to a Web page where he/she can create pages and they can be automatically uploaded, by clicking the button at the bottom of the creator's page. The drills can be done on any machine with an Internet browser connected to the Internet.

2. Procedure of creating an on-line drill/quiz page by the New Shiken System.

(1) The user (teacher) goes to the creator's page.
(2)The user copies the example HTML, pastes the HTML in the text box on the page, changes the example questions to his/her own, then the user puts the answers to the questions in each of the answer boxes also on the same page.
(3) The user sends the questions and answers in the boxes to the program by clicking the button on the same page.
(4)The drill page will be automatically made by the program in our server.
(5)The returned message will tell the address of the newly created drill page.
(6)The user has a dry run of the page and improves it, if anything is wrong, by repeating the above procedure. The user can refer to the source code and answers of each page preserved in the program when he/she improves it.
(7)The user makes as many pages as he/she wants to.
(8)The user goes to the page to make a compound drill/quiz page. He/She selects several pages which have been already created, and then clicks the button at the bottom to see the combined drill/exam page.

A Collaborative Learning Support Based on Inference Mechanism of Group Actions and Reactions: Framework and Evaluation

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Abstract: For the collaborative learning, it is necessary that computer-support systems should grasp the learning process for deriving answer among participants and coordinate smartly so as to make all participants well-understood. Therefore, our objective is to construct the collaborative learning support system which supports the learning by generating appropriate advices for the learning group according to the situation. In order to enforce the students' abilities to cope with various exercises, to discuss various viewpoints as well as to derive the answer are necessary. So, the extent of discussion as well as the progress of deriving answer are also focused as a learning situation. To handle such learning situations respectively, the resolution derivation scenario and the divergent tree are introduced. In this paper, we describe the mechanism of grasping the learning situation and evaluate our experimental results. The result indicates the effectiveness and gives the perspective for improving our system's functionality.

1 Introduction

Nowadays, Internet and Intranet are very popular and provide a powerful interaction environment without depending on the physical distances among participants. However, there are many problems when such an environment is applied to the collaborative learning as an infrastructure for educational fields. In order to cope with the problems, various approaches/methods have been investigated. For example, as for the construction of cooperative groups, the mechanisms to find the appropriate co-learners according to the students' learning situations or understanding levels were proposed (e.g. Ikeda, et al.[1]). Also, as for the promotion of smooth discussions, several interaction models were proposed for the purpose of detecting conflicted situations or grasping the students' contributions for discussion (e.g. Tedesco, et al.[2]), and so on. These researches provide effective learning environment for deriving answer from viewpoint of promoting interaction.

On the other hand, it is also important to focus on problem solving process in addition to such coordination facilities for interaction. In case that participants tackle exercises attended respectively with right answers, it is necessary that the computer-support systems should grasp the learning process for deriving answer among participants and coordinate smartly to make all participants well-understood. For example, Constantino-Conzalez, et al.[3] introduced a private coach for each student to the learning environment where students discuss solutions to construct appropriate ER diagram. The private coach monitors the participation of corresponding student and also compares his/her ER diagram, which was prepared beforehand, with that of group, in order to encourage them to share and discuss the solutions which have the conflict with group's. Nakamura, et al.[4] provided a pseudo student who corresponds to each learning student, grasps the learning situation of corresponding student, and participates into the discussion in order to activate the discussion.

In the collaborative learning, students do not study individually, but behave as members of a group. Moreover, well-collaborated group has more knowledge than individuals. Therefore, it is effective to manage the learning situation from a viewpoint of the group activity, but not of individual students. Our objective is to ensure the effectiveness of collaborative learning by generating appropriate advices for the learning group according to the situation. Currently, the target learning situation is limited in order to manage the learning group easily: the final answering path of the learning group is always unique. Under this consideration, the learning group is able to be regarded as one supporting object.

In this paper, we describe the mechanism of grasping the learning situation of our collaborative learning support system for mathematical exercise and evaluate our experimental results. In Section 2, we address the system configuration and the mechanism of grasping learning situation. In order to enforce the students' abilities to cope with various exercises, to discuss various viewpoints as well as to derive the answer are necessary. So, the extent of discussion as well as the progress of deriving answer are also focused as a learning situation. To handle such learning situations respectively, the resolution derivation scenario and the divergent tree are introduced. Then, in Section 3, the system evaluation based on our experiment is shown. The result indicates the effectiveness and gives the perspective for improving our system's ability. Finally, we conclude our paper in Section 4.

2 System Configuration

2.1 Interaction tool

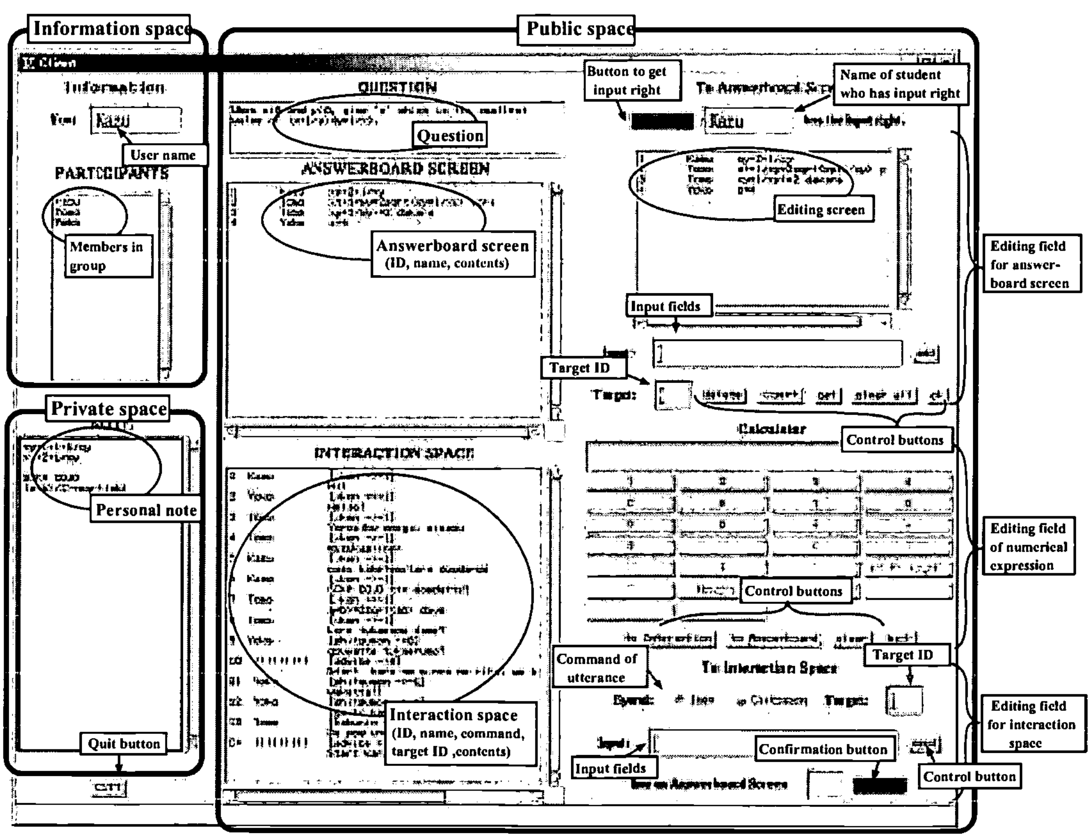

Figure 1: User-interface in collaborative learning support system

Figure 1 shows the user-interface in our collaborative learning support system. When a student participates into the learning group, his/her name appears on information space to make his/her existence explicit for others. Collaboration activities for attaining the goal take place on the answerboard screen and interaction space in the public space. Interaction space is prepared for free conversations and functions as a chat system. On the other hand, answerboard screen is regarded as a blackboard in our real world in which learning group's answer is organized. In this screen, only one student, who acquires the input right, is able to fill in. Currently, the exercise applied in this system is mathematic and, as for the correctness of the system's behavior, there are some limitations for the representation of equations. Therefore, the support tool for inputting equations in our public space, which is called "calculator", is provided. The system grasps the learning situation only from inputs written on this public space, such as answerboard screen and interaction space. On the contrary to the public space, our private space is a plane text window in which each student is able to use freely. The description written on that space is not shared by other students.

2.2 Mechanism for Grasping Learning Situation

During the learning, students are able to resolve some learning situations that are not so seriously ineffective through the discussion: so, our system does not watch up detailed learning situations. However, our system is required only to catch the learning situations that seem difficult for students to cope with by themselves. Two following viewpoints are focused as the learning situations: progress of deriving answer, and extent of discussion. Figure 2 shows the conceptual diagram for these viewpoints. When the answering steps in all answering paths are arranged as Figure 2, the learning situation is transformed by projecting to X-axis, which indicates the progress of deriving ratio, and Y-axis, which represents the extent of discussion in the system.

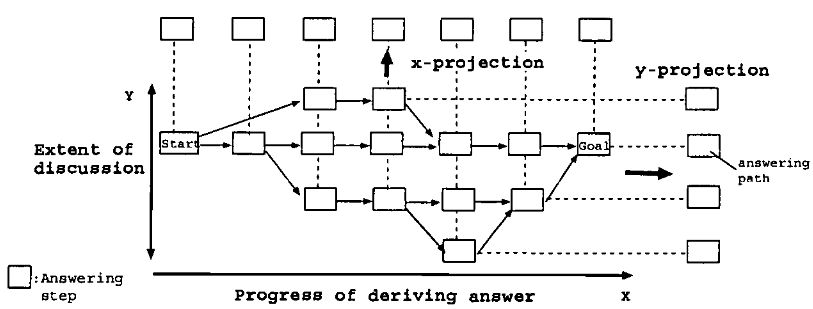

Figure 2: Learning situation

In order to grasp the progress of deriving ratio, the resolution derivation scenario is introduced. The resolution derivation scenario represents the answering progress according to the time sequence, and consists of ordered states which correspond to individual answering scenes. Each state contains statewords which are the identifiers of the state itself. When the stateword is input during the discussion, the system specifies the current answering state by keywords matching and then marks the state by means of a pointer called "current". Each state also has its own derived ratio in whole answering process. Therefore, the change of the derived ratio for state, pointed by "current", shows the progress of learning. In addition to "current", the system also contains pointers called "upper" and "lower", by which understanding range of learning group is represented. Based on these pointers, impasse situation such as no-progress of deriving answer is detected. Furthermore, students who cannot understand the current answering step are grasped by the distance between the derived ratios for the states pointed by "current" and "lower". More details about this mechanism can be seen at Kojiri, et al.[5].

On the other hand, the extent of discussion is able to be regarded as different answering viewpoints expanded during the discussion. The difference among answering paths is defined by the ratio of uncommon answering steps in whole answering process. Each answering step depends on the preceding answering steps: once different answering viewpoints are adopted, the following answering steps are based on different viewpoints even if their specifications are the same. Thus, the difference among answering paths is defined as a derived ratio for divergent points. For the purpose of grasping the different degrees, the divergent tree is introduced, which arranges whole answering process into a tree structure according to the divergent points among individual answering paths. In the divergent tree, each path corresponds to the answering path and the node with child nodes is the divergent point. A node contains nodewords which discriminate both each node and the derived ratio of the corresponding divergent point in whole answering process. The system calculates the range of the difference among answering paths, derived during the learning, and assists the students to notice other answering paths of different viewpoints. More details are able to refer to Kojiri, et al.[6].

Based on this mechanism, current version of our system detects ineffective learning situations: no progress has been made in a specific time; understanding levels in learning group are too different; no well-discussed answering viewpoints exist; and so on.

3 Experiment and Consideration

3.1 Experiment

For the experiment, the learning group was organized by four university-students; two freshmen, one bachelor, and one master students. The experiment took place in a computer room, but they were seated separately enough not to talk in face to face. All students were familiar with communication through computers to some extent.

The exercise which we prepared is shown bellow. 4 different answering paths are prepared based on the answers collected beforehand from 10 graduate students of our laboratory members. In the mathematical exercises, the answering paths are able to be divided into several stages according to the answering methods to be applied. Therefore, statewords and nodewords are defined as the equations which are derived in those stages, respectively.

EXERCISE: When $x > 0$ and $y > 0$, give the smallest value of $(x + 1/y)(y + 1/x)$

3.2 Results and Consideration

Figure 3 is the result of the learning according to the resolution derivation scenario and the divergent tree. In this figure, the changes of learning situations, which are called "scenes", are shown with their triggered inputs. As individual scenes, the true understanding levels of students, which we asked afterward in detail, and the learning situation of what the system grasped are represented. The true understanding levels of students are indicated by the circled alphabets such as A, B, C, and D, which correspond with four students respectively. In this experiment, the student A knew which answering method takes a correct answer when the exercise was proposed. Other students understood the exercise gradually through discussion.

As for the learning progress along the resolution derivation scenario(Figure 3(a)), since students input their opinions after they became sure of them, the learning situation grasped by the system was somewhat behind in comparison with that in our real world. In addition, the system cannot understand the real situation if students do not input their opinions to the public interface: for instance, the student A's understanding level was not grasped because he did not insist. However, these mis-understandings are no problem as long as the learning proceeds smoothly.

During the experiment, two kinds of situations were detected as ineffective situations: one was impasse situation that there was no progress of deriving the answer for a certain period, and another was that some students who could not understand current answering step and did not insist their opinions may exist. For the former situation, COMMENT's 1, 2, and 4 were generated as advices. These advices functioned effectively to the learning situation. That is, after COMMENT's 1 and 2 were derived, the student A proposed hints for deriving answer so that the understanding levels of individual students became higher. As for COMMENT 4, the student B wrote an answer to the answerboard screen. On the other hand, comments corresponded to the latter situation can be seen as COMMENT's 3 and 5.

Although these comments seemed unnecessary for this learning group, they are still appropriate for the collaborative learning in the web world which our system focuses on, because members in the group may be uncertain in such environment so that it is necessary to ask for other students' understanding levels occasionally. In this case, the student B confirmed other students about the current answering step after the COMMENT 5 was generated.

As for the derived answering paths detected by the divergent tree(Figure 3(b)), the answering paths which students considered were marked by circled alphabets. When the learning started, only a student A knew the answering path correctly and the system grasped that no one understood the answering path. During the discussion, paths 1 and 2 were derived, but because of the flexibility of the keyword matching, the system also detected the path 5. Finally, the path 2 was successfully detected as the group's final answering path. So, after the answer has been derived at *scene 10*, the system generated COMMENT 5, in order to make the learning group consider underived answering paths, such as paths 3 and 4.

As a result, the system was not always sufficiently able to grasp the learning situation correctly, especially when there were students who did not insist their opinions explicitly. However, the advices that the system generated when it detected ineffective learning situations affected to the learning group effectively to promote the discussion activity.

4 Conclusion

In this paper, we addressed our system that supports the collaborative learning from a viewpoint of promoting collaboration. Also, we introduced the mechanism of grasping the situation of learning group. Then, we evaluated our system based on the experiment results. The results show that our grasping mechanism could detect the learning situation sufficiently which had occurred during the discussion.

Finally, for our further research, we have the following topics:

- to generate the timely effective advices according to the grasped learning situation,
- to cope with more flexible learning situations: that is, to free from limitation described in Section1,
- to generate teaching/studying materials, and so on.

Acknowledgments

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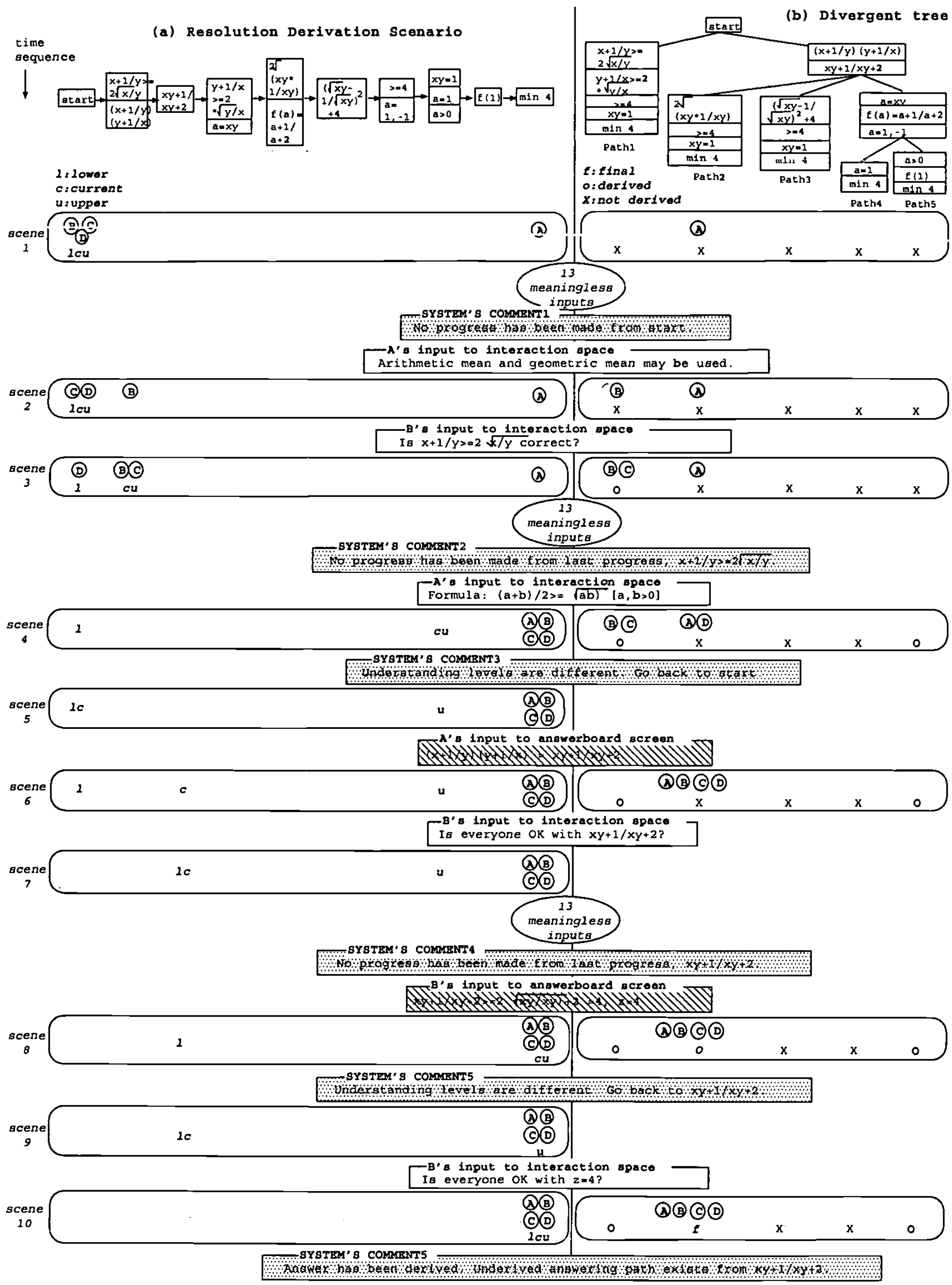

Figure 3: Results of experiment

Universitas 21 Learning Resource Catalogue using IMS Metadata and a New Classification of Learning Objects

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Abstract: Version 2 of the Universitas 21 (U21) Learning Resource Catalogue (LRC) has been completed. The catalogue is a repository of IMS metadata (records) of learning objects. The prototype of the catalogue had hundreds of records of vastly different type and size (granularity). This great range of objects came about because learning objects have been defined in very simple terms yet they can vary greatly in size and complexity. The learning objects were described in IMS terms, and characterised by metadata that can be lengthy and complex. It was recognised that a classification of learning objects at a high level (prior to assigning metadata) can convey much information to a user and simplify the process of determining the type and characteristics of a learning object. This classification system of learning objects is presented and demonstrated here. Examples of two of the five classes are: basic objects that have no inherent educational context; and objects that have a technological pedagogical model with embedded content. The classes enable a high-level search and identification of object descriptions (records) stored in the catalogue. The structure, function and utilisation of the online catalogue using learning object classes and metadata will be demonstrated.

Introduction

In a previous paper, Koppi *et al.* (2000) described the value of a Learning Resource Catalogue (LRC) to a teaching and learning institution and illustrated how an online catalogue of learning object metadata (IMS: http://www.imsproject.org/) had been prepared and utilised by a consortium of universities (Universitas 21). This paper is concerned with the catalogue system relevant to this group of universities. There are other examples of database systems using the concept of learning objects such as ARIADNE (2000) and MERLOT (2000).

Upon examination of the collection of learning object metadata from several universities in the Universitas 21 LRC database (Version 1) it became clear that the concept of a 'learning object' was very wide indeed. One of the variables of the objects was the size (granularity) which had a wide range. Wiley *et al.* (1999) were also concerned with the difficult problem posed by the large range in size of learning objects and that large learning objects had limited reusability. In fact, an entire curriculum could be seen as a learning object. For U21 purposes, it was concluded that prior to the creation of metadata for cataloguing purposes, it would be useful to have a sorting mechanism for the learning objects.

Learning objects, have been defined simply by the IEEE's Learning and Technology Standards Committee as: "any entity, digital or non digital, which can be used, reused or referenced during technology supported learning" (http://ltsc.ieee.org). This simple definition means that there is a very wide range of learning objects that have been created by many different people.

In keeping with the definition, a learning object entity may be simple, such as an image, or much more complex, such as a learning program containing images, text and activities. This latter entity may be considered to be a single entity or to be an agglomeration of several entities, i.e., objects embedded within objects. A fundamental part of the definition is that the entity can be reused. The more complex the entity (containing multiple objects) the less reusable it actually is. Reusability is a matter of degree – an entity may still be a learning object even if the reusability is limited.

One of the reasons for the diversity of learning object types is that the creators of learning objects may be very different people with different skills, such as subject matter experts e.g., academic staff who provide specific information, educational designers who provide a pedagogical model, or a programmer who builds a technical framework. A learning object may be created independently by any one of those classes of people. It is also possible that one person creates an object that contains information in an educationally structured way and that same person also creates the technical implementation. A learning object classification system has facilitated the identification of learning objects and their utilization.

Classification of Learning Objects

One of the authors (Lisa Hodgson) was responsible for designing and refining the classification scheme utilised by the U21 LRC. Five classes have been used. These are listed here and then each class is described with examples.

1. Raw asset
2. Learning asset
3. Task or exercise
4. Pedagogically derived technological application containing content
5. Pedagogically derived technological application devoid of content

Class 1: Raw asset

This can be defined as an object with potential for use in an educational setting although it contains no inherent educational context. Raw assets are learning objects that have massive potential in reuse in a virtually unlimited capacity. Examples of raw assets include:

- A picture of a master painting
- A topographical map
- A video of an apple falling from a tree
- An audio clip of a famous concerto
- A poem

These raw assets have the widest reusability potential as they can be customised and adapted to suit a wide range of contexts, disciplines, learner levels, and pedagogy. To have meaning in an educational setting, either the course creator or the student must put them into a context.

Class 2: Learning asset

While similar to a raw asset, a learning asset has been placed into an educational context by the addition of certain information. Examples of learning assets include:

- A picture of a master painting with facts, such as the artist who painted it, the period it was painted and the techniques used
- A topographical map with an explanation on the procedure for reading the map or the purpose and uses of such a map
- A video of an apple falling from a tree accompanied by an explanation of the theory of gravity
- An audio clip of a famous concerto with information about the structure of a concerto, or definition of minor and major keys using the music to illustrate the theory
- A poem with information on the use of metaphor in poetry

- A paper or article explaining a concept or theory

Both raw assets and learning assets are dominantly passive objects in that they do not explicitly require the user to interact with the knowledge i.e., no task is given.

A learning asset is loosely equivalent to a resource that a lecturer may source to accompany a lecture. A learning asset can therefore be associated with a didactic lecture. The learning asset is a resource that is put inside a context or used to explain a concept.

Raw and learning assets are classes of learning objects that have very little or no learning theory or pedagogical framework. The potential for reuse of both is high, however a learning asset is slightly less reusable, depending on the complexity of the educational information given with the learning asset – the more complex, the less reusable.

Class 3: Task or exercise

A task or exercise can be a learning object. The activity is usually within a context or discipline and can (but may not) include raw and learning assets to aid in the task execution by the student. This class differs from the raw asset primarily because it is always contextual; a student must carry out an activity and attain a particular level of performance in a particular context. While raw assets may have an implied learning objective (e.g., after viewing the video of a falling apple, students may relate it to the theory of gravity), they do not include a means of the learner exploring that implication. Examples of task or exercise learning objects include:

- A picture of a master painting with a task asking the student to write an essay on the use of colour to convey mood, or explain the dominant techniques employed by this artist as illustrated in this typical work
- A topographical map with an explanation of how such a map is created and a task asking the student to create their own topographical map of their environment
- A series of multiple choice questions that explore the understanding of gravity
- An audio clip of a famous concerto with an exercise that asks the student to map the compositional structure of the piece of music
- A selection of themes and a request that the students write a poem based on one of the themes using metaphors as a primary structuring tool
- A group of papers or articles introducing a theory and a structured-writing task that asks students to summarise the various viewpoints expressed

Class 4: Pedagogically derived technological application containing content

This class of learning objects, while similar to the previous class, is different in that the learning objects have embedded content. It may include a whole course or curriculum and has the disadvantage of having the lowest reusability. To be useful it must fit all the teacher's parameters, such as, pedagogical framework, user level, context, and technological delivery mechanism. It also has the lowest re-development needs being already complete and ready for implementation. However, if modifications need to be made they may be costly. Because these objects are complex, it may be difficult to link with other similar objects to make a coherent learning experience for students. Examples of this type of learning object include:

- A web role play with a united nations scenario and defined roles for student participation
- A multiple choice assessment module that test students on their understanding of organic chemistry
- A module that allows students to annotate a set of x-rays to highlight abnormalities
- Problem based mode of enquiry module that uses small groups to investigate the viability of alternative methods of fuel besides petroleum-based products

Class 5: Pedagogically derived technological application devoid of content

This class of learning object is a technological application of a pedagogical model. It may be thought of as a shell or template (e.g., WebCT), and is a technological framework without content or context designed according to a pedagogical rationale. This type of learning object has a high degree of reusability because it has a structure, but the content is added by the course designer. Lecturers or course creators would utilise such an object (provided that it was governed by an appropriate pedagogical model that would permit relevant learning experiences) by adding specific content and context to customise the object to their course.

The disadvantage of this learning object, in terms of reusability, is that it requires compatibility of technologies between the object, the delivery system and other objects or components such as recording of grades and student tracking. Careful consideration into the standards and tagging of such objects will be required. Examples of this type of learning object include:

- A role play simulation generator which allows a lecturer to set up a scenario that allows students to participate in a role play
- A multiple choice self-assessment module that allows lecturers to create a bank of questions and generate quizzes for student self-assessment
- A chat room that enables two way communication between teacher and student
- A module that allows students to annotate images and write comments which can be saved together
- A problem-based enquiry module that allows lectures to add problems and resources and organises students into teams to undertake the problem solving activities.

Utilisation

Version 2 of the Universitas 21 Learning Resource Catalogue has many refinements in the tools for creating catalogue records that utilise IMS metadata to describe learning objects. In addition, a classification of learning objects has been employed. . The classification occurs at a high level prior to the creation of IMS-based metadata. The catalogue can be searched on the class of learning object as well as on other criteria. The structure, function and utilisation of the online catalogue will be demonstrated.

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SITUATED AND SOCIALLY SHARED COGNITION IN PRACTICE: Designing a Collaborative Network Learning Experience for Adult Learners

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Abstract. The main purpose of this presentation is to draw attention to assumptions that guide the instructional design process when implementing and organizing network-based learning environments in practice. In this case, the situated and socially shared cognition model and participation metaphor create the guiding paradigm for collaborative learning action, which stress the socially shared knowledge construction and collaborative context of learning environment. The case design reviewed here is the Nursing Science module in Open University, which is carried out through a WebCT-based network learning environment. As a conclusion, a collaborative learning model and instructional design paradigm integrating the dimensions of intentionality, content, context, community, participation, facilitation and self-assessment, are discussed.

Key words. Situated cognition, socially shared cognition, collaborative learning, network learning environment for adult learners

1. From individual to socially shared cognition: searching for a collaborative instructional paradigm

There is a growing tendency to strive for integration of individual and social dimensions in new learning environments. Situated cognition, or a situated learning approach, has made a significant impact on educational thinking since it was first analyzed and introduced by Brown, Collins and Duguid (1989). This instructional paradigm has been further developed by Jean Lave and Etienne Wenger (Lave 1988, Lave & Wenger 1991; Lave 1997; Wenger 2000), whose work has been instrumental in providing the research base and practical implications for the theory. A community of practice is seen as an environment where knowledge construction occurs and where culturally derived norms are formed and learned (Billet 1998). On the other hand, the sociocognitive view stresses the development of socially shared cognitions in groups. Social interaction is seen to be a paramount site for the development and practice of cognition. One might expect groups to perform better than individuals on various tasks, including learning, concept attainment, creativity, and problem solving. (Levine et.al. 1993; Scardamalia & Bereiter 1994). Both these views are heavily based on the work of well-known educational thinkers like Vygotsky and Dewey. The use of these kind of collaborative learning ideas as an approach to the design of learning environments has significant implications for the instructional design of web-based learning environments. As an instructional strategy, these situated or socially shared cognition models have been seen as a means of relating subject matter to the needs and concerns of learners (Shor 1987) and coordinating cognitive interaction with others (Levine et.al. 1993). These social ideas of learning understand it as a sociocultural and collaborative phenomenon rather than the action of an individual acquiring general information from a decontextualized body of knowledge (see Kirshner and Whitson 1997). The core idea in design is that knowledge and skills are learned in the collaborative contexts that reflect how knowledge is obtained and applied in real-life situations. In general, knowledge is understood as a result of social construction and production of meaning. Learning is understood as an interactive discourse with shared knowledge and enculturation process to the culture and institution behind the shared knowledge.

Learning becomes a social process dependent upon transactions with others placed within a context that resembles as closely as possible the practice environment. Anna Sfard (1998) discriminates between two differing metaphors for instructional design: the acquisition metaphor and the participation metaphor. The acquisition metaphor refers to human learning as acquisition of something. Learning is understood as knowledge acquisition and concept development in mind. This gives a one-sided idea of what learning and knowledge are. One can characterize the assumption of knowledge as dualistic. Knowledge is seen as a permanent and immutable truth that the learner is trying to absorb. Generally, learning is seen as an individual mental and inner state and reception of knowledge. Instead of that, the participation metaphor sees learning as participation in a certain community's meaningful action. Learning is understood as a socialisation and growth process into that community, where the culture, shared knowledge and values are absorbed. What is central is the dialogue where knowledge is shared and constructed and where the meaningful experiences are coming about. When organising learning, this directs attention to the development of communities and environments of practice, not individual learners only. The situated and socially shared cognition views and participation metaphor create a guiding paradigm where learners' social and communicative skills are supported, guidance for collaboration given and the whole learning environment can function as a knowledge-building community.

2. The Case Design Reviewed

The case design reviewed here is the Nursing Science module in Open University, which is carried through a WebCT-based network learning environment. These program platforms developed for web-based instruction, like WebCT, Lotus Learning Space, Future Learning Environment (FLE) and many others, contain discussion groups, group work areas and other communication channels, which support learning as dialogue, knowledge sharing and knowledge construction with other learners. Information networks provide possibilities for this kind of communicative learning without the limits of time and study place commitments. The development of collaborative learning practices is seen as important, which is something more than just combining and directing individual learning processes together. In this case the Nursing Science module was divided into three courses, which all share the same organised structure (see Fiq.1).

When outlining the collaborative basis and participation metaphor in practice it is important to pay attention to the organisation of communication and learning processes in the learning environment. In this case learning is not only virtual; it also involves contact teaching as orientation and small group work under a mentor's supervision. The task of the small group is to continually assess the intellectual growth of the individual and the community of learners. In an adult learning group, the mentor fosters the notion of cognitive apprenticeships (see Brown, Collins, and Duguid 1989). When virtually participating in a network discussion group, individual learners witness how colleagues solve problems and have developed their own solution paths. In an ideal situation, these tools and methods of cognitive apprenticeship include discussion, reflection, evaluation, and validation of the community's perspective. Instructors (teacher and mentors) must provide a scaffold for new learners, that is, know the type and intensity of guidance necessary to help learners master the situations they face in the new learning settings. As learners acquire additional skills, less support will be needed. Instructors recast their roles from content transmitters to facilitators of learning by tracking progress, assessing products produced by learners, building collaborative learning environments, encouraging reflection, and helping learners become more aware of contextual cues to aid understanding and transference (Ottoson 1997).

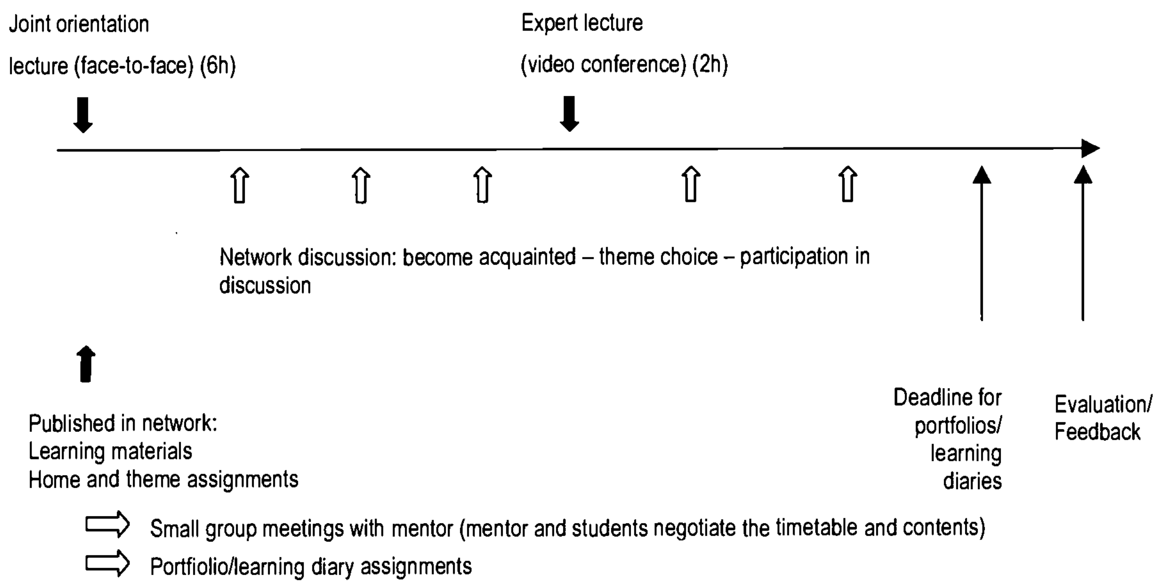

Figure 1. The Structure of the Network Learning Process in Open University Nursing Science Courses

The educational basis of participants was a specialist vocational degree in the field of nursing or a first year university examination in Nursing Science in Open University. Most of the participants are females. The target group is interesting because it is not considered a typical network learner group. The central requirements in these network courses are to participate in network discussion and to construct a learning portfolio. The learning portfolio consists of several assignments: learning diary, analysis of network discussion themes and written home assignment. Students are encouraged to do the home assignment and analysis assignment together with a fellow student (or students).

The main research question in this case was to try to find through these collaborative learning experiences some evidence and conceptions of creating a general design paradigm for collaborative network learning settings. The main research data collection and analysis method was qualitative content analysis of the authentic learning diaries from the first two network study modules. Descriptive statistical data supported the analysis. The content analysis process was carried out resting on the situational and sociocognitive learning theory. The learners' concrete experiences were constantly compared with these theoretical assumptions. The whole qualitative analysis is thus a result of a discourse involving theoretical and practical conceptions, not the learners' experiences alone.

3. Experiences of Collaborative Learning in Network Context

The community of students attending these network-based courses consisted of two larger groups: altogether 39 students in the Tampere area and 13 students in Lohja. Both locations have their own mentors supervising one or several smaller study groups. An average nursing science student in network studies in this case is a 37-year old female with family who is active in working life (age range from 23 to 54 years). It is notable that 61.5% of them had previous experience of adult education in Open University. Some of them had attained a remarkable amount of university level courses. Almost everyone had also work experience from the field of nursing (average 11 years).

Content analysis of learning diaries showed that the learners' study attitudes, goals and approaches for learning in this case were quite disparate. The learning environment experienced and constructed by learners was different from that organised by instructors. From the perspective of the learner's personal goals it is a matter of exchange and practical value of the education and personal meaning of studies as well. The approach to learning and personal meaning of studies can tell us more of an individual learner's goal structure, underlying motives for participation and strategic choices during the studies. In this case, the vocational approach to and goal for learning was predominant. Almost half of the participants (48,1%) could be classified into this category during their studies. Vocational, practical goals for learning refer to acquiring qualifications for work and applying the knowledge to practice The aim is to promote professional expertise and growth. The essential interest focuses on how studies can be connected integrated into practice and how knowledge can be utilized. Personal growth and theoretical fascination are of secondary importance. This places demands on situational and collaborative learning: how to formulate meaningful and authentic assignments and themes, which serve the vocationally oriented learner's needs? The learning diaries also contained references to flexibility of network studies. These kind of learning possibilities were better accommodated to work requirements and life situation (i.e. shift work) than regular extension studies. Network studies enable learning for adults without the limits of time and study place commitments. Many adult learners were also able to learn better and with greater depth through these network studies. However, online courses require self-motivation on the part of the learner: the learning process is best characterized by internal motivation. Learners must be also able to manage their own time and set deadlines for themselves. Failed time management was often cited as reason for difficulties in online learning.

Participants created their own knowledge out of the raw materials of experience, i.e., the relationships with other participants, the activities, the environmental cues, and the social organization that the whole learning environment developed and maintained. As Young (1993) suggests, learners should be offered situations that will engage them in complex, realistic, problem-centered activities that will support the desired knowledge to be acquired. For network learners the studies in this case involved working with theoretical and practical problems and the development of their own qualifications. Situated cognition reminds us that adult learners are a rich and diverse source of stories; data that can transform the study group from a source of transferring knowledge from instructor to learners to a resource for interpreting, challenging, and creating new knowledge. Interactions among the learners and environment holds the promise of having learners directly intervene in and change the processes that surround their lives at home, in the community, and at the workplace. Learners in a situated environment must be encouraged to identify their own questions, goals, and issues that arise through emerging theme discussions in the network or as self-evaluation through learning diaries. In general, we reached the conclusion that the social and cultural environment where the learning occurs essentially influences the knowledge creation in the learning process. In this case, we learned that adult learners need opportunities in the learning environment to participate actively by formulating and evaluating problems, questions, conclusions, arguments, and examples. Face-to-face group meetings with mentor as well as network discussion groups worked fine for this. In an adult group of this kind, collaborative learning refers to creating the conditions in which participants will cxperience the complexity and ambiguity of learning in the real world (i.e. working life). Different kinds of group arrangements (face-to-face and/or virtual) proved to be successfui instructionai tools in this.

4. Conclusions

Collaboration and shared cognition in learning places the learner and the community of learners in the center of the instructional design. In our network study groups learners were called to learn by analyzing their goals, asking questions and formulating problems, to obtain information relevant to these questions and to interpret this information and share their experience with others. Collaborative learning was based upon consensus building through cooperation by group members (see Sharan & Sharan 1992). In the case design reviewed here, our collaborative learning model integrated content, context, community, participation and facilitation (see Anderson, Reder & Simon 1996; Choi & Hannafin 1995; Brown, Collins, and Duguid 1989, Lave 1988) with intentionality and continuous self-assessment. Thus, the network learning environment design in this case could be structured according to the following principles:

- ✓ **Intentionality** - support for personal goal analysis and placement
- ✓ **Content** - support for autonomous acquisition of information and shared knowledge construction;
- ✓ **Context** - the situations, problems, themes, values, beliefs, and learning environmental cues by which the learner gains and masters content;
- ✓ **Community and collaboration** - the organization of groups for knowledge-building with which the learner will create and negotiate meaning of the knowledge and situation (small group with one or two colleagues - mentor group - network discussion group - entire group);
- ✓ **Participation** - the social organization of process, rules and roles by which learners working together and with experts solve problems related to study themes and everyday life circumstances;
- ✓ **Facilitation** - facilitation according to cognitive apprenticeship model; and
- ✓ **Self-assessment** – continuous authentic assessment in the form of learning diary and learning portfolio.

When organising learning, these assumptions direct attention to developing learning communities and environments of knowledge-building, not individual learners only. The construction of knowledge is viewed as the product of interaction between individuals' prior knowledge and socially constructed knowledge. This kind of collaborative learning is a negotiated and transformational process, in which individuals test and contest their knowledge with others. What is also important is the self-assessment of learners, which is well suited to process oriented learning. What we realized was that this kind of instructional paradigm works particularly well for adult learners of theoretical science study modules.

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In-service and Pre-service Teacher Training: A Study of Online Dialogue

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Abstract: This brief paper reports the design, progress, and preliminary results of a study conducted to determine the nature of online dialogue among pre-/in-service teachers after training in the use of a student/teacher hypermedia software tool. Teachers were trained to use behavior support software for students with emotional behavior disorders. An online discussion following the training was designed to allow participants to discuss the program. Data were collected via an electronic archive of all participant responses. Analysis includes the coding of types of responses as well as qualitative determination of emerging themes. Questions about level of understanding, support offered, evaluative comments, and critical thinking were analyzed. Study design, data collection tools, and preliminary results will be shared with the audience.

Software to Support Students with Emotional Behavioral Disorders

Integration of students with emotional behavior disorders (EBD) into the public schools is problematic (Simpson, 1999). By successfully changing problematic behaviors and developing skills for success, children with EBD are likely to improve their learning and social experiences at school. Little focus has been placed on assisting this population through specialized software to date. One new program, a multimedia tool to help children develop self-management skills, is now available. KidTools (Fitzgerald & Semrau, 2000) is a software program designed to provide students tools to manage their own behavior, and to provide teachers with information about the strategies. Through the use of these tools, children are likely to benefit from the positive supports to maintain more control over their behaviors. However, students must be taught and then guided to use this software system effectively. Likewise, teachers must understand the background and implementation of the software tools. However, according to Woodward, Gallagher, and Reith (2001) a dilemma exists in that the developer's intent and the teacher's use often do not coincide.

Design of the Online Discussion for Implementation of KidTools

In this study, the interactions of teachers learning to use the KidTools (Fitzgerald & Semrau, 2000) behavior support software program were archived in the forum discussion section of a web-based teaching software program. Often during online discussions, participants are reluctant to begin the discussion. Therefore, it was necessary to encourage discussion through provocative open-ended questions as well as in-process prompts for more meaningful and in-depth dialogue (Bonk, et al., 1998). In order to prompt participant involvement, forum topics and open-ended questions were posted before the discussion began and discussion leaders from the research team sustained participant involvement with prompts. Research questions in this study are:

1. Did social discourse during the on-line discussion demonstrate a higher level of understanding or innovative use of the KidTools software?
2. Did social discourse during the on-line discussion provide evaluative feedback about the software?
3. Did emergent themes suggest that the intent of the software developers was intact?
4. Did teachers provide scaffolds for their colleagues?

Methodology

The conference was held as an open-ended discussion for pre-service and in-service teachers with three experts online for ten days, followed by continuing, non-facilitated discussion for five days. The topic of the conference was self-management strategies for children. All participants received a CD with the children's program *KidTools* to review prior to the online discussion.

Participating volunteers were asked/prompted to discuss implementation issues during the online conference. After the conference, data analyses for frequency and types of contributions were performed. A qualitative analysis determined emerging themes associated with the instruction, implementation and use of the KidTools behavior support software. A coding system was adapted for this study from one created by Oliver, Omari, & Herrington (1988).

Preliminary Data

There were 97 participants in the conference (33 active participants), three national experts, and two software developers involved in the conference, with 131 messages posted. The average postings during the facilitated portion of the conference were 15/day with an average of 24 themes per day, in contrast to an average of 2 postings per day with 2 themes per day during the non-facilitated portion of the conference. Demographic data were collected to discern participation patterns from user differences based on training setting, reason for participation in the conference, access to Internet, prior teaching experience, and previous experience in electronic conferences.

Importance of the Work

Coding of archived responses during asynchronous on-line electronic discussion helps us understand the type of responses and accumulation of learning that occurs (Henri, 1992). The coding system was used to analyze statements and social interaction among teachers who participated in workshops to learn the behavior support software. When providing in-service training, trainers assume immediate implementation of what was learned. The post training discussion format helped sustain the dialogue about the use of these behavioral supports and assisted in implementation. Information was gained to improve future online discussions as supplements to in-service training. The online discussion also aided developers in evaluating whether the software was used as intended, and if not, what features or changes are desired.

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The Virtual Friends: An Electronic Discourse among Pre-service Teachers and High school Students with Learning Disability

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Abstract: The Virtual Friends project consisted of electronic mail exchange between pre-service student teachers and high-school pupils with learning disabilities over a period of four months (one semester). The purposes of this project were to enhance the professional growth of the pre-service teachers and to concomitantly advance emotional, social and academic goals for the participating adolescents. Each of ten student teachers mentored one pupil with severe learning disabilities via e-mail. The student-teachers also engaged in an electronic discussion forum with their student-teacher peers, their field supervisor and their college- professor. This paper focuses on the contribution of electronic communication to the training of pre-service teachers in four areas: (1) elevating their self-efficacy beliefs, (2) deepening their understanding of adolescents with learning disabilities, (3) practicing collaboration among pre-service student teachers and (4) enhancement of their skills with electronic communication tools.

Introduction

The use of electronic communication, such as e-mail and discussion group, becomes common in academic settings, more so in university courses than in teacher education environments (McComb 1994; Topp 1966). The use of electronic communication offers many advantages, such as the lack of time and space limitations, fast communication with relatively low cost (Harasim 1996), and potential learning of contents and skills, including reading and writing (Reil 1991-2). Further benefits of such communication includes the removal of psychological boundaries which exist in face-to-face communication, giving enough time for reflection and the planning of reaction (Hedrick, McGee & Mittag 2000), and increasing students responsibility to take an active role in their learning (McComb 1994). The use of electronic communication can support also meta-cognitive activities, needed to acquire pedagogical skills. The electronic discourse can become a platform for reflective thinking of the becoming teacher about knowledge of content, strategies and teaching experiences and also about him/herself as a person and as a professional teacher (Carter 1990). The research demonstrates that reflective experiences in the teacher preparation stage can enhance pedagogical experiences in the field (Gipe & Richards 1992). Student teachers, even those that do not tend to actively participate in face- to- face discussions in the classroom, may become active in electronic discussions (Harasim 1993).

The term student teacher reflects the internal tension in the status of the to -be teacher. S/he needs to take double role: as a student and as a future teacher, and has to shift culturally, from the role of a student in the course of his/her job preparation to that of a teacher upon completing his/her studies. Hamilton and Pinnegar (2000) claim that if we expect student teachers to develop from students into teachers they should be given the responsibility to care for others and not just to be taken care of. To widen their interactions, pre-service teachers should communicate with their teachers as well as their peers, field mentors and pupils. Unfortunately, the electronically - based interaction research in teacher education refers mainly to the interactions between the college professor and a group of pre- service student teachers. To enhance the knowledge construction of the student teachers, Hedrick, McGee & Mittag (2000) suggest to include in these interactions also pupils from elementary/high school and field supervisors. The Virtual Friends activity described hereby gave the student-teacher an opportunity to mentor a pupil with special needs, to become an attentive friend who listens to his/her concerns, to show empathy and to deliver caring feelings.

The Virtual Friends project

This project consisted of electronic mail exchange between pre-service student teachers and high-school pupils with learning disabilities over a period of four months (one semester). Its purposes were to enhance the professional growth of the pre-service teachers and concomitantly to advance emotional, social and academic goals for the participating adolescents. Ten student teachers mentored each a pupil with severe learning disabilities via e-mail. Via the electronic discourse the pupils expressed their fears and dream. They told their virtual friends about daily events, disagreements with parents and friends, social isolation and disappointment for not meeting parents and teachers expectations. They described their school failure experiences and asked for advice regarding drugs and violence. The student teachers read attentively the e-mails, carefully avoiding any judgmental statements. In return they told the pupils about their daily hereabouts and future plans.

The student teachers were also engaged in an electronic discussion forum with their student peers, their professor in a course on learning disabilities, which they all attended concomitantly and their field supervisor.

The contribution of the activity

To study the contribution of the electronic communication to the training of the pre-service teachers we examined the students dialogues in the electronic discussion forum. 204 letters were written to the forum, of which 122 by the student teachers, 50 by the college professor, and 32 by the field supervisor. 70% of the discourse in the forum included discussions (initiated mostly by the students (33.3%) and the professor (31.4%), and few by the supervisor (5.4%). Other parts of the discourse consisted of information about computer usage and requests/suggestions for technical assistance (3%), announcements (10%), and social discourse and caring talk (17%).

The electronic-based discourse evolved throughout the project. At first the student teachers expressed their concerns regarding their competency to be mentors to these students with special needs and their ability to use the electronic media. Four months later and upon completion of the project they described the contribution of this activity to their education in the following four areas:

(1) Elevating self-efficacy beliefs: The student teachers stated that following their participation in the project they felt more confident in their ability to listen attentively to pupils personal needs and to guide them. They also felt more skilled with the computer and its use for inter-personal communication my success in these relations via the e-mail fills me with confidence to do similar activities also with my future pupils , and I learned how to use e -mail, and it can serve me to establish professional communications as a teacher .

(2) Deepening their acquaintance with the population of adolescents with learning disabilities: During their pre service training the student teachers did not meet adolescents with learning disabilities. The e-mail communication enabled them to become closely acquainted with these pupils, and to learn about their special educational and social needs. This demonstrated learning through doing and it was supported by the discourse in the electronic discussion group as I would like in the future to teach this age group (adolescents), the electronic communication enhanced my sensitivity to their difficulties, their priorities in life, and their perceptions about the world . Now I kn ow more about their linguistic-communicative problems and how their reading and writing deficiencies block their ability to express themselves . At the same time, the student teachers emphasized that they look now at the pupils as itive, social, and emotional needs, and not focusing on the difficulties only.

(3) Practicing collaboration among pre-service student teachers: As described earlier, the student teachers had a computer-mediated discussion group (electronic forum) at their disposal in which they could reflect on their on-line dialogue with the high-school pupils both among themselves and in cooperation with the college staff and in-service teachers. In this electronic discussion forum, the

student teachers could express doubts, ask questions, and offer mutual support concerning their virtual friendship with the pupils with special needs. This collaborative framework created a sense of a learning community, with members and rules of its own. The students highly appreciated the electronic discussion group as a means to professional collaboration and mutual support I felt that it was a place where we could think together and that we could get professional advice from peers .

(4) Enhancing skills with electronic communication tools: Although the pre service training curriculum includes various courses in computer skills the student teachers emphasized that this activity was an example for authentic learning about computerized usages in education I can now actually realize how I can use electronic communication to achieve educational and social goals .

Conclusions

The Virtual Friends project linked theory and practice (Korthagen & Kessel 1999) and accompanied the students professional development with an on-going reflective learning via the electronic discussion forum (Korthagen & Wubbel 1996). The dialogue in the electronic forum contributed to the development of the corpus of knowledge pertaining to learning in general and the learning of pupils with disabilities in particular. Through this activity, the student teachers learned content knowledge (standpoints and needs of adolescents with special needs and how these are reflected in their relationships with other people), about the influence of non-academic factors on learning (change in social status in the family and among the peer group, and its influence on learning), about the field of didactics (how to use language that is not complex, but is still challenging, in the dialogue with the pupil), and about themselves as people and as professionals. They learned to know the pupil as a whole person with cognitive, social, and emotional needs, without specific focus on the difficulty only. In parallel, the high-school pupils with learning difficulties also benefited from the v
could share their learning and social doubts with an older friend, improve their learning skills of reading and expressing themselves in writing, and practice their interpersonal communicative skills. The computer turned into a friendly instrument for them, and they used it as a word processor and as a means to communicate.

The student teachers recognized the high potential of electronically mediated learning experience. All of them declared that they would willingly initiate such an activity in their own classes.

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Exemplary-based learning: a new way of Web-based training

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Abstract: In April 2000 the European project Collaborative language independent development environment for exemplary based re-usable learning objects in IP learning platforms (CODEX-IP) started to create: an innovative learning model - exemplary-based learning (EBL); a new development process for the collaborative development of re-usable learning objects between training centres in different language areas; a new integrated development environment based on EBL and the development methodology. In this paper the EBL model is explained shortly.

First EBL-guidelines

After a literature study the first guidelines for EBL instructional design were formulated:

- Examples function as learning objectives (as they show in a visual way what will be learned)
- The end-user is responsible for choosing one's own learning path based on the available examples (which is related to learning on demand, learner centric learning, personalised learning)
- Content parts are as independent as possible (as learners can learn in a non-linear way)
- Examples are taken from a realistic context for the end-user (to make the content as relevant as possible for the learner).

An example of a result functions as a:

- Learning objective, it shows the learner what can be learnt via the instruction;
- Demonstration of a result, it shows what the learner can do or make;
- Anchor, to help the learner connect new information to his cognitive structure;
- Navigation element, it helps the learner to go to the topic he wants.

An example of a result includes a title, a visual presentation of a typical result with all the important attributes and a sentence for clarification. At the same time a demonstration of a process can function as an example as well, which is related to the master-apprenticeship idea.

Pilot studies

A pilot study was carried out to gather information and suggestions about the first EBL guidelines for instructional design. In total 24 people tried out a web-based Word 2000 training on "Paragraph formatting", 10 persons from the Netherlands, and 14 persons from Spain. They had a different background and a diverse level of Word knowledge and skills. The persons worked for 60-90 minutes with the learning environment, did a small test, filled out a questionnaire and were interviewed about this questionnaire afterwards. Although the trial groups were small, it seems that the persons with a high level of Word knowledge and skills preferred short instructions (procedures) for carrying out a task. Users with a low level of Word knowledge tend to prefer step-by-step exercises in which they are more guided by carrying out a task. Due to their prior knowledge they have more difficulties with understanding the steps in the procedures. They had a need for step-by-step exercises but also for the more 'do-it-on-my-own' exercises in which the learner can test whether or not he/she understands a procedure. The trial group found it helpful to have first an example of the result of a task as they could see what they could learn in a section.

Working with the learning environment

Figure 1 shows the process of working with the learning environment in an on-the-job situation. It starts with a problem at the workplace (e.g. the learner doesn't know how to make a footnote). The learner can choose to read the (short) procedures to carry out a task, to read more about these procedures (read explanation), to practice and/or to contact others to help by a problem at the workplace.

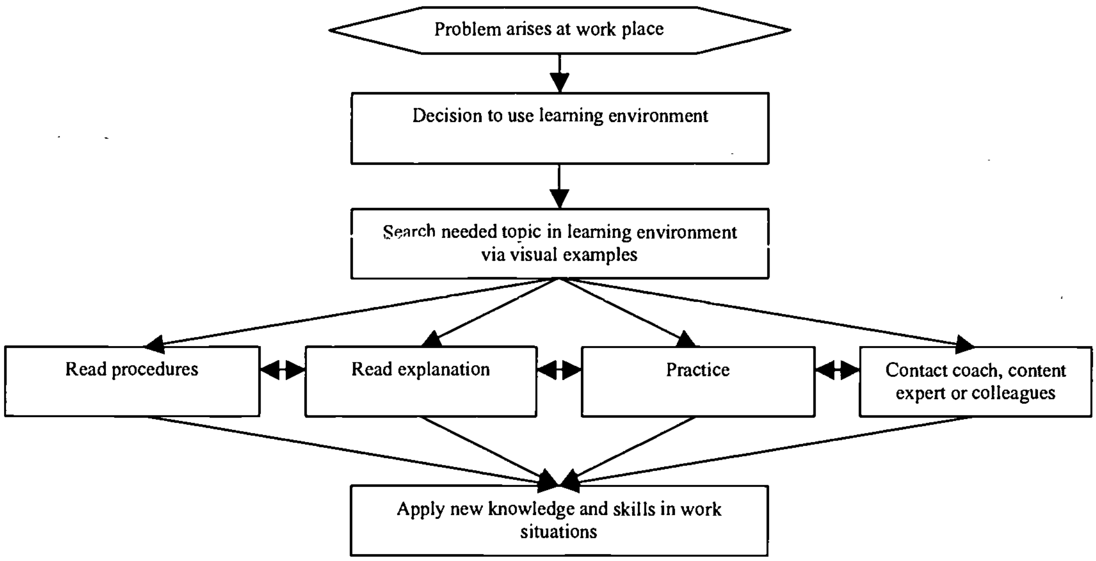

Figure 1. Process of working in EBL-environment

Elements for an EBL-learning environment

Elements for training based on EBL can be: overview of the content of the course (both graphical and textual), examples of results of processes, description of procedures, demonstration of procedures, prior, extra and related information, guided exercises, exercises which can function as self-tests. Because the different parts of a programme should be worked through in the order the end-user prefers, the content should be as independent as possible.

EBL-Parameters

To characterize EBL 19 parameters were formulated in a total of four categories: organisational aspects, process of learning and teaching/training, content, and technological aspects. An example of two of them:

EDUC 5	**Modelling**	◀ **X**-----------------------	**Discovery-experimentation**

This dimension focuses on how tasks and skills are learnt. Both use the strategy 'learning by doing' but with a different accent. In EBL the focus is on modelling. After the learner finds the example, which represents the problem, it is shown how to solve it. Exact steps are given by providing the procedures. Step-by-step exercises help the learner to carry out the task without problems.

EDUC 6	**Reproduction**	◀ ----------------------**X**	**Performance**

Reproduction and performance are results of learning and closely related to declarative and procedural knowledge. Is the training focussed on knowing the meaning of the icons of Word toolbars (reproduction) or on making a bulleted list (performance)? The objective of an EBL-environment is that learners can carry out specific tasks.

In this first year the development and learning environment with the integrated building blocks is developed. In the second year EBL and the environments are tested in companies in Belgium and Spain.
Access to public deliverables and more information about CODEX-IP: http://www.codex-ip.com

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The role of visual expression in the genesis of epistemological interpretations: The study of learning through multi-media in a post-secondary classroom.

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Abstract: The paper focuses on the cognitive contribution of the aesthetic experiences to learning in a higher education setting. Specifically, it examines whether the use of students' imagination and their visual expression contributes to the genesis of the students' epistemological beliefs. The paper reports on a qualitative case study in an educational psychology course within a pre-service teacher education program. Using the analysis of student-created mixed-media projects, it offers a discussion of the role of the students' imagination in construction of meanings associated with beliefs about learning. Part of the analysis explores specifically whether specific kinds of the aesthetic experiences help foster students' creativity and imagination, and whether those experiences influence the students' beliefs about learning.

Statement of Problem

This study is motivated by the disconnection between the quality of learning experiences in the contexts of higher education settings and the nature of creating one's own system of beliefs and understandings. While the dominant approaches to post-secondary teaching treat the student learning experiences as mediated largely through cognitive rational processes, a large body of literature suggests that the individual's beliefs are shaped by imaginative, non-rational processes, which involve intuition, improvisation, and the act of creating a new form of some sort (Arnheim, Dewey, Eisner, Greene). This study focuses particularly on the processes of creation embedded in the aesthetic experiences and artistic forms of expression, examining the ways in which these experiences influence learners' epistemological beliefs—beliefs about learning. If one is to agree that epistemological beliefs define the way and the form in which knowledge schemata will develop for an individual (Spiro et al., 1996), then one would agree on the need for providing a certain quality of learning experiences within an academic program. This quality should meet the demands of complexity faced by the graduates in organizational and social structures upon graduation where, among other skills, an ability to see multiple solutions to a problem (multiplistic thinking) and to act flexibly in novel situations are often required. Such skills can be fostered when the belief about learning is formed tolerant of the notions of ambiguity, situation-adaptive assembly of knowledge, and self-reliance. In other words, the skills required of the graduates can be enhanced when their belief systems are characterized by the features more conducive to the processing of complexity—a process "in which aesthetic satisfactions are pervasive" (Eisner, 1985).

There are post-secondary educators who do not consider the aesthetic experiences as essential instruments in the development of epistemological beliefs. In consequence, their teaching approaches fail to attend to the ways in which imagination and creativity influence learner's thinking. The critique of the current instructional practices in higher education illuminates on the reasons that limit the development of epistemological beliefs of prospective professionals. Specifically, it calls attention to the fact that over-reliance on rational ways of learning and the dominance of verbal expression cause two serious problems: (1) Oversimplification in students' thinking, which reveals itself in their adherence to the "either/or" paradigm (Brunner, 1998). This paradigm manifests itself: in linear thinking; looking for one correct answer to a problem; intolerance to the ambiguity of the demanding situations at work or the divergent nature of human relationships. (2) Detachment of post-secondary learning experiences from the students' life and work contexts and perceptions of self-worth (Dirkx, 1998). Within the classroom discourse, which often focuses on "talking about practice", the students run the risk of becoming detached from their future communities of professional practice, i.e. of being insufficiently prepared to a discourse of practice—"talking within practice" (Martin et. al., 2000). Therefore, while in the degree program, the prospective professionals often remain alienated, in a sociological sense, from the performative world of their future work. The understandings gained in the college classroom are, therefore, hard to use in the contexts of real life.

The answer to this problem might be in integrating certain types of learning experiences into college-level education, specifically those that involve student imagination and creativity through exposure to aesthetic experiences. Such experiences have a potential to support multiple pedagogical objectives, expose the students to transdisciplinarity of related issues within the course content, and engage them in a complex communicative exchange, allowing for acquisition of the language of "multiplicitness".

A number of studies report on the importance of imaginative ways of knowing in the contexts of adult, career, and vocational education (Marsick & Volpe, 1999; Marsick & Watkins, 1997; Saavedra, 1996; Taylor, 1998). In higher education literature there is little that deals with notions of reflective learning as an imaginative process, mediated through images, feelings, and emotion (Keifer-Boyd, 1997; Wagner, 1999; Warren, 1995). Referred to as a mytho-poetic view (Dirkx, 1998), this perspective on learning puts learners' experiences at its core and suggests that making meaning of one's experience is apprehended through symbols and images. In other words, the shaping of one's epistemological belief involves the aesthetic modes of thought.

This study focuses on a particular form of the aesthetic experience—visual expression, examining its contribution to the genesis of the students' epistemological beliefs. Visual experiences—the creating and observing a piece of art, for example—can help deal with the indicated problems through the potential of the visual images to serve as modeling devises for a learning activity, contributing to discoveries of systemic relations between the discrete pieces of knowledge. Combined with the consolidating capacity of verbal expression, visual images help generate new understandings of what was gained in the earlier learning experiences. The analysis of data implied such focus by examining examples of students' visual expressions of their thinking about learning—the student-created multi-media documents, such as self-portraits, conceptual maps, individual web sites, photo imagery and digital video—works of art created by students individually and collectively.

Conceptual Framework

Using the analysis of student-created mixed-media projects, the study explores the role of symbols and images in the construction of students' understanding of the processes of learning. This analysis is situated within perspectives on activity theory, which stems from the cultural-historical school of Russian psychology (Vygotsky, 1978, 1971; Leontiev, 1978; Luria, 1976). The advancements in these perspectives invite the study of cultural artifacts as integral and inseparable components of human activity that mediate the sense making of this activity (Judin, 1978; Norman, 1988; Wartofsky, 1979). Within a productive process of such sense making, a metaphoric thinking and, particularly, the visual images, become icons that play a decisive part. They allow for the limits of certain experiences to be altered by discovering new systemic relations. They offer opportunities for what Eisner calls "imaginative sees to generate theoretical interpretations that give the particular situation a fresh significance" (Eisner, 1998).

The second point of departure is grounded in the views of Arnheim, Tufte, and Funch on the role of nonlinguistic symbol systems. These are particularly instrumental in "reading" the students' "visual explanations" the visual representation of thoughts and understandings. According to Tufte (1996), the act of visual design becomes an act of insight, creating the basis for change in one's perspective on learning. Images and symbols, especially those evoked by the artistic forms of self-expression, serve as "arresting metaphors" (Stein, 1998). They heighten the ability to make sense of one's learning experience through selective perception. A series of meanings one makes over time in a variety of learning experiences contributes to construction of one's epistemological beliefs. By watching for the repetitive refrains and 'arresting metaphors' in an understanding about the kinds of interpretations students make about certain concepts introduced. These interpretations, in turn, inform about the students' current epistemic positions.

This study elaborates on the propositions above by describing how the students' visual representations can contribute to change in their epistemological beliefs.

Context of the Study

The study examined representations of beliefs about learning by entry-level prospective teachers at a large Mid-Western University. Specifically, it examined a series of visual explanations constructed by the students as part of their reflection on the experiences of the course—exploring, seeing, getting to know, and representing their thinking about learning—within the social and discursive structures of the course on educational psychology.
The course included a series of interactive classroom events where students were engaged in continual acts of emotional and intelligent deliberation, often in artistic forms. Such events included a variety of projects planned, conducted, and reflected upon by the students, individually and collectively. Among the projects were "teaching sessions" in which groups of students presented their topic of investigation, related to educational psychology, to the rest of the class. Such "teaching" might have included a 'session-on-line", that is a group of teaching students should have created a session to be taught and assessed on line. Another type of the project was an Electronic Newsletter that reflected on a series of essays written by the class on a particular topic. The newsletter provided an opportunity for a group of students to read, think about, reflect on, and represent their interpretations of their peers' thinking about the same topic. A student-recorded and edited digital video became yet another form of student visual expression of thinking about learning. By capturing peers, presenting their visual explanations of learning and talking about those, the video would have revealed the specific selections of the interpretive themes which a group of students would have come up while constructing the video.

While having the students represent visually their thinking about learning, the teacher explored the opportunities of multi-media instructional systems. The technology component of the instructional environment—web sites, computer-based presentations, digital video—specifically designed by the teacher to support certain kinds of cognitive tasks, aimed to reflect on the interplay of the conceptual and situational aspects of the course, along with multiple representations and knowledge interconnectedness inherent in hypermedia. Such environment was designed to help create multi-dimensional instructional cases that would enhance crafting each student's art of a reflective teacher. Such an environment was designed to help create multi-dimensional instructional cases that would enhance students' imagination and creativity and also tap into their conceptions of what it means to learn.

Data Source

Research data included mixed-media documents created by the entry-level pre-service teacher students over the summer semester 2000: conceptual maps, photographs, individual and collective web sites, presentational files, and video-records of the classroom events. The group included 20 undergraduate students, predominantly white, about half males and half females. Most of them had middle-class high school background. Approximately half of the students were in their late 20s and early 30s (some enrolled in a post-baccalaureate program), while half were in their early 20s. Few students had their own families and children. The majority of the students were exposed to web design and the use of technology in the classroom for the first time.

The study specifically examined the features that the students' artful projects possess, in other words, features that. display certain kind of students' thinking. The students' written work (autobiographical accounts of their past learning experiences; comments on the class events and peers' projects; reflections on the readings and video materials) was used in support of their visual explanations. Data also included video- and audio files, documenting students' talk about their classroom experiences as well as questionnaires and surveys completed by the students at the beginning and the end of the semester. Open-ended, 1-hour interviews were conducted with the students during the following academic year. Data further included curriculum materials and multi-media documents developed by the teacher and characterizing instructional cases, within which the students' experiences were embedded.

Methodology

The study examined the student-created visual explanations from three major perspectives: (1) What kinds of visual explanations were created by the students in mixed-media formats? (2) Whether (and, if so, how) the visual explanations influenced the students' understanding about learning? 3) Whether any inferences can be made regarding the students' epistemological beliefs? Visual explanations were described through vocabularies used by the students in writing as well as artistic representations other than writing—such as portraits, design patterns embedded in the web pages and Power Point presentations as well as conceptual maps.

A qualitative, interpretive approach is employed to examine the ways in which students' visual representations of thinking might contribute to change in their epistemological beliefs. The analysis of students' beliefs about learning is done in an assumption that different epistemological beliefs manifest themselves through different visual images of knowledge and learning. The rhetorical structures inherent to visual representations can inform us about the ways and the form in which knowledge schemata is shaped for an individual learner. To categorize the rhetorical structures in students' visual representations, we employed propositions of the grounded theory (Glaser & Strauss, 1967) and pursued a constant comparison analysis of the emergent themes, as they interplay while the analysis unfolds. This process included systematic coding procedures and conceptual integration.

The students' visual explanations of their individual 'theories' of learning were juxtaposed to their verbal articulations: the essays that the students wrote in reflection to the various classroom events and the video watched in class; their autobiographical accounts of learning experiences, as well as the transcripts capturing the students' talk about their understanding of learning (during the class meetings and the interviews). To categorize the rhetorical structures in students' visual and verbal representations, we employed two groups of contrasting criteria that are associated with the features of two kinds of epistemological positions (criteria adapted from Spiro et. al.1988):

1. One is associated with oversimplification of complexity known to be related to:
   Single representations; analytic compartmentalization; orderliness; intolerance of ambiguity; rigid prescriptions from memory; concepts detached from life experiences; passive perception.
2. The other is characterized with opposing features—more conducive to the processing of complexity: Multiple representations (the use of multiple explanatory frameworks, assembling partial representations to form complete accounts); synthetic integration and interconnectedness among the parts; disorderliness and heterogeneity (expects deviation from routine); tolerance of ambiguity; use of pre-existing knowledge in a combinatory manner; experiential tone of concepts.

These criteria were used to describe the nature of the visual and verbal explanations of the students' thinking about learning. The juxtaposition of the students' visual and verbal explanations was mapped onto the timeline, in which the time units were comprised of the critical course events—events conceived as aesthetic experiences, the design of which sought to provoke certain kind of students' responses providing for partnership between the students' intellect and intuition. An example of such an aesthetic experience might be a response to a loosely structured task, opened to students' choice of conceptual themes (i.e., open to their own purpose for reasoning) and representational genres (i.e., open to their creativity). For instance, it can be a response to the task of expressing visually one's understanding of connections among learning experiences one might have had in the past, so that to illustrate one's own current theory of learning. A mid-term exam became such task, while combining three forms of the students' expression—written, oral, and visual mind-mapping. A collective share time where the students revealed their perceptions of the preferred expressive means (*'My second Language'* session) and the exposure to a movie, chosen specifically to elicit the students' current understanding of learning through a rich and provocative texture of the video material, represent two other examples of the 'critical' course events.

The openness to the students' own choice of the frame(s) of reference, the form (i.e., a history; a family of visual "novels"; a functional block-chart, etc.), their own vocabularies, as well as their own expressive means makes a student's reflective action an aesthetic experience, with its internally coherent purpose and a space for intuitive discoveries. The outcome is a fiction. One can fantasize about it, pretend about it. As a fantasy, it stirs one's feelings about self and the worth of life. Some researches tend to think this has to do rather with character than the intellect. Such outcome, however, implies utility of a special order: *seeing* one's self anew, which is to Arnheim - to begin *thinking* anew. When it comes to reflecting on one's own experience, then it is likely that seeing anew and thinking anew would trigger the re-considering of the questions like: Who am I? What do I believe? How did I come to know it? The indications of students' attendance to the questions like these the vocabularies used in written assignments and the connection of the concept to the aesthetic properties in their visual, imagery explanations—were further analyzed as to whether any plausible inferences could be made regarding the students' epistemological positions. While the author did not anticipate finding a one-on-one correspondence between affect that might emerge within an aesthetic experience and the students' epistemological development, some proof of a significant relationship between the two was found. This allows to suggest the intuitive antecedents of epistemological beliefs.

Findings

conveyed verbally and visually and mediated by technology—shape an emergent content of the course with its emerging language, which, in turn, provides the basis for processing feelings and emotions. We also argue that the processing of feelings triggers the students' imagination and the act of creating visual forms that display certain kinds of thinking. Such acts of creation generate a more discriminating perspective and manifest a mode of educational inquiry 'beyond the confines of rational discourse' (Taylor, 1998). Finally, we contend that the use of visual expression becomes a mediating tool shaping the predisposition for change in one's perspective on learning and teaching. Students construct reflective multi-media documents through free design, collaborative interpretation, and creativity. The act of creating these documents results from individual and collective improvisation. Provoked by the lived experiences of the students' creative acts, the "inner work" (Palmer, 1998) generates, in turn, new symbols, associated with greater self-awareness of one's own perspective and new understandings, both at individual and collective levels.

Implications for Higher Education Teaching

Based on these findings, the ideas below outline useful implications for pedagogy. These ideas seem to be of particular relevance for teacher preparation programs: (1) the students' visual expression fosters critical reflection, creating a kind of -awakeness" (Greene, 1978) and representing the process and the means for explorations of self in relation to the epistemology of learning; (2) images and symbols, evoked by visual expression—those resulting, for example, from the interpretive "reading" of a peer's drawing or creating a reflective video-clip—bridge the school (content), the home, and the self, freeing the students' creativity; (3) these images and symbols heighten the ability to make sense through selective perception, contributing to the construction of beliefs about learning; (5) multi-media instructional systems, which involve the students' explanation of their thinking through artistic media (other than writing), shape public space for personal reflection and enhance the emerging language of "multiplicitness", the ability to use multiple frames of reference an alternative to the dominating "either/or" paradigm (Brunner, 1994; Spiro et al., 1992, 1988).

Conclusion

The paper joins an on-going debate on various ways of knowing, The analysis of the student created mixed-media projects focuses on the cognitive contribution of visual expression and the role of imagination in learning within a higher education setting. The paper addresses specific aspects of the instructional approach, which employ aesthetic modes of thought and use the student visual explanations in an effort to foster multiplistic thinking of pre-service teachers.

Parallel to analyzing the role of visual explanations in influencing the students' epistemological beliefs, the paper presentation also seeks to illustrate the process used by the teacher (who is also the author of the paper) to interpret her students' visual explanations. In addition to a traditional text of the paper, a "product" of the study will be presented, which uses the multi-media presentational formats to illustrate the emergent research themes (for instance, an interactive web site with digital movies and photo imagery provided with annotations). One such theme is the relationship between the researcher's "logic of discovery" and the "logic of demonstration" (Nisbet, 1976). The investigation into this theme helps shed light on the ways in which the aesthetic modes of thought might be helpful for the researcher's understanding of qualities of learning and teaching that otherwise might be unseen.

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Visual Thinking in Service to Crafting a Teacher

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The poster-demonstration will introduce a qualitative case study in an educational psychology course within a pre-service teacher education program. The study focuses on the cognitive contribution of visual expression and the role of imagination to learning in a higher education setting. The poster has two purposes: (1) Using examples of the student-created multi-media projects, to offer a display revealing the contribution of students' visual representations to their thinking about learning. (2) Using examples of the instructional multi-media cases, to share the lessons learned from an instructional approach, which employs aesthetic modes of thought in an effort to foster multiplistic thinking of pre-service teachers. Analysis explores specifically whether the use of specific kinds of the aesthetic experiences helps foster students' imagination and whether those change the students' beliefs about learning. By integrating photo-collages, portraits, conceptual maps, and digital video, the display attempts to make the research themes more visible.

Scenario-based Design of Flexible Hypermedia Learning Environments

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Abstract. Software development processes need to cover usability relevant information. Although several methods have been proposed how to collect usability relevant data, there is a lack of suggestions on how to deal with this information and how to ensure that it is available in a proper way at the relevant stages of the software development process. This paper proposes a framework to store and retrieve usability relevant data using object-oriented OOA and OOD methods together with scenario-based analysis. As this framework combines advantages of all these methods, uses a XML-based, relational database with server pages and networking, it is an ideal repository for distributed design teams.

1 Introduction

The focus of this paper is on usability engineering in the development process of adaptable web-based course material. Such applications are under development at our institute for the domains of e-business and web-based education training material for virtual universities (cf. Hartwig/Kritzenberger/Herczeg 2000).

As hypermedia are used by users with many different goals and levels of knowledge (cf. Kritzenberger/Herczeg 2000), there is a need for systems that allow to modify and adapt parameters accordingly. Although adaptability has been a long time the primary domain of artificial intelligence research (cf. Brusilowsky 1998) there is a growing interest of usability engineers (De la Teja/Longré/Paquette 2000). They see part of the success of developing software adaptable to the indiv
needs and preferences depending more on managing the development process and integrating the assessment data produced at each stage of this process than on increases of information technologies.

Therefore, much attention has been paid to the software development process with several attempts to improve it and to integrate usability information into it, e.g. ISO 13407. Ideally, the usability engineering (UE) starts with the definition of the potential users and an analysis of their work situation in order to specify design requirements. The analysis phase focuses on understanding users and processes needed for their work and the result of the analysis should be documented by means of user-centered work-modeling techniques. Several techniques are available to do that, like survey technique similar to market research, contextual research (cf. Holtzblatt/Beyer 1993) or participatory design. Regardless which technique is actually used for analysis, normally a lot of data are produced, as demonstrated for example for contextual research. The data produced in one phase can hardly be recorded in appropriate ways and integrated or reused in other software development phases. Therefore, it does not make a great difference for the practice of software development processes, if these data are gathered or not. Data have to be usable by different members of a design team at a different stage and with different backgrounds. Furthermore, the members who are active at different stages of the development process will raise new data, which add to the conceptual design model and should therefore be available, too.

2 Knowledge Management for Usability Engineering

Usability engineering (UE) is an iterative process of development, which consists of six stages: analysis, requirements specification, design, implementation, evaluation and maintenance. In all these stages data are produced which are also needed in the following stages by different members of the software development team. In our approach all members of the design team, which in the development process of learning environments consist of content author, designer, producer and quality manager, use a relational database with a web front-end. This database should include all the context information as well as the content of the teaching units. In a first step this information is only presented to the involved persons but no contents are automatically generated.

For database organization object oriented techniques are used (cf. Hartwig/Kritzenberger/Herczeg 2000). Classes of information like "user attributes", "organizational requirements", "content", etc. are identified and then may be freely combined into "views". These views are role dependent, for example the content author may concentrate on the analysis data and the contents. Whereas the producer, who has to implement the learning unit, may need additional design rationales added by the designer. A quality manager can base his evaluation of the system on the requirements identified and documented during the analysis phase. As the size and the number of the learning units is difficult to handle, techniques of the OOA are used, e.g. abstraction, inheritance and generalization. If for instance many different user groups are to be considered, they may be ordered hierarchically: "All users", "users of the teaching unit", "A special group within these user group". Attributes of the most general object ("All users") are inherited by all following objects and then, e.g. the designer's view includes all attributes, from the general to the specific ones. OOA techniques, like underspecification and refinement make the handling of large object sets easicr and allow all participants to start with rather raw data and to refine them during the iterative process. Using OOA techniques based on a database has several advantages. The database supports the complete lifecycle of the course unit and makes all information and design rationales available again for maintaining or updating the course. As the contents of the database are XML(XHTML)-based they can be included into the courses with less manual effort. Furthermore, the connection of each unit to the position and role in the database is kept. Additionally for each production phase there is appropriate additional information available, like design rationales and the related context information. Updating a content in the database automatically updates the course and avoids inconsistencies.

3 A Task Analysis and Design Framework

The following framework layer represents a generic model (cf. Herczeg 1999, Herczeg 2001), which covers the specific characteristics of the user population as well as the situational factors and the process of using the software, e.g. a hypermedia learning environment. It is based on the concept of object-oriented system design. It was developed in the context of interactive applications (cf. Herczeg 1999) and proves more and more to be a generic platform for analysis and design of software systems.
The following figure shows the task analysis framework, which is a set of object classes from which a model of the system can be built. It enables building a functional as well as a contextual model. It uses the basic ideas of object-oriented analysis and design (OOA, OOD), but enlarges the object classes with extra attributes covering context of use information, e.g. describing the conditions of use, the environment, goals etc.

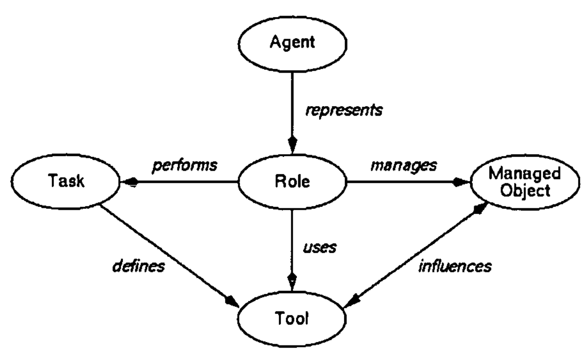

Figure 1: Task analysis framework (from Herczeg: 1999:26)

The framework consists of the following entities:

Managed Objects: defines the resources managed by the system, e.g. for the domain of educational material these are the modules of the application and information space.

Tasks: have to be performed by those agents, who use the system according to their role. For the domain of the learning environment tasks are typically performed by learners as learning tasks, e.g. doing exercises, trying out, memorizing something, constructing and so on). Tasks define tools, which help or enable executing the task. In educational material (like web-based training systems) the task can also be systematically specified by a learning theory.

In our example of educational material this means that the task can be described as "learning" at the highest level of abstraction. In the sense of a refinement hierarchy, at a more detailed level, subtasks may be described as "basic orientation", "acquire knowledge", "apply knowledge", "transfer knowledge", and so on. At the most detailed level the model may describe atomic tasks. This leads to the idea of a refinement hierarchy of the task in which the behavior of the system is described at increasing levels of detail. The lowest level of detail is that of atomic pieces of behavior. In the direction of the aggregation hierarchy the system has subsystems at the next level of aggregation, which are themselves part of a compound system at the next higher aggregation level.

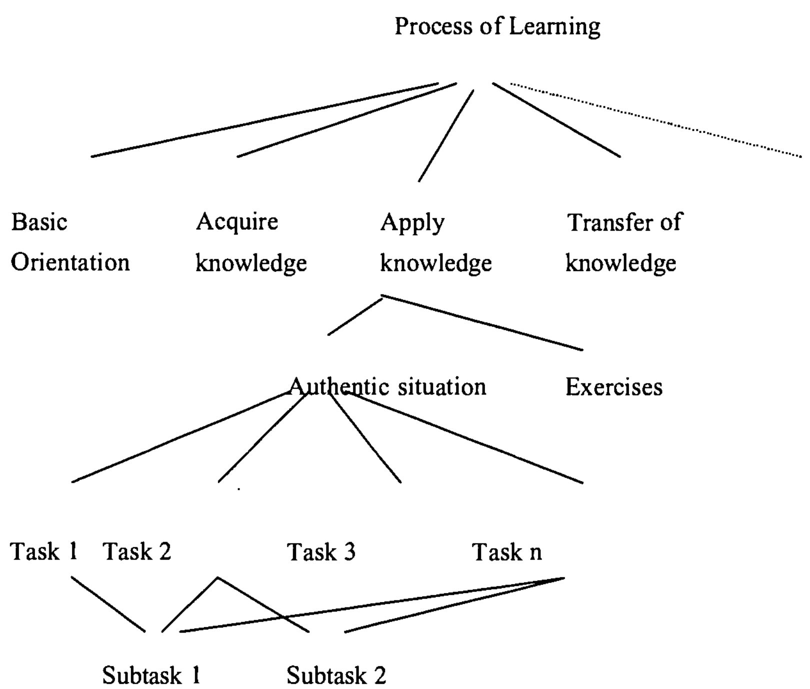

Figure 2: Example of Task Structure for the learning process

Roles: are represented by agents. In the case of educational systems this means that the role is represented by agents, who are the learners.

Agents: describes users and their profiles, which may be active in one or more roles. Learners may be diverse, but learners may also have several characteristics in common and can therefore be divided into several user groups. In this case role would be identical with defined user group. In this case the role represents also to some extent the context of learning, which is widely defined by characteristics of the learner and the profile associated with this specific learner group (cf. Kritzenberger/Herczeg 2000).

Tools: support for the execution of tasks. In the example of educational systems this can be represented by a teaching or pedagogic model. (The leading question: Which method fits best for reaching specific teaching goals?)

The framework described above is realized in a prototype (cf. Figure 3).

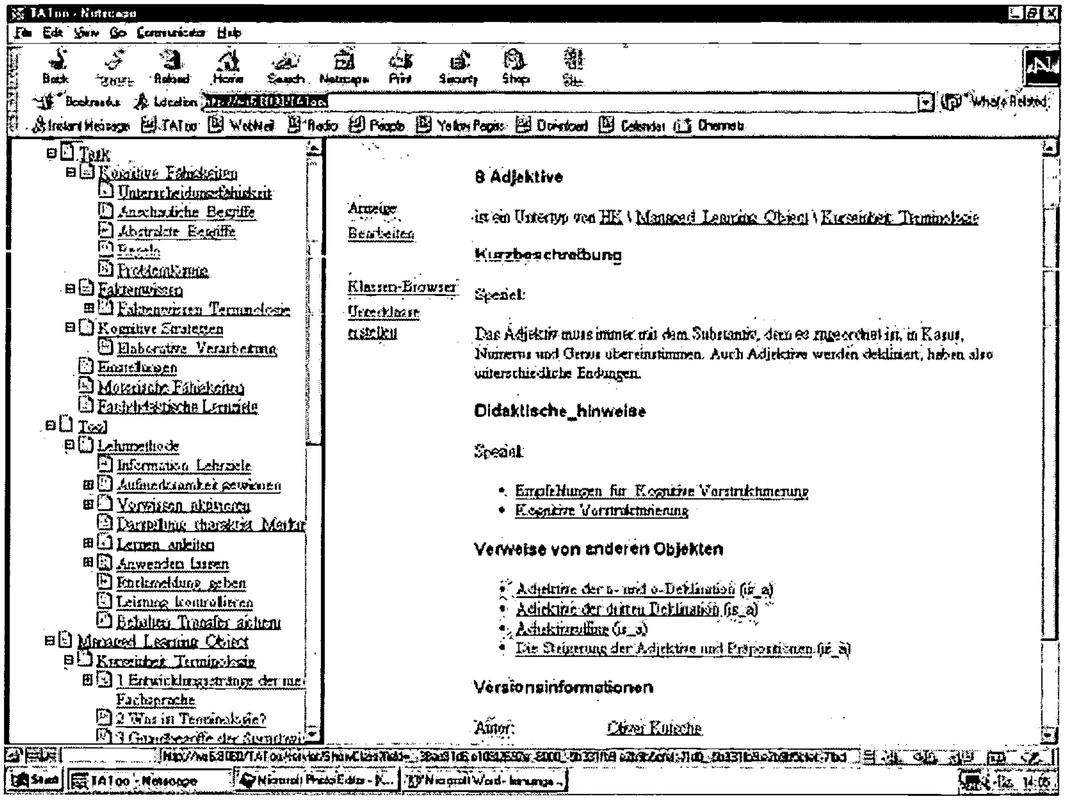

Figure 3: Screenshot of prototype modelling a course unit on medical terminology

Figure 3 shows a screenshot of the prototype modelling a part of the course on medical terminology (subject: adjectives) as part of a course of studies in medical computer science. In the left frame there are the elements from the framework with task, tool, managed learning object and user group. In the right frame there is a view on the managed learning object "Adjectives". The screenshot shows an under the heading "Verweise von anderen Objekten" how the content authors had considered an ordering and logical sequencing of the content. Furthermore there is general didactic knowledge on how to structure courses, which should also be considered when the course unit is constructed. This information needs to be stated explicitly, if it should be present in all stages of development and forms a kind of meta information if the learning objects should be re-used with different views on the material, e.g. for building a course for another user group.

4 Enhancing of OOA with Scenarios

As discussed in the previous section, data are collected, specified and stored according to the described framework. As the framework allows for further attributes describing parameters of the context of use or user characteristics, it is possible to add information, which is essential for the usability of the system. Usability relevant information is for example characteristics and needs of special learner groups. These data provide specific information, which can be gathered by data collection in organizations by asking questions like who are potential users, or by analysis of imagined scenarios (cf. Carroll 1995).

Lets make an example from the domain of educational material to get things more clear. For the use of educational material it is normally important to be aware of the previous knowledge of the users, as the learning material has to be adapted accordingly. Although this seems to be a very clear parameter for system variation, these data are less precise than they seem to be. For example, it is not clear right from the beginning, in what way the educational modules have to be altered, because usability information like previous knowledge is not sufficiently defined. Nevertheless, it is important to assess these data and possibly refine this information in the course of the development process unless it is precise enough to make relevant design decisions. If it is integrated into the object-oriented framework, it can be handled with object-oriented methods, as demonstrated with the following example.

An example scenario: Learner groups in a virtual university

The educational material offered in a virtual university will not only be used by traditional students of universities but by a variety of different user. Therefore, one can distinguish different user groups, which can be further distinguished by their basic needs according to the available educational material. For example, learner group 1 wants to do basic studies in the domain in order to pass exams and earn diploma. The learners want to study all modules relevant to the curriculum, need guided tours to differ relevant from irrelevant knowledge with respect to passing exams. Learner group 2 wants to do post-graduate studies. They have already passed an exam and have learnt how to learn. Learner group 3 does not want to go through all the knowledge modules offered in the database, but wants to study only some modules for task-oriented knowledge acquisition. Often a current problem or a knowledge gap is the starting point for learning. Learner group 4 is characterized by exploring the knowledge domain according to personal interests. The behavior of learners in this group is comparable to browsing libraries, reading books and magazines.

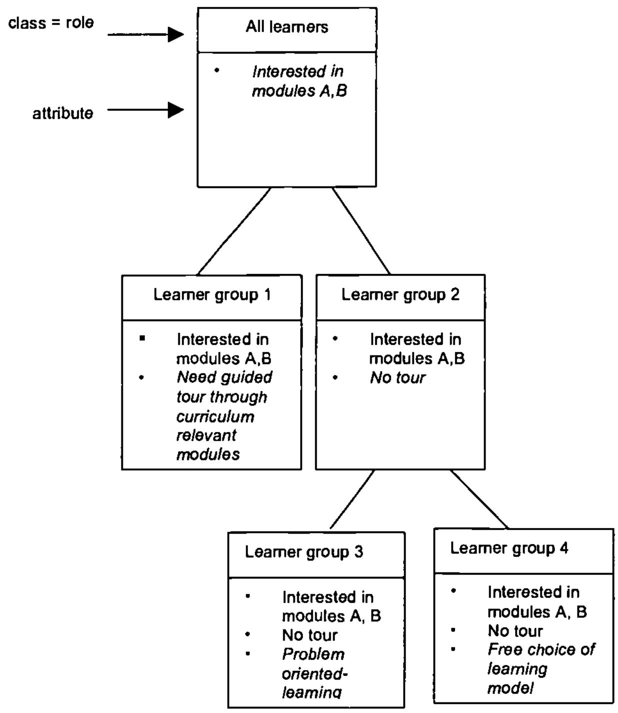

Figure 4: Hierarchy of learner groups demonstrating attribute inheritance for usability information

The data are stored as XML data records in a relational data base (cf. Kutsche 2000). An important advantage of this method is that classes of information are introduced. Such classes are for example, "user attributes", "content" and so on. These classes can be freely combined into views on the database, like the example of a role dependent view in figure 5 illustrates. In general, modeling and storing of classes with varying attributes allow flexibility in storing and selection of data. To take again the example of the learning environment, this data organization allows to cover attributes, which are valid for the whole context, and attributes, which are valid only for certain parts of the context. Moreover, another advantage is object-orientation, which allows generalization or abstraction with different detailing of information at different abstraction levels. So, developers don't have to deal with too many irrelevant data and information. Even numerous and complex attributes stay manageable, because specific attributes are only valid for certain user groups.

Another helpful quality of XML-based relational databases for the development process is, that it can be easily translated into other SGML-type languages like XHTML or LaTeX in order to visualize and document the contents. As the framework is web-based with server pages and the database is capable of serving a network, it is available for each of the members of the design team to insert data directly and can be used even for distributed teams.

5 Conclusions

The object-oriented framework described above allows flexible management of usability data during the whole development process. Even complex and informal data, e.g. from scenario descriptions, can be included and selected according to situational and role specific needs of users. As far as our experience with the application of hypermedia learning environments is concerned, the framework offers the possibility to include learning modules and connect usability information on different levels of abstraction. For the our application of a learning environment this will also be a basis for adaptation criteria.

For the future work, the framework for modeling learning environments will be further detailed. As software engineering is an iterative process that requires constant updating, the usefulness of our framework will be further proved by practice.

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Interface Design and Software Tools for Creating a Multimedia Program Measurement Instrument

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Abstract

This paper discusses how the author developed a Multimedia Program Measurement Instrument in consonance with proven design principles from the behavioral and cognitive sciences for instructional design and using several software tools. This is a program developed for her dissertation research[1] which was used for the initial pilot and field testing in the Spring and Summer 2000 semesters followed by a second pilot and field testing and Final Experimentation in the Fall 2000 semester at the University of Central Florida, C&I Instructional Systems. Her study is concluding in the Spring 2001 semester. The research study addresses the effect of three types of icon symbol formats viz., abstract, drawing-pictorial, and photographic-pictorial on a user's learning and performance. The measurement instrument consists of a lesson followed by a quiz on the "Advanced Features of a Digital Video Camcorder". Divided into three parts, the first part discusses the design of the interface and how principles of design was applied for ease of use. The second part of the paper discusses the tools for creating the multimedia program and to capture user's action and scores on the test. The paper is concluded in the third part by drawing up suggestions for applying similar approach to a variety of uses, whether standalone CD-based or web-based.

The Design of the Interface

Factors that were given primary consideration in designing the multimedia (Fleming and Levie (Eds) 1993) measuring instrument interface for ease of use, mental effort (Winn 1993), attention (Aspillaga 1996) and clarity of presentation were: consistency, predictability, simplicity (Haag and Snetsinger 1993) and information density (Mandel 1997 and Tullis 1997). The program interface starts with a 'welcome login' window where the user enters personal information. The whole experiment is concisely, briefly and clearly explained using a minimum of text and presented via pop up boxes while the user mouses over the conceptual words. This is done to keep mental effort of a user to a mimimum. The user is then familiarized with the lesson interface explaining what to anticipate, what a user is allowed and not allowed to do during the experiment. During the lesson (trials and sections) the user is guided by pop-up text prompts telling the user to go to next lesson, trial or when done with the last trial 3, section3[2] to proceed to Quiz.

Using a real-world (Mandel 1997) digital camcorder metaphor, the screen has a jpeg DVCAM photo (Fig 1) which serves three purposes viz. as a background for the content area (DVCAM) ; as a context that acquaints the users on the location of the parts and control dials and, as a bounding box that holds all icon, text and movie information. This background appears throughout the Lesson only. For text, the location, size, color and type of font (Ross 1988) stays the same for the different types of information. For example, the font type (AGaramond), color and size and location for the 'Step Number' button stays the same throughout the lesson. The same rule applies to the heading and prompts. The importance of the text information determined the size of font, i.e. words such as 'Lesson, Camera, Program, VCR and Quiz' needed to be emphasized and had to use (font size 14) than the heading text (font size 12). The icon images were of the same size and location with a buttonized, raised 3-D look. Predictability was solved by using a consistent design of having the icon in the upper left corner, step number on top of the icon, text meaning below the icon and process meaning in motion video on the right of the icon. This arrangement made it easy to locate information minimizing confusion and getting lost on the interface. Textual prompts appeared whenever a section, trial or lesson was concluded, guiding the users on the next thing to do so they avoid feeling uncertain on what to do and where to click next. The objects on the interface such as the icon, the text explanation and the movie file which appeared after the icon is invoked are grouped in close proximity[3] within a 3.5" radius. I maintained the same radius for presenting the single-answer multiple choice question. I used a bigger 4.5" radius for the several answer multiple-choice questions. This avoids the information seeking behavior of the eyes to move around the interface when trying

[1] Began Spring Semester 2000, at the University of Central Florida, Orlando, Florida on UCF Graduate Student Volunteers.

[2] The last part of the lesson

[3] Close Proximity concept – information is processed faster and understood better when located close to one another

to locate information (Tullis 1997). This kind of perceptual grouping[4] also allows for making meaningful associations among the information being presented (Winn 1993). Overall, the interface has a simple, uncluttered look.

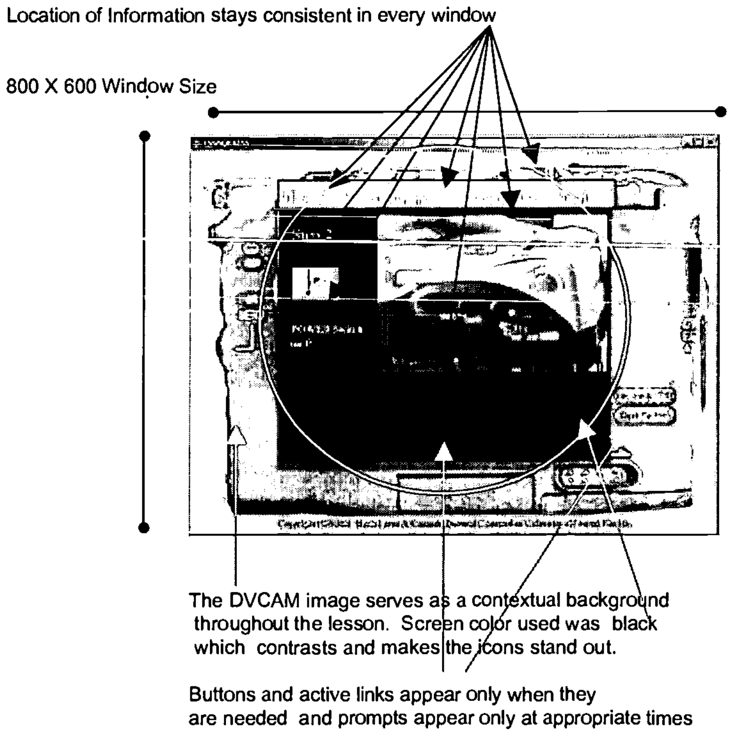

Fig. 2 Screen Capture of the Lesson Interface (not to scale)

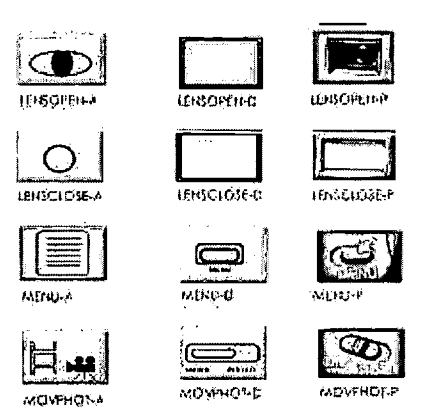

Fig. 1 Buttonized Images

The Tools

The Lesson is divided into three sections. One section is devoted to presenting the sequential steps to set the Canon ZR digital video DV camcorder DVCAM to CAMERA mode. Once in that mode, the DVCAM can be set up in various ways[5] which will have an effect on the recorded output. For illustrative purposes and to show the basic difference between digital video recording in contrast to standard analog video recording, the option of setting the DVCAM to DIGITAL EFFECTS for the Camera Menu was chosen. The steps lead to the last part of finally setting the DVCAM to Digital Effects and then shows the different types of effect one can use for a project. Of the seven[6] built-in digital effects, only 4 viz. Fade-Trigger, Art. Sepia and Strobe were used. Another section is devoted to presenting the sequence of steps to set the DVCAM to PROGRAM Mode. In this mode, six options[7] are available to suit the recording environment. For illustrative purposes the LOW LIGHT option was selected. When set to Low light, the DVCAM is able to record in dimly-lit places. The other section is devoted to presenting the sequence of steps for setting the DVCAM to VCR mode. When in the VCR mode, a user can view the recorded product.

[4] Perceptual Grouping – Buttons, objects such as a group of menu buttons, in this case, group of information that relates to the icon being grouped together are meaningfully associated with one another.
[5] Camera Menu options are: Shutter Speed, Digital Effects, Image Stabilizer, Digital Zoom, 16:9, White Balance; Self-Timer; Remote Sensor; Recording Mode; Audio Mode; Wind Screen; Backlight; Brightness, Date and Time set.
[6] Fade Trigger-At Start, the scene gradually fades in from a black screen. When stopped, it gradually fades out; Wipe-At Start, the picture begins as a thin vertical line in the center of the screen gradually expanding sideways to fill up the whole screen. At Stop, the image is wiped from both sides of the screen; Scroll- At Start the picture appears from the right hand side of screen expanding sideways to fill up the whole screen. At Stop, the image is wiped off.; Art- Adds a paint-like solarization effect to the image. Black and White-Records the image in black and White; Sepia-records a monochrome image with a sepia tint; Strobe-On-screen actions become a series of still images i.e. slow motion effect.
[7] Auto

Each step is represented in three different icon design. For that reason, MS Image Composer and JASC PaintshopPro[8] were used. Image Composer was useful for minimum photographic image enhancements such as cropping, erasing, sharpening, blurring and texturizing. PainshopPro, another image editing software's, Drawing Tool, not only allowed me to draw freehand shapes, geometric shapes, vector arrows etc. but was also handy in enhancing graphic objects. Through its Image and Effects Menu, I was able to fill shapes e.g. arrows with colors, rotate the direction of vectors and enhance their brightness and illumination. The last feature was particularly useful in enhancing the photographic-pictorial symbols resulting in a sharper, clearer image. When all the graphical digital assets were completed, each one was given a uniform dimension and applied a Buttonize effect to give it a raised clickable 3-D look (Fig 2). Video files were created by first recording the different steps in analog format. Using a software converter called DAZZLE, these analog files were converted into MPEG files. Once captured and saved onto the PC's hard drive, these MPEG files were enhanced, edited and cut. When set in Snap Capture and View mode, these same MPEG files could be used to extract JPEG images as well. To create the whole multimedia program. Macromedia Authorware Attain 5 was used. Authorware is an object-oriented, multi-platform authoring tool which recognizes various file formats for animation, audio, video, text and graphics. Its Knowledge Objects Application shell was useful in developing the LOGIN portion which is where the user inputs personal information such as name (first, last and middle) and subject number. Knowledge Objects are mini programs that a developer can add to the main authorware application. There is a Quiz Knowledge Object, an Application Knowledge Object, a Movie Controller Knowledge Object etc. The rest of the multimedia measuring instrument program was completed using the flowchart, icon-based authoring approach.

To track the user's actions, a screen recording software called Camtasia was used. Time and scores on the quiz are captured on the hard drive. These MPEG files dynamically records all of the user actions in real-time and can be replayed later for review. User's behavior on the program reflected by the movement of the cursor appearing as an arrow or a hand can then be observed during replay.

Conclusion

The behavioral and cognitive design principles guiding the creation of the multimedia measuring instrument can be used for similar learning, performance and evaluation exercise for different content areas in interactive simulations, CD or web-based training and other technology-related training. The tools I used for creating the instrument are but a few of the many applications available. It is now common practice to download trial versions of even the fanciest software[9] for 30-45 functional days. After the elapsed period, these downloaded applications will stop working and will prompt the evaluators to purchase the product. Much of my instructional technology application try outs are done this way.

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[8] Evaluation version downloadable at www.jascpaintshoppro.com

[9] www.macromedia.com, www.jascpaintshoppro.com, www.techsmith.com

Interface Design and Tools for Creating a Multimedia Measurement Instrument

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This paper discusses how the author developed a Multimedia Program Measurement Instrument in consonance with proven design principles from the behavioral and cognitive sciences for instructional design and using several software tools. This is a program developed for her dissertation research which was used for the initial pilot and field testing in the Spring and Summer 2000 semesters followed by a second pilot and field testing and Final Experimentation in the Fall 2000 semester at the University of Central Florida, C&I Instructional Systems. Her study is concluding in the Spring 2001 semester. The research study addresses the effect of three types of icon symbol formats viz., abstract, drawing-pictorial, and photographic-pictorial on a user's learning and performance. The measurement instrument consists of a lesson followed by a quiz on the "Advanced Features of a Digital Video Camcorder". Divided into three parts, the first part discusses the design of the interface and how principles of design was applied for ease of use. The second part of the paper discusses the tools for creating the multimedia program and to capture user's action and scores on the test. The paper is concluded in the third part by drawing up suggestions for applying similar approach to a variety of uses, whether standalone CD-based or web-based.

Do new media need new didactic methods?

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Abstract: The need of new didactics is an often heard claim in the context of the integration of new information and communication technologies (ICT)[1] in education. This paper pursued this question and found, that most of the effective applications of ICT in educational settings are not based on a completely new didactic approach. However, the call for new didactics seems to be grounded more on a lack of knowledge about existing didactic possibilities than on a real requirement.

The confusion of media technology and pedagogy

ICT have made incredible advances over the last few decades. From room-filling machines, computers have continually downsized to desktop and even portable models. The latest generation of computers actually deserves the label "multimedia". Parallel to these innovations, the internet has become a service that is now also available to the average individual. But the real power of multimedia and internet is to be found in the concept of "hypertext" and its extension "hypermedia. These innovations are interesting not only from the technological and economical viewpoint, they also offer new possibilities in education. However, do these new ICT require "new didactics" as claimed?

The short answer to this central question is "No, new didactic methods are not stringent prerequisites for an effective integration of new ICT into educational settings" (Kerres, 1998, p.30). Many effective examples of ICT applications in education are based on known didactic concepts and methods. For example, computer-mediated communication often reverts to the seminar model of classroom teaching. Or CD-ROMs: They are often used in a not very innovative way simply as replica of books enriched with animations, video and sound. But on the other hand, very sophisticated CD-ROM based multimedia productions also exist in which the principles of "discovery learning" are applied in a very effective way. Furthermore, the same didactic methods that make the best out of traditional classroom lecturing, will also contribute to the success of tele-teaching by television or videoconferencing.

The call for new didactics seems to be founded in a fundamental confusion between media technology and pedagogy. Although the insights of Clark are now 15-20 years old, they have not lost their timeliness: media are simply vehicles to deliver instruction (Clark, 1983, p.445). ICT have no impact on underlying theories of learning, although they play an important role in designing instruction and delivering content and information. Furthermore, it is not only the technologies that have changed over the last decades. Psychological theories of learning have also changed significantly - evolving from previous cognitive theories, constructivist theories have recently come more and more into vogue. Parallel to this evolution of theories of learning, a wide range of new didactic methods have been developed: discovery learning, problem-based learning, anchored instruction, cognitive apprenticeship etc.

Integration of ICT: Pedagogy driven instead of technology driven.

The challenge today is how to transfer this know-how to the new ICT (Kerres, 1998, p.30), rather than the often heard question *"How must instruction be adapted to new ICT?"* An urgent issue for research in didactics is how to integrate the new media into existing didactic concepts in order to foster the most efficient and productive

[1] The collective term *information and communication technologies* (in the following abbreviated as ICT) will be used in this paper to denote all systems and applications based on computer and telecommunication technologies, for example, internet, CD-ROM, multimedia applications, tele- and videoconferencing systems.

learning possible (Eberle & Abplanalp, 1999). A central aspect consists in the question of which media or combination of media do best fit which educational purpose. However, up to now empirical research did not succeed in proving the superiority of a specific medium in a defined learning environment (Kerres, 1998, p.28; Russell, 2001). In most cases where the use of computers was found to be advantageous *"...it was not the medium [itself] that caused the changes but rather a curriculum reform that accompanied the change."* (Clark, 1983, p.445). Empirical research on media in education is hampered by the superimposition of instructional method and media. Consequently it can be deduced that media themselves have little influence on the achievement of learning goals. Thus, looking for the one best medium is little reasonable and even irrelevant. Instead it is the choice of suitable instructional approach that must take precedence over the decision for or against a certain medium. First the educational needs, second the suitable didactic approach and only third the selection of an appropriate medium (see figure 1, left side).

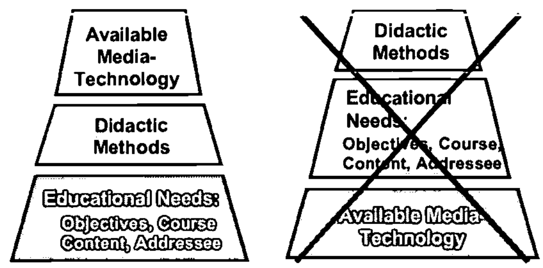

Figure 1: The decision-making pyramid in the choice of an appropriate medium for an educational setting

Unfortunately, in most of the cases the implementation of ICT is technology driven. Too often the wish or availability of new technologies dictates the agenda (Kerres, 1998, p.28). In these cases, technology is either used to only enrich teaching environments as peripheral or optional offer, or - at the other extreme - institutions try to substitute teachers with new media by imitating traditional face-to-face instruction. Neither of these approaches genuinely improves learning. In such technology driven scenarios, the instructors change their curriculum and adjust their didactic approach to fit the demands of the technology (see figure A1, right side). If the curriculum has to be changed, it must be because there is a better method that can only be brought about with new media, and not vice versa. In order to effectively exploit the potential of new ICT, educators themselves must meet two additional criteria: Firstly, a solid knowledge on the part of the lecturers of at least the basics of didactics is imperative. Secondly, it requires a certain amount of imagination and creativity to successfully combine this didactic know-how with the possibilities offered by ICT. With sufficient creativity, it is feasible to produce not only efficient ICT-learning environments but even to create entirely new didactic methods.
It is challenging and interesting to follow the different ways that are tried out with new media. But even if new methods evolve, ICT do not need a new theory of learning. Hence, the claim for new didactics is based on a lack of knowledge about existing possibilities didactics offer already today than on a real requirement.

Summary

- New ICT do not need new didactics.
- It is not the medium but the didactic approach that is responsible for the changes in learning efficiency.
- The educational objectives determine the choice of the didactic approach. The didactic approach again together with the circumstances of the whole learning environment determine the choice of the media.
- The possibilities of new ICT can only be fully exploited if the involved instructors dispose of the relevant didactic foundations.

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A Small History of A Communication Board

for Collaborative Learning Among Distant Elementary Classes

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Abstract: We developed three types of communication board systems to promote class-to-class collaboration for environmental learning. Each board has advantages and disadvantages. We can summarize these between *learning context* and *idea-comment relationship.* On a communication board system, we can see links between a comment and it's target idea on the web page. On the other system, they can read comment chains about some topics easily and even be able to discuss something on the communication board, but comments are apt to have weak relation to the original web page, which represents a learning activity by a classroom. It is better to combine some other media with the communication board in order to have a successful and balanced collaboration.

Background

One of the most important purposes of the Internet use in elementary schools is to promote collaboration among children in distant classes. Communication through the Internet among classes should be activated to attain the purpose. It is very rare for Japanese children to communicate independently with friends in distant schools during class work. Most teachers tend to lead children's learning contexts and put the students together into a series of similar learning activities. This seems to conflict with individual or group use of the Internet for learning. In reality, each teacher usually creates a lesson plan, and children use the Internet in accordance with the plan.

This leads to a situation that is not suitable for Japanese elementary children to communicate with a general electric bulletin board system, because it requires personal communication. We need a special BBS system to promote both class-to-class and personal electric communication. We started developing a kind of communication board system to meet these needs in 1996 (Dept. of School Programs of NHK, 1998).

The first system was named *DBC-Web*. After that we developed other types of communication board systems. The later systems are developed based on some requests from users of the former systems. The improvement of the system was mainly focused on styles of children's communication. We tried to promote more frequent and interactive argument on the systems. For future development, it is essential to recognize the advantages and disadvantages of each system.

Outline of each Communication Board System

-DBC-Web

This system is based on a card database system named D.B.C. (Database for Children), which was developed with SuperCard in 1993 for environmental learning at Fukumuro elementary school. Each card of the original D.B.C. has a "picture field" for a photograph or a picture by the learners, a "data field" for location, temperature, climate, and other data, and an "opinion field" for learners' opinion related to the information in the other fields.

The *DBC-Web* enabled learners to publish the data on the D.B.C. to a web site. Children go on field research trips and make a brief investigation about their surroundings. They input outcomes from the activities to the D.B.C. Finally they display the data on a classroom web site (Fig. 1).

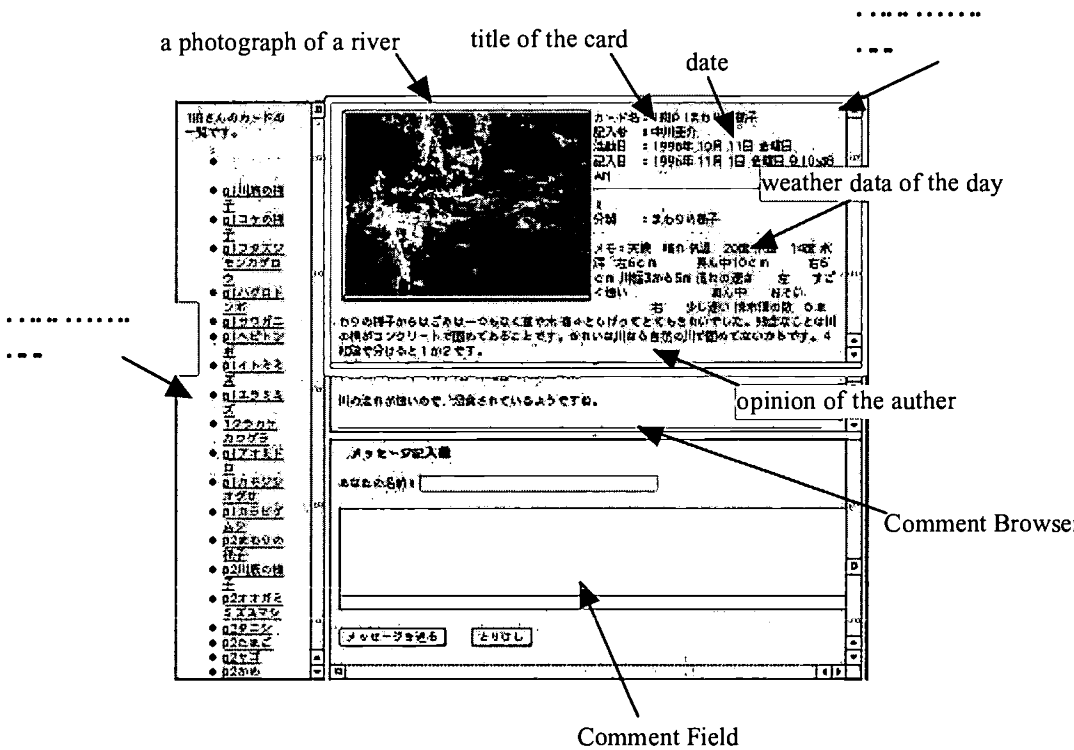

Fig. 1: *DBC-Web*

The gray outlined frame is for data on the D.B.C. and the page has three other frames: card changer, comment browser and comment field. The left frame is to select the data card to view (card changer field). Children are able to get comments from other elementary students by way of the bottom frame (comment field) and read them in the middle frame (comment browser). Each data card has a different comment log. Children can exchange opinions about each card.

-Health of the Earth (1st model)

The second communication board system works together with a TV program series titled "The Only One Earth" (Kurokami et al. 1999, Dept. of School Program of NHK, 1999). This series is made to facilitate environmental education at 5th and 6th grade of elementary school and includes 20 different shows. Each shows are 15 minutes long and produced to be used in usual lessons of integrated curriculum. We are supposing that every class using the system is watching most of the series.
A series of TV program has a long story to show audiences about various environmental issues. At the initial period some concrete issues like air pollution, water pollution, and garbage disposal. Gradually these issues are integrated into more abstract theme like ecology system.

A teacher conducted in-depth learning about environmental issue after watching the TV program. Pupils made web pages in groups or in a class about their activities and the results of their learning. These web pages were put on our communication board system server. The communication boards were connected with each web page (Fig. 2) published by classes that participated in our project.

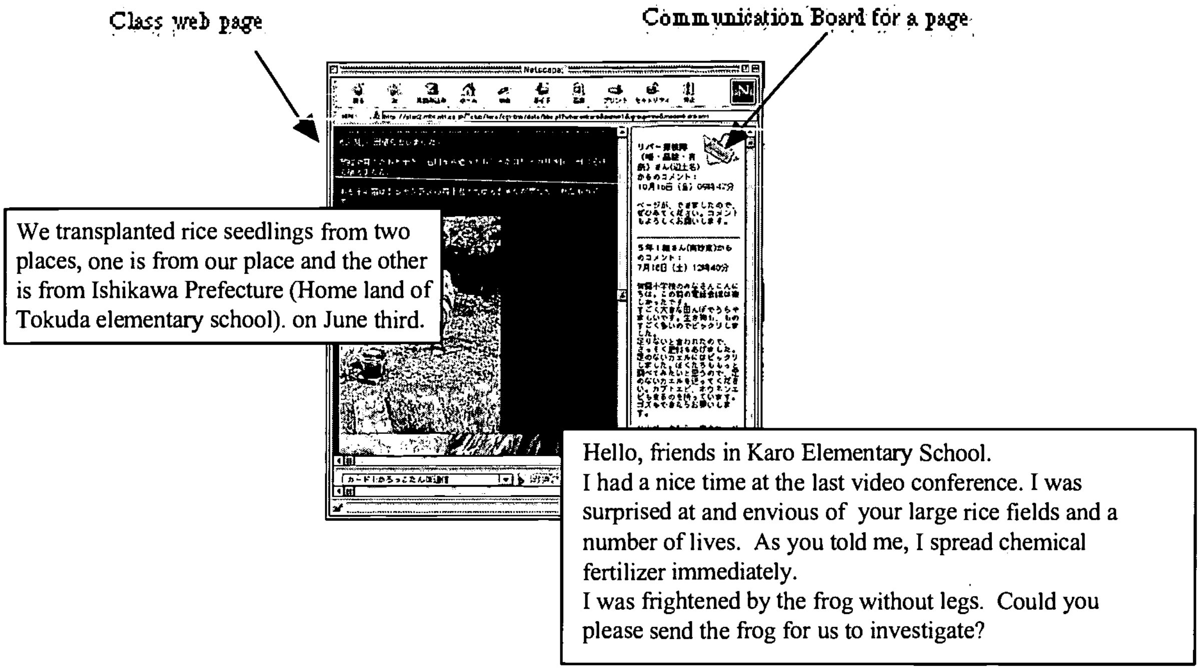

Fig. 2: ***Health of the Earth (1st model)***

Communication on the board is based on the context of activities done in each classroom. Distant learners are able to produce comments to every other class. For example in Fig. 2, the web message in the left frame is about a rice planting activity. Beneath the message and photograph, there is a message informing others that they found a frog without legs in their rice field. On the right side, we can see comments from another schools, which says the pupil was frightened to see the legless frog. This interaction can be a bud of more fruitful communication between their classes.

-Health of the Earth (2nd model)

This is the revised version of the 1st model. With this system, there is no need for learners to send html documents to our Internet server. Users register their own web page (URL) to the communication board system. They usually make their own web pages about various classroom affairs. If they want to get comments from, they just send the URL of the page to our comment board system.

When learners access a registered web page from our communication board system, two windows appear on the desktop. One is the page accessed and the other is a communication board. A school or a class has just one communication board on this model. Therefore whole comments will relate to the story of learning activities published on the class web page.

Fig. 3: ***Health of the Earth (2^{nd} model)***

Advantages and Disadvantages of Each System

We can learn a lot from these three types of communication board systems.

As the *DBC-Web* is a kind of database system, every finding by children on field trips can be saved on the system. Each record has a connection to children's investigation so it contains very concrete findings without interpretation or explanation. On the other hand, information on the *DBC-Web* is broke up into pieces and the number of records is too big to be read by project friends. At the same time, the relationship among records can't be represented in any way. It is very difficult to get any idea about the story of classroom activities from the information.

Health of the Earth (1^{st} model) consists of web pages sent by project classrooms and communication boards for each web page. Children in a classroom have to organize their ideas with findings on fieldwork and make one or more web pages, while an electric bulletin board is generated for each page. They can get the same number of bulletin boards as web pages. As web pages and bulletin boards have a one-to-one correspondence, it is very easy to find the target idea of comments from distant learners. On the other hand, distant learners intending to produce comment to the whole message of the site faced some confusion. There is no way to do that and every comment is forced to by written on the same communication board. This makes discussion on the board difficult.

On *Health of the Earth (2^{nd} model)*, we lose the connection between communication board and target idea. We get context of comments at the price. Comment chain is continued to enable users to discuss something on the board. From a learning management view, children need not make special web pages to send to our Internet server for the project. This saves time so that children can spend more time doing fieldwork or other research.

Possibility of Communication Board in Educational Use

Collaborative learning on the Internet has many advantages and disadvantages. For instance, advantages include exchanging vivid local information, making it easy to think globally, and promoting learning motivation.

We can list risks of faulty information from distant learners, relying too much on others to get information, and being time consuming as a few disadvantages. Educators have to find a balance between the good and bad points.

	Advantages	*Disadvantages*

DBC-Web	• Every finding by children can be saved on the database. • Every data has a photograph on the data sheet and the image of the information is easy to grasp. • Each data is related directly to findings of the investigation	• Too many cards are produced to be read and understood by co-learners. • Relationship among records can't be represented. • Whole activities of a class are difficult to understand.
Health of the Earth (1st model)	• Findings of the fieldwork is made up into web pages and this can be a good chance to re-understand of their work. • Every web page reflects a context of learning. • Target page of comment is clear.	• Comments are scattered on each communication board. • It is almost impossible to trace comments in time flow. • Discussion on the communication board is difficult.
Health of the Earth (2nd model)	• Findings of the fieldworks is made up into web pages and this can be a good chance to re-understand of their work. • Context of communication can be saved. • Discussion on the communication board is easy. • Participants need not make special web pages for the project.	• Target page of comment is not clear. • Communication on the board is not always related to the web pages.

Table: Features of Each Communication Board

From this small history of our communication board systems, we may add a new viewpoint to a list of weights: *learning context* or *relationship between target idea and comment.* On one system we can see the relationship clearly at the sacrifice of losing context of comments, and on the other system we can get context instead of the relationship.

Communication boards can promote collaboration among some distant classrooms in a sense, but we always take notice to compensate for the lost weight with other media like video letters, and videoconference. Communication boards become more useful in combination with other educational media.

Actually, 13 classrooms participating in our project this year are using video conferencing frequently. Communication between/among classrooms is direct and synchronous, but the chance of the conference is limited. Because of difficulty of coordinating schedule and connection fee, possible period of the conference is about an hour a time. Sometimes, hot arguments about a complicated theme occur on the limited condition. Usually, however, it is difficult for children to reach any conclusion in a conference.

Meanwhile, discussion on the BBS was asynchronous and gave children a longer time to think about the theme. Messages could be sent individually at any time. The opinions of each child could be expressed on the board.

Teachers always read their messages and follow the stream of the discussion and determine when to have videoconferences. The focus of the videoconference is also lightly controlled by teachers. They use videoconferences and BBS according their purpose.

We have to suppose that communication between/among classrooms is supported not only by our communication board systems but also by the other media and even by teachers and children.

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Doing research on web-based learning

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Interaction in technology-supported collaborative learning environments can be beneficial for learning in many ways (e.g. Lehtinen 1997, Järvelä & Häkkinen 2000). At their best, they may help their users to transform the practices of learning and instruction. As for the research perspective into web-based learning, many aspects of the working process can be captured through the electronic data, automatically stored throughout the study project. However, we should carefully consider to what extent it is possible to make generalizations concerning the effects of technology on learning outcomes with the aid of a single source of data. A central concern related to the research of technologically mediated communication and learning is the choice of an appropriate research approach to capture the complexity of the phenomena under investigation. This poster discusses a discourse approach to the study of web-based learning.

Developing SLA in New Language Learning Environments

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Abstract

The paper reports on the findings of a study conducted on the basic courses of Slovak. The purpose was to examine the development of Slovak language acquisition in the new learning environments (self-access centre). Communicative competence was explored from the perspectives of language production and language process, and it was assessed by means of language level tests and self-assessment questionnaires. Both intro- and retrospective methods (questionnaires, analyses of learner diaries) were used to reveal the learners' attitudes towards the employment of new language learning environments and towards learning Slovak in general. The study showed that some students were reluctant to use the self-access centre utilities for their self-study due to their beliefs in traditional learning methods and lack of computer literacy. However, those students who were able to utilize the new learning environments achieved better results than those who were not able to utilize them. The study is an example of the acquisition of a less frequently taught language in new learning environments and a case of overcoming prejudices. As such, it contributes to the development of pedagogy of less frequently taught languages.

Introduction

It is a well-known fact that SLA (Second Language Acquisition) requires a lot of time and effort, and that teaching alone can seldom produce fluency needed in authentic language use. In addition to teaching, the learner must also develop skills for continuous learning and self-assessment (Räsänen & Randell, 1999; Karlsson et al., 1997). Furthermore, the use of the Internet, as one of the primary media of literacy and communication, requires the development of information literacy which involves the ability to find, organize and make use of information (Warschauer & Kern, 2000).

The growing requirements for efficient learning and teaching, institutional saving policies and the need for learning something new were the main factors for creating a supplementary self-study program of Slovak for Finnish students. The main focus was on the development of SLA (Second Language Acquisition, Slovak Language Acquisition) skills and competencies and promoting self-directiveness in language learning. Multimedia applications (tcxt, sound and video) were applied in the first stage of the program (language, culture, literature studies) and network applications (information search, use of electronic communication tools, discussions and simulations) in the second stage of the program.

The Study

In the first stage of the program, the communicative competence of the learners was explored from the perspective of language production. All students from the basic up to the advanced level were tested at the beginning and at the end of the term. Language level tests were complemented by questionnaires which aimed at revealing students' attitudes towards learning Slovak (use of learning strategies, motivation) as well as their attitudes towards the use of new learning environments.

In the second stage, the communicative competence of the learners was explored from the perspective of the learning process. Five students were observed from the basic up to the advanced level. The observation began in 1999 and is still going on. Their learning process has been observed in the classroom, by means of questionnaires, personal dicussions and learning diaries. Language proficiency development has been assessed by language level tests (at thc beginning and at the end of the term). Their experiences of using new learning environments have been discussed during feedback sessions.

A separate group was composed of distance students and some advanced level students who were unable to participate in the contact classes (5-7). Teacher-learner communication was provided via electronic communication tools only (on-line communication, e-mail). This group participated in the contact feedback sessions only once, otherwise the feedback was given in the electronic way

Findings

Some examples of the SLA skills and competencies practiced in the self-access centre were as follows:

Listening skillsaudio / video tasks; communication based on speaking and listening;
peer working
Speaking skillsaudio tasks; guided conversation and pronunciation practice, role plays, simulations;
peer working
Reading skillsreading www-texts ; library search skills; Web-sites; combination of texts and other media; vocabulary building
Writing skillsprocess writing (essays , letters); e-mail; combination of texts and other media; peer reviewing
Communication skillsintercultural skills practice;
e-mail discussion groups, news groups, www-chat

The purpose of practicing the SLA skills and competencies in the new learning environment was to enhance different skills of listening, speaking, reading and writing, to investigate and process authentic linguistic and cultural information, to enhance autonomous (self-directed) learning, to build learning skills and participate in some collaborative projects (research communicative networks). The last but not the least significant purpose was to build electronic literacy - abilitity to write and read in the new media (Warschauer & Kern, 2000).

As Lemke points out in Warschauer & Kern (Warschauer & Kern, 2000), in a learner-centered curricular learning paradigm someone else decides what the students need to know, and usually it is the teacher, but in interactive learning paradigm learners determine their own learning goals and interests. Autonomous (self-directed) learners are able to take charge of their own learning and use the communication opportunities on the Internet (p. 176). This was obvious also among the groups studied here.

The most eager Internet users were also the most autonomous learners, able to employ all the possibilities of acquiring authentic knowledge about the language, history and culture. They enjoyed the flexibility and freedom of choice offered by the Web - the possibility to use the teaching materials at home, to communicate with the teacher and other students at any time they wished (teacher's response via e-mail), etc.

Some students found the use of self-access facilities difficult due to lack of experience and technical support. Multimedia applications were welcomed but the use of computers was avoided at the beginning. Lack of good electronic materials in Slovak is also one reason why printed texts were preferred. Some students preferred a more 'traditional' way of learning Slovak probably because www-materials in the Slavonic languages are scarce in general. On the other hand, they also seemed to believe that learning Slavonic languages in an unconventional way is not even possible.

For some learners the new learning environments provided new exciting learning experiences (interactive tasks and facilities that allowed for direct communication with the teacher). They helped to increase their motivation, self-confidence and progress, as well as enhanced their capacity of self-directiveness (information search, discussion and chat-groups, etc.).

Conclusions

The use of new environments for learning less frequently taught languages requires much more training in information technology and especially in the pedagogy of network-based instruction. In principle, there is a great appeal and challenge in the prospect of using the www and self-access instead of the classroom - the richness of the authentic world providing opportunities for interactive learning. However, the key question is not only how to use information technology for language learning and teaching but also, how to teach the language in such a way that the students would become enabled to utilize the technology available and to overcome any student- or teacher-stereotypical concepts of language learning and teaching in general. And that is an issue which concerns all languages – whether widely or less frequently taught and used.

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The Third Generation of Computerized Counseling

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Abstract: How we cope with social situations can be thought as a form of expertise that can be learned. Computerized counseling is an interesting new alternative for learning social skills. A more far-reaching application is automated counseling which is based on a host computer and a pocket computer or a wearable computer. This kind of system has the advantage for making it possible to help people in real-life situations. In this paper I outline the basic structure of computerized mobile counseling.

Introduction

Pocket computers are becoming very popular. These computers have, at least, three important properties: mobility, sharability and context sensitivity (e.g., Inkpen 1998). Mobility means that they, for example, provide access to Internet resources, even when they are carried out by users during day-to-day activities. Sharability, in turn, makes it possible to share information using computer technology, and context sensitivity provides sensitive to the location in which pocket computers are used. These properties make pocket computers particularly suitable for specific purposes. Here I will present ideas how to use pocket computers that are connected to a main computer to assist people who are seeking psychological help.

In recent years it has been developed computerized forms of psychoeducational counseling (for a review, see, e.g., Wagman 1988). At present the most far-reaching application is automated psychotherapy or counseling which is based on a host computer and a handheld or wearable digital assistant. My aim is to develop foundations for this kind of application. The principal purpose is to develop a fully automated counseling that can, for example, help clients in different contexts. Here I provide an initial exploration of this issue.

Theoretical Background

The work is based on the theory of person schemas (e.g., Horowitz 1998). Person schemas include, e.g., self schemas, schemas of another person and role relationship models. The repertoire of schemas determines by which way interpersonal relations are structured. I use abstraction hierarchies to present social transactions. Abstraction hierarchies are hierarchical descriptions of the goal-relevant restrictions for a specific problem area (Vicente & Rasmussen 1990). Abstraction hierarchies are, for example, used in cognitive psychology to describe goal-oriented performance in different domains. The main levels of these descriptions, from the lowest to the highest, arc function, tactics, strategies and purpose. The idea here is that we all are experts in producing complex behavioral patterns in social transactions, and different people use different strategies and tactics in social situations.

What is common to conflict situations is the fact that negative emotional states emerge and people use different kinds of behavior patterns to handle conflicts. If the aim is to get rid of negative emotions and defensive behavior patterns, the first task is to become aware of these patterns and get some insight into their causes. Next, we have to make new plans, learn new practices and decide to use them. According to Horowitz (1998), behavioral change is based on three important stages: awareness, insight and decision. These changes, in turn, occur at three major levels: states of mind, altering defensive controls of ideas and emotions and person schemas.

Computerized Counselor at Your Service

A computer-based counselor may help the client at all these stages and levels. In order to do that it is necessary that the host computer has specific information resources. Firstly, the computerized counseling system has to possess knowledge about its own behavior and that of the client (Wagman 1988). The computer should have a database of the self schemas, state of minds and defensive mechanisms that are typically used to reduce emotional arousal. The system must also have a database concerning possible social situations and possible strategies and tactics to handle these situations. Secondly, at the diagnostic phase, the computer must become acquainted with the user. The client uses text or speech to describe how he/she operates in different kinds of stressful life events: what the client thinks, how he/she behaves and which kind of emotional states the stressful events evoke. During these interviews the computer gathers knowledge of the client's schematic structures related to self and others and his/her defenses and emotional states in social situations. Experiences in development of computerized psychiatric diagnostic interviews (e.g., PsychDiagnoser) can be utilized in developing the diagnostic system (Zetin & Glenn 1998).

The personal digital consultant may help the client in several different ways. Firstly, based on interviews it may present personality profiles and make suggestions how to handle particular conflict situations. At this stage, the aim is to promote recognition and understanding of maladaptive states of mind and behavioral patterns. For example, using computers, it is possible to practice new skills in simulated transactions. At the next stage, the client uses a handheld counselor in real-life situations. For example, when the client is approaching a stressful life event, the animated consultant may suggest how to cope with it. In addition, text, music and videos can be used to promote more adaptive states of mind. At the evaluation phase, the client gives feedback to the system, and the system, in turn, evaluates the client's behavior.

Future of Computerized Counseling

Advances in computing technology make it possible to develop context-sensitive consultants. In addition to the location within which the system is used, it could, for example, be sensitive to the people with whom the client is interacting. In the not too far distant future, the computer may also recognize changes in autonomous responses and alert the client if his/her emotional state is changing. All the knowledge concerning the client can be analyzed and stored. This database can function like some kind of external autobiographical memory register. The computer may later use the database to present to the client optimal solutions to emotional problems.

Evaluation

Will computerized counseling ever succeed? It can be argued that face-to-face therapeutic contact is essential to the successful treatment process. One possibility is that, even though automated counseling is primarily aimed at being used without face-to-face therapeutic intervention, it is also possible to include it in a part of a traditional therapeutic process.

A computerized counseling system necessarily remains quite rigid, if a fixed set of schemas, states of mind, behavior patterns and emotions are programmed. That is, there will never be a complete match between the client's personality and the suggested personality profile, and thus, the solutions the computer offers will never be ideal.

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Multisensory Virtual Environment for Supporting Blind Persons' Acquisition of Spatial Cognitive Mapping – a Case Study

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Abstract: Mental mapping of spaces, and of the possible paths for navigating these spaces, is essential for the development of efficient orientation and mobility skills. Most of the information required for this mental mapping is visual information (Lynch, 1960). Blind people lack this crucial information, thus facing great difficulties (a) in generating efficient mental maps of spaces, and therefore (b) in navigating efficiently within these spaces. The work reported here is based on the assumption that the supply of appropriate spatial information through compensatory channels (conceptual and perceptual), may contribute to blind people's spatial performance. A multisensory (haptic, auditory) virtual environment simulating real-life spaces has been developed and tested. A description of the learning environment and results from a pilot study are presented.

Rationale

The ability to navigate space independently, safely and efficiently is a combined product of motor, sensory and cognitive skills. This ability has direct influence in the individuals' quality of life. Mental mapping of spaces, and of the possible paths for navigating through these spaces, is essential for the development of efficient orientation and mobility skills. Most of the information required for this mental mapping is visual information (Lynch, 1960). Blind people lack this crucial information, thus facing great difficulties (a) in generating efficient mental maps of spaces, and therefore (b) in navigating efficiently within these spaces. A result of this deficit in navigational capability is that many blind people become passive persons, depending on others for continuous aid (Foulke, 1971). More than 30% of the blind do not mobilize independently outdoors (Clark-Carter, Heyes & Howarth, 1986).

The work reported here is based on the assumption that the supply of appropriate spatial information through compensatory sensorial channels, as an alternative to the (impaired) visual channel, may contribute to the mental mapping of spaces and consequently, to blind people's spatial performance. Research on blind people's mobility in known and unknown spaces (Golledge, Klatzky & Loomis, 1996; Ungar, Blades & Spencer, 1996), indicates that support for the acquisition of spatial mapping and orientation skills should be supplied at two main levels: perceptual and conceptual levels.

At the perceptual level, the deficiency in the visual channel should be compensated with information perceived via other senses, e.g., touch and hearing. Haptic information appears to be essential for appropriate spatial performance. Haptics is defined in the Merriam-Webster dictionary as "of, or relating to the sense of touch". Fritz, Way & Barner (1996) define haptics as " tactile refers to the sense of touch, while the broader haptics encompasses touch as well as kinesthetic information, or a sense of position, motion and force." Haptic information is commonly supplied by the cane for low-resolution scanning of the immediate surroundings, by palms and fingers for fine recognition of objects' form, textures, and location, and by the legs regarding surface information. The auditory channel supplies complementary information about events, the presence of other people (or machines or animals) in the environment, materials which objects are made of, or estimates of distances within a space (Hill et al., 1993).

At the conceptual level, the focus is on appropriate strategies for an efficient mapping of the spacc and the generation of navigation paths. Research indicates two main scanning strategies used by people: route and map strategies. Route strategies are based in linear (therefore sequential) recognition of spatial features. Map strategies, considered to be more efficient than the former, are holistic in nature, comprising multiple perspectives of the target space (Fletcher, 1980; Kitchin & Jacobson, 1997). Research shows that blind people use mainly route strategies while recognizing and navigating new spaces (Fletcher, 1980).

The Proposed Study

Advanced computer technology offers new possibilities for supporting blind people's acquisition of orientation and mobility skills, by compensating the deficiencies of the impaired channel. Research on the implementation of haptic technologies within virtual navigation environments reports on its potential for initial training as well as for support and rehabilitation training with sighted people (Giess, Evers & Meinzer, 1998; Gorman, Lieser, Murray, Haluck & Krummel, 1998), as well as with blind people (Jansson, Fanger, Konig & Billberger, 1998; Colwell, Petrie & Kornbrot, 1998).

In light of these promising results, the main goals of this study are:

- The development of a multisensory virtual environment enabling blind people to learn about different (real life) spaces that they are required to navigate (e.g., school, work place, public buildings).
- A systematic study of blind people's construction of cognitive maps of real spaces by means of the virtual environment.
- A systematic study of the contribution of this mapping to blind people's spatial skills and performance in real environment.

The Virtual Environment

Developer/Teacher mode

The multisensory virtual environment simulating real-life spaces comprises two modes of operation: Developer/Teacher mode, and Learning mode.

The core component of the developer mode is the virtual environment editor. This module includes three tools: (a) 3D environment builder, (b) Force feedback output editor, (c) Audio feedback editor.

By the 3D-environment editor, the developer can define the environment characteristics: size and form of the room, and objects (e.g., doors, windows, walls, rectangle, cylinder). The Force-feedback output editor allows attaching Force-Feedback effects (FFE) to all objects in the environment. Examples of FFE are vibrations produced by ground textures (e.g., stones, parquet, grass etc), force fields surrounding objects, friction sensation. The audio feedback editor allows the attachment of appropriate audio units to the objects, e.g., "first window", "turn right".

Figure 1 shows the environment-building editor screen, by which the researcher/teacher can build new navigation environments, according to the users' needs in progressive levels of complexity.

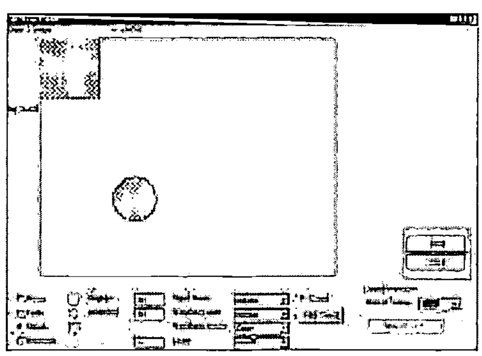

Figure 1: 3D environment builder

Learning mode

The learning mode includes two interfaces: User interface and Teacher interface.

The user interface consists of a virtual environment that simulates real rooms and objects. The subject navigates this environment using the Microsoft Force Feedback Joystick (FFJ). The feedback received while navigating the room includes sensations such as friction, objects' force fields and vibrations. By using the FFJ the subject can get foot-level information, equivalent to that she/he gets by his feet as he walks in the real space. In addition auditory information is generated by a "guiding computer agent", aiming to provide appropriate references whenever the subject gets lost in the virtual space. Figure 2 shows the user-interface screen.

The teacher interface integrates series of features serving teachers during and after the learning session. Several monitors on the screen present updated information on the subject's navigation, e.g., position, objects reached. An additional function allows the teacher to record the subject's navigation path, and replay it to analyze and evaluate her/his performance (Figure 3).

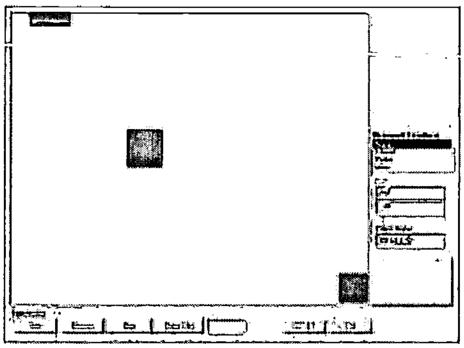

Figure 2: The user interface

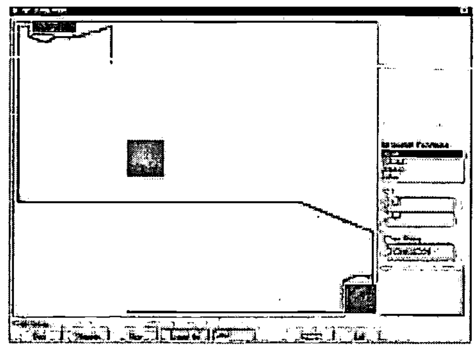

Figure 3: The teacher interface

The Case Study: A blind subject's performance within the Force Feedback Virtual Environment and in the real environment

The pilot case study aimed to analyze a subject's performance regarding five main aspects:

(a) Technical issues in using the virtual environment (e.g., use of FFJ, response to FFE).
(b) Ability to identify the virtual environment's components (e.g., identification of objects, recognition of spatial features).
(c) Navigation and mobility within the virtual environment.
(d) Construction of a cognitive map of the simulated room.
(e) Performance in the real environment.

Method

Subject

G., is a twenty-five years old, a late blind (G. became blind at the age of twenty). He is a computer user for more than three years, using voice output.

Procedure

The study consisted of three stages: familiarization with the virtual environment, navigation in the virtual environment, and navigation in the real environment.

At the beginning of the familiarization with the virtual environment stage the subject received a short explanation about its features and how to operate the FFJ. A series of tasks were included regarding: (a) FFE and audio feedback; (b) mobility within the virtual environment (at varied levels of complexity). Data on the subject's performance was collected by direct observation, and by video recording. This first stage lasted about three hours.

The navigation in the virtual environment stage included three tasks: (a) exploration and recognition of the virtual environment; (b) a target-object task (e.g., walk from the starting point to the blackboard in the room); (c) a perspective-taking task (e.g., walk from the cube -in a room's corner- to the rightmost door -the usual starting point). Following the exploration task the subject was asked to give a verbal description of the environment, and to construct a scale model of it (selecting appropriate components from a large set of alternative objects and models of rooms).

Several data-collection instruments served this stage: a computer log recording mechanism, which stored the subject's movements within the environment; video recording; recording of the subject's verbal descriptions; the physical model built by the subject. The second stage lasted about three hours.

The navigation in the real environment stage included again two tasks: (a) a target-object task (e.g., reach and identify an object on the rectangular box); (b) a perspective-taking task (e.g., walk from the rightmost door to the cylinder). Data on the subject's performance was collected by video recording and direct observation. The third stage lasted about half an hour.

Results

Familiarization with the virtual environment components

G. Learned to work freely with the force feedback joystick within a short period of time, walking directly and decisively towards the objects. Regarding mobility, G. could identify when he bumped into an object, or arrived to one of the room's corners. From the first tasks G. could walk around the object's corner and to walk a long the walls, that by using the FFE and the audio feedback.

Navigation within the virtual room

Exploration task

G. navigated the environment in rapid and secure movement (Figure 4). He first explored the room's perimeter, walking along the walls. After two circuits he returned to the starting point, and begun to explore the objects located in the room. Figure 4 shows the intricate walk paths in the exploration task. The exploration session lasted about 43 minutes.

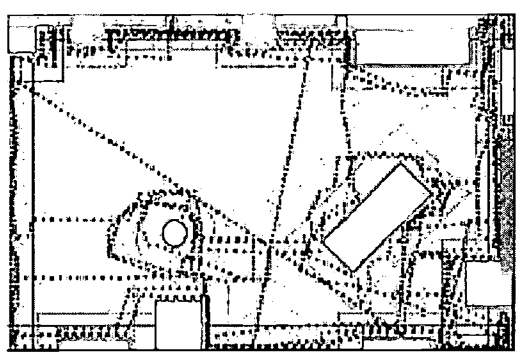

Figure 4: Subject's navigation in the virtual environment

Target-object task

To get to the required object G. navigated the environment applying the object-to-object strategy. From the door (the starting point) G. walked to the cube and from the cube to the target - the blackboard (Figure 5). G.

reached rapidly the target -in 20 seconds- by choosing a direct way.

Perspective-taking task

Here once again G. applied the object to object strategy (Figure 6): he went from the cube (the starting point in this task) to the box, and then to the target, the door (which was the starting point in the previous tasks). G. choose a direct way, and completed the target in 52 seconds.

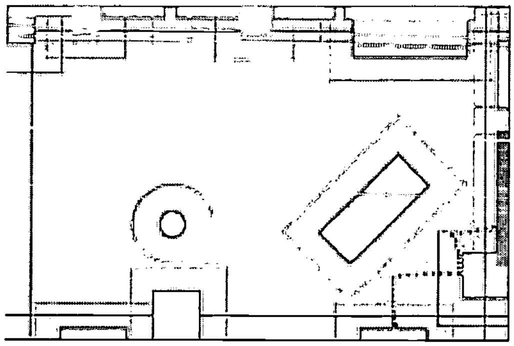

Figure 5: Target-object task

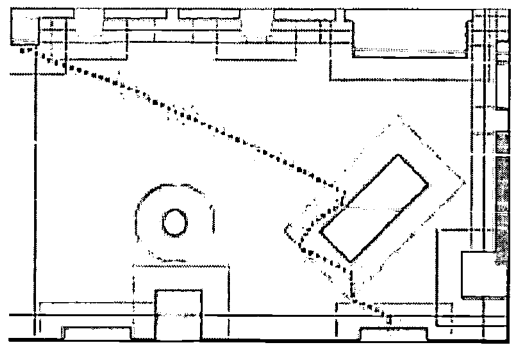

Figure 6: Perspective-taking task

Cognitive map construction

After completing the virtual environment exploration task G. was asked to construct a model of the environment. As shown in the picture of the model composed by G. (Figure 7), the subject acquired a highly accurate map of the simulated environment. All salient features of the room are correct (form, number of doors, windows and columns), as well as the relative form and size of the objects and their location in the room.

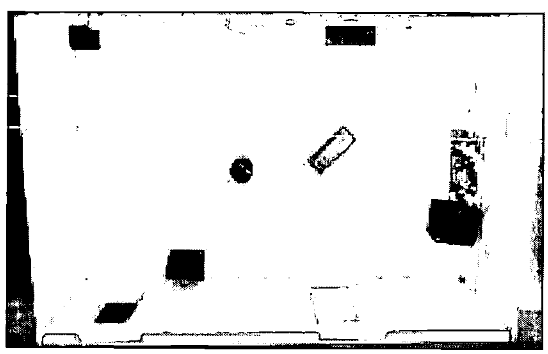

Figure 7: Subject's model of the virtual environment

Navigation in the real environment

The subject walked through the real environment from his very fist time in it in a secure and decisive behavior. At the first task (reaching a target object: the leftmost box), G. Used the entrance door as initial reference, and walked along the walls in direct way to the box. He complete the task in 32 seconds. At the second's task (perspective-taking), G. applied the object to object strategy, and completed successfully the task in 49 seconds.

Discussion

The case study reported in this paper is part of a research effort aimed to unveil if and how the work with an haptic virtual environment supports blind people's construction of spatial cognitive maps and their navigation in real environments.

The case study results are encouraging. The subject, G., mastered in a short time the ability to navigate the virtual environment. He developed a fairly precise map of the simulated environment, and the completeness and spatial accuracy of this map became evident in two revealing situations. The first was the physical model built by G. after navigating the virtual room - the simulation of a space he did not know. The second was his impressive performance in the real environment. He entered the real room which he had not known until then, and which he was not given the opportunity to explore, and completed efficiently and in a very short time the different navigation tasks.

Based on these an other preliminary results, a systematic empirical study (involving 30 subjects) of the effects of the haptic environment on blind people's navigation abilities is currently being conducted. The results have potential implications at varied levels, for supporting: blind people's acquaintance with new environments; their acquisition process of spatial knowledge and skills; their learning of concepts and subjects for which spatial information is crucial.

Acknowledgement: The study presented here is partially supported by a grant from Microsoft Research Ltd.

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Intelligent Agents for Support of Distance Learning Environments

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Abstract: In this paper the author explores the use of Intelligent Agents to support the design and functioning of distance learning environments. Intelligent agents in this paper refer to software agents with an artificial neural network (ANN) component. The use of this technology will help educational institutions provide quality instruction to an increasing number of students without an equivalent expenditure of resources. The technology facilitates the creation of authentic simulations and allows the instructor to provide individualized instruction to students using the most effective approaches for each learning style.

Introduction

The classroom instructional paradigm forces the teacher into the center of a web of classroom activities, where individual strands representing learning objectives, evaluations, and even class discussions come together to be manipulated, directed and monitored. In this situation, the overworked teacher is frequently left with little choice but to adopt the traditional lecture format, where the emphasis rests on product delivery instead of student learning (Wilson, 1995). It is only to be expected that as student enrollment increases the amount of individual tutoring and feedback given to the student by the instructor decreases.

In an attempt to address the issue, many institutions invest in technology and offer distance education courses as a supplement to the traditional programs, without changing either the course content or presentation paradigm. However, traditional teaching approaches are incompatible with the effective use of technology in addressing both learning approaches and individual learning styles (Evuleocha, 1997).

A well-constructed environment for distance learning will present the course content in a multimedia format, ensuring that a variety of learning styles are accommodated. Ideally, the environment will be constructed so that it also automates performance tracking and assessment. When this administrative burden is removed from the instructor, there will be more time to work with the students and address learning issues. In an environment that includes intelligent agent technology, each student can receive tutoring, feedback and interaction on an individual level.

How the Agents Function

The neural network component of the agents supports the recognition of a broad range of input signals. A multimodal system is ideal for on-line learning environments because of the integration of speech, gestures, text, voice, images, real-time video and traditional pointing and selection tools (Pavlovic, Rajeev, & Huang, 1997). It is obvious that such systems need the fault tolerance of neural network technology in order to differentiate between valid information and noise. This type of system is ideal for the development of web-based learning simulations.

The pattern recognition abilities of neural networks are vital to tracking student progress in a learning situation where the instructor is not constantly present. The network enables the agent to track patterns in student responses. The pattern shows which areas are misunderstood or poorly understood, so that tutoring can lead the student to mastery before the weakness affects the learning of other related concepts as well. The agent has access to the expected response from a database of knowledge from human experts. The agent compares the expected response with the actual response to determine whether it is sufficient. When there can be improvement in the response, the agent selects the most appropriate tutorial material and presents it to the student. Once the agent has identified the individuals' learning pattern, it can predict student responses and prepare personalized corrective strategies and materials regardless of the number of students being taught. The agent can independently choose to apply these strategies before the student realizes that there is a knowledge deficit in a given area. This pattern recognition capability is so precise that even application of the early versions of this technology was able to identify patterns in student learning that were so subtle that a human would miss them, and could differentiate between actual learning problems and errors made through carelessness or fatigue (Lively, 1992).

Agents in Simulations

Simulations are very useful in situations where the student needs to perfect skills prior to actually using them in real-life situations. For example, in chemistry, they have been in use for some time for identifying chemical components in mixtures, and optimizing formulations. Another application has been in the training of meteorologists and others in the atmospheric sciences, which use simulations to track and predict the outcome of atmospheric events. The use of simulations for training even stretches into the field of pharmacology, where neural networks create simulations that can accurately predict the medicinal properties and effects of drugs (Widrow, Rumelhart, & Lehr, 1994).

The medical field is now using similar programs for artery tracking to help diagnose coronary artery disease (Hanna & Campbell, 1995), simulated neurosurgery, and new surgical procedures. The new simulation training in some cases incorporates even the sense of touch. Medical students practice "threading flexible endoscopes down a virtual patient's throat or manipulating the long surgical instrument used in laparoscopy…suturing tissue and inserting a catheter into a vein using laparoscopic tools." (Sorid & Moore, 2000, pg. 26). These simulations provide a complete learning environment and are adjustable to the individual student. They pinpoint areas of weakness and prepare the students psychologically for dealing with any complications that may arise during actual surgery. The natural language processing capability present in many of the simulations understands and processes natural language so that students can verbally present questions to the agent and receive appropriate responses (Billinghurst & Savage, 1996).

Tow recent examples are Adele and Ali, both from the University of Southern California Information Sciences Institute's Center for Advanced Research in Technology for Education. Ali, or Automated Laboratory Instructor, is an agent that facilitates undergraduate chemistry courses through the use of web-based virtual laboratories. The environment includes a set of web-based simulations controlled by the student. The student is provided with visualizations of the experiment being simulated as well as receiving a realistic and complete set of data for analysis. The simulation includes a tool set allowing the students to use, collect, analyze and manipulate the data as well as the Laboratory Instructor. The instructor guides the students through the material, monitors their progress, provides feedback and tutors individual students by recommending relevant materials to help them address their specific learning difficulties. (Johnson & al, 1999).

Adele is an agent is used for training in family medicine and geriatric dentistry. It was designed to run on conventional desktop workstations with conventional interfaces. In order to expand the agent's effectiveness, it runs in a student's Web browser so that Internet resources can be used during the lesson. Designers solved the problem of network latency by placing the agent's reactive behavior on the student machine.

The agent persona is generated using a behavior state approach consisting of a library of searchable behavior fragments. These include visual segments showing the repertoire of movements, audio clips accompanied by a commercial speech synthesizer to serve as utterances, and occasionally segments of other background sounds, such as music. A behavior-sequencing engine dynamically joins selected fragments at run time. The result is that Adele displays seamless behavior and appearance to the student.

Conclusions

Intelligent agent based simulations are an excellent option for institutions that are attempting to expand their offerings while providing efficient husbandry of institutional resources. The capabilities of the technology allow instructors to address a range of learning styles as well as provide individual instruction for each student.

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The Invisible Student: Total Technology Control of Course Delivery and Management

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Abstract: The architecture of the Brigham Young University delivery system for some independent study students is unique. Students may complete the following steps on the Internet: (1.) browse for a course, (2.) explore a particular course, (3.) register for the course, (4.) submit lessons. 5. receive faculty feedback (from a large database), (6.) take tests, and (7.) receive grade/transcript. These are all accomplished using technology. There will be no human intervention, thus the notion of an "invisible student." However, evaluations show high performance and high satisfaction among students. The major benefit to the delivering institution is unlimited enrollment capability. Some classes have thousands of enrollments and the system is not overloaded. Students appreciate the immediacy of everything, and particularly the answers to all missed questions (something they rather experience in the classroom).

Introduction

Brigham Young University (BYU) currently has 206 courses on the Internet, 115 of which are college courses, 59 are high school courses, and 32 are personal enrichment courses (noncredit). Evaluations were collected from over 10,000 students who used the Internet for these courses in the year 2000. Responses showed high satisfaction on the part of the student in three areas. First was the instantaneous feedback to all missed questions (more feedback than most students were used to receiving). Second was the personable response of the faculty. No attempt had been made to fool the students, but the evaluation showed that most students thought the feedback was synchronous. It was asynchronous. From the beginning, the system design consisted of a large databank of feedback statements, designed and written by the faculty, which were then sent to the student, based on the answers that they supplied. The third high satisfaction response was the opportunity the students had to check their progress on the Internet at any time.

A major benefit that occurred among students using these courses was the increased completion rate. Traditionally, the completion rate for most independent-study programs in the U.S. has been around 60 percent. Students enrolled in the BYU Internet courses have a 70 percent completion rate. No research has been completed to explain this increase, but students seem to keep a better momentum because of the immediacy and scholarship of the responses they receive to their work.

The Model

When the Brigham Young University independent-study system was designed, the notion of ample feedback to every missed question was the foundation for the system (not just correct-incorrect). Existing distance education models that used faculty synchronously had limits to enrollment and speed of feedback. Therefore, the BYU model was designed to house large numbers of feedback statements for the students. Faculty were paid to write well designed asynchronous feedback for the database. The system could then handle many students without overburdening the faculty. The system could then be completely managed by the computer.

To support the feedback concept, other technologies were designed to make the systems completely independent of time, space, place, pace, or faculty. The following components were designed for the system: • a web course catalog • automatic registration and credit card clearance • internet delivery of course instruction • internet lessons submission • computer grading of all submissions, including tests and final course grade •

computer feedback for all missed questions (as designed by faculty) • testing • grade posting • personalized Web report card accessibility for all students • and transcript distribution.

With the system in place it became possible for a student to shop around in the catalog, select the course of choice, examine the course content, register (credit card), receive a password to allow access to the course, submit lessons, submit tests, receive grading on all submissions, receive a final score, and finally receive a computer generated transcript in the mail—all without human interaction. Although excellent student services are available for all students, it is theoretically possible for a student to come and take a course from independent study and receive credit/transcripts without anyone knowing he or she was there. *The invisible student.*

Strengths/weaknesses

The attitude of some faculty is that asynchronous learning is a weakness. However, face-to-face instruction, however strong it may be, is not necessarily a reality even in the classroom. Consider large classes where individuals never have access to the teacher. Also consider shy or less aggressive students who seldom get interaction even in small classes. While lack of synchronous interaction may be perceived as a weakness, research has for years shown that distance education is not significantly less effective than on-campus classroom education. Thomas L. Russell (http://teleeducation.nb.ca/nosignificantdifference/) compiled 248 research reports, summaries, and papers dating from 1928 to 1996 into a meta-analysis which he called "No Significant Difference" Phenomenon. Michael P. Lambert, executive director of Distance Education and Training Council, in Washington, D.C. (1999) said, "It is clear that distance education is here to stay. . . .Within the next three years, I predict that 3 out of 4 institutions of any significant size will be offering distance education courses." However, Lambert is well aware that "the faculty is the single biggest asset of any university and is at the same time the single biggest stumbling block to the rapid adoption of distance learning techniques on a massive scale." Lambert says that, "some faculties fear distance learning, seeing it as a threat to their jobs, to academic freedom and to sound learning." But Lambert predicts that "over time, most faculty will learn to love distance learning and come to see it as a personally liberating and empowering force, where they will become tutors and facilitators."

Management

While the *invisible student* is only invisible if he or she chooses to be, the system is benefiting him or her in many ways. In the BYU system the internet courses are easy to update and keep current (unlike printed inventory that must be used before reprinting). They are easily formatted and changed to be attractive and conveniently navigated. The cost of courses have remained a reasonable price per credit hour.

Benefits also accrue to BYU Independent Study. The system has reduced mail handling by 400,000 pieces per year even as enrollment has increased.

Conclusions

The current BYU independent study-system has shown that Internet courses result in a quality learning experience for the *invisible student*, one that they report to be highly satisfying. Students are particularly laudatory of the feedback component. At the same time, BYU Independent Study has been able to handle unlimited enrollments and still have a commendable degree of student services. The system has also proven to be profitable.

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Development and Evaluation of a Web-Based Learning Program for Pharmaceutical Management Professionals in Thailand

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Abstract: The usefulness of the Internet technology especially the World Wide Web (WWW) is incredibly enormous. Since the decreasing cost and rapid growth of technological advances have created a promising dimension in the teaching-learning interface, it is vital to exploit such innovation to improve the educational value of technology in pharmacy education. The purpose of this project is two-fold: *firstly*, to assess the needs on knowledge and skills that are considered essential among pharmaceutical management professionals as well as the use of the WWW by those individuals in both private and government sectors. *Secondly*, to evaluate the effectiveness of a newly developed web-based educational program by comparing the course participants' satisfaction, pre-test/post-test score as well as their perception on time and cost savings versus a traditional learning program. The research findings from this pioneer study can be a valuable resource for modifying courses to enhance pharmacy continuing education in Thailand.

Background Information/Statement of Problem

The use of the Internet, especially the World Wide Web (WWW), is dramatically increasing. There are tremendous advantages in using web-based computer-aided instruction in education (MacKenzie & Greenes 1997). For the effectiveness of such educational media compared with a traditional learning method in health sciences, though few studies exist, evidence indicates that a web-based program is more likely to be better or on par with traditional programs in terms of course management (Poling 1994); enhancing problem solving skills (Chishlom et al 1996); employing teaching-learning practice (Hedaya et al 1999); course interaction and satisfaction (Engle & Parent-Stevens 1999). On line discussion capabilities allow student-student and student-instructor/guest speaker to interact and network with one another more practically. Thus, advanced educational technologies are encouraging the development of distance learning on the *"anywhere, anytime"* premise (Grillo et al 2000). Numerous programs offering higher education degrees as well as certificate and other non-credit courses have been initiated, relatively few, however, in the healthcare discipline (DiPiro 1999). Further training and development of technology in pharmacy education is necessary and will continue to be explored (Zarotsky & Jaresko 2000).

Regarding technology development in Thailand, the awareness is evidently reflected by government support in terms of infrastructure as well as human resources investment during the past decades (Palasri et al 1999). Due to the high impact of the Internet on Thailand's development, it is extremely crucial that both government and private entities work together toward the long-term benefits of the country. Furthermore, the Pharmacy Council of Thailand recently enacted the new regulation on pharmacy licensing which requires the pharmacists to have continuing education credits for the periodic license renewal. This policy will have an impact on those professionals working in either the private or government sectors. Consequently, as Khon Kaen University is regarded as the *hub of education* in the Indochina region, it is vital to redefine our educational standards and capabilities in order to sustain in the higher level of competitiveness during this digital globalization era. Ultimately, by exploiting the educational technology to enhance pharmacy education, we can not only support the National Education Policy on expanding opportunities for higher education, but we can also contribute toward helping the Thai society improve its continuing educational system by creating knowledgeable and updated professionals.

Project Details

Goals and Objectives

The overall goal of this project is to explore the potential of using web-based educational technology in continuing pharmacy education in Thailand. Our study population will include the pharmaceutical management professionals who graduated BS in Pharmaceutical Science from 1980 onwards and are currently practicing or working in the pharmaceutical-related field. There are five specific objectives in this project, which includes:

- To assess the needs on knowledge and skills considered essential in their related job responsibilities.
- To assess the knowledge, skills, access to, and use of the WWW.
- To assess the key components that learners perceive to be important to their learning in continuing pharmacy education
- To develop a web-based learning course according to their needs.
- To evaluate the overall satisfaction and effectiveness of the developed web-based learning course in comparison with the traditional program.

Methods

This study comprises four phases for a period of two years beginning in March 2001.

Phase I: Survey of educational needs and technological accessibility

Validated questionnaires survey will be mailed to the member list of the Pharmacy Council of Thailand for needs assessment on knowledge, skills and continuing pharmacy education that are considered essential among professionals. The feasibility of educational multimedia use among those individuals will also be explored in terms of skills in computer/WWW application as well as their access and use.

Phase II: Developing educational multimedia program

A topic of workshop course will be selected from Phase I Survey based on practicality. Educational multimedia such as computer-generated slides and presentations, course information and other plethora of useful links on the WWW including web board and exclusive listserv for course participants will be developed.

Phase III: Implementing the educational multimedia program

The workshop course will be introduced for the period of six months starting in October 2001. Participants will be randomly assigned to attend either the web-based or the traditional workshop course. The instructors for each course remain the same in both groups. Feedback on course information, educational materials and media for each workshop module will be closely monitored throughout the program.

Phase IV: Evaluating the effectiveness of educational media

The effectiveness of the newly developed web-based learning program will be assessed in terms of participant's satisfaction; analysis of the networking activities; improvement of pre-test and post-test knowledge scores of each workshop participant; as well as their perception on time and cost savings versus the traditional program.

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Collaborative Learning: A Web-based Case Study

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Collaborative learning is not confined to classroom-based learning. It can be incorporated into Web-based education. In collaborative learning, students work together as member of a learning community such as working on a problem-solving task by questioning each other, and discussing and sharing information. Some of the best features of Web-based education are flexibility, independent learning, interactive communication and collaborative learning. Quite contrary to the misconception that the Web reinforces learners' isolation, this paper supports the view that the Web can be used constructively to create a collaborative learning discourse. A case study was conducted to examine how the use of the Web could enable students and teachers to work collaboratively in a university context.

The Web in the Eyes of the Learners

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Introduction

Web-based learning experiences have been introduced to students. Thus, it should accommodate the views of the learner about the web and its role in education. In pursue of this idea, a qualitative study was conducted to examine university students' attitudes towards the Web. Students were invited to participate in Web-based discussion as part of their learning experiences. The collected data were examined and discussed. Apart from positive and negative attitudes toward the Web, students' views were presented from a social critical perspective.

Learners' perception

Laurillard (1993, p.14) suggested that there is little research generally on student learning at the university level and that university course outlines invariably focus on content, rather than on why or how students will learn. In her view, teachers should mediate learning in the sense that they should understand something fundamental about how students learn and make learning possible for them. Internet-based courseware has been introduced to on-campus and off-campus teaching. The concept 'virtual class' is no longer something to imagine but has started to receive increased attention from educational researchers in interactive multimedia. Research on Web-based education tends to focus on two major aspects: the technicality of courseware construction and its educational rationale.

A qualitative study was conducted to examine university students ' attitudes towards the Web. The use of a discussion board in this study was to identify the meanings and concepts underlying learners' attitudes. Both undergraduate and postgraduate students were targeted. There were approximately 200 students each year. They were required to participate in Web-based discussion as part of their learning experiences.

Over 400 messages were collected over a three-year period. Most of them were approximately 100 words in length.. Their responses covered positive and negative aspects of the Web and its role in education. Most responses (74%) pointed out both aspects. The rest tended either to praise the Web (17%) or condemn the Web (9%). Education students were particularly targeted as they were familiar with Web-based teaching and they were introduced to a courseware on communication as a component of their course. There were three discussion topics covering four different aspects relating to the theme ' the Web and its role in education'. Each topic started with a discussion statement, which aimed at stimulating responses from learners. The three discussion statements were on the role of the Web in education, critical educational Web, and learners in courseware development.

Here is a summary of the results.

- Learners viewed the Web as a powerful resource, an inspiring teacher and an innovative device, which gives learners motivation, responsibility and independence in learning. The Web provides a dynamic discourse, which could not be replaced by the traditional face-to-face teaching. Learners can travel virtually in a world of knowledge and interaction. Below is a sample of learners' responses about the positive aspect of the Web.

"I had no idea what the Web is about. When I started to use it for my assignment which required us to search for Web-based journals, a new window opened for me. After a period of confusion and uncertainty, I could not get away from the Web. It is so useful to me not only academically but also for many things such as how to search for things on the Web. It is amazing! How could I suty without it!!! Impossible!"

- Computers have permeated society to the extent that one starts to examine the negative effects computers can create to society in addition to the benefits they have brought so far to business, education, industry, and daily life. Though there was overwhelming praise for the contribution of computers to education revealed in the qualitative data described above, students also seriously questioned the negative aspects of computers in education in general and of the Web in education in particular. The negative effects range from mild points such as superficial, impersonal to serious condemnation such as imperialistic, politically disempowering, socially destructive, commercially driven. Here are two samples of negative responses from learners.

  The first sample touches on the use and abuse of the Web.

  "I was completely turned off when I attempted to search for some cultural information on the Web. Most of the time I was bombarded with obscene sites dealing with sex, business exploitation, political propaganda and so much rubbish on the Web. Some were very explicit and others were disguised. Of course, you can say: we have the choice: to read and not to read them. This is not the point. The crucial point is that Web-users are exploited in the name of freedom and flexible learning."

  The second sample reveals a different kind of imposition.

  "We are asked to avoid discriminatory language in academic writing. That is fair for those who were brought up and now living in that cultural context. I come from a different cultural background which has different values and behaviour regarding religion, gender, political ideas. Do I need to ignore them and conform to the new ideology because of my choice to study at this institution? We need to be aware of the sensitivity of those issues if we want to use the Internet for a wider range of learners.."

- Apart from many responses, which reflect some concern as well as admiration for the Web and its role in education, learners also offered some ideas which should be taken into consideration by Web instructional designers and teachers. Issues raised in their responses include the importance of *partnership* in Web-based courseware development, learner-centred approach of Web-based teaching, and learners as critical partners.

  "We are asked to avoid discriminatory language in academic writing. That is fair for those who were brought up and now living in that cultural context. I come from a different cultural background which has different values and behaviour regarding religion, gender, political ideas. Do I need to ignore them and conform to the new ideology because of my choice to study at this institution? We need to be aware of the sensitivity of those issues if we want to use the Internet for a wider range of learners."

Conclusion

The Web has recently brought innovative ideas to teaching, learning, and research. In Web-based education, courseware developers need to take into account the notion 'learner-friendly' in constructing Web-based software for on-campus as well as off-campus teaching. For any educational software to be learner-friendly it must start with the learners. This study has shown what learners expect of us. Now, it is our challenge to take their views constructively and creatively.

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Interactive Video Distance Education Classroom Design For Effective Instruction and Learning

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Classroom design is crucial for effective instruction and learning. Two major problems exist for instructors and students in interactive video distance education design: (a) the constraints of instruction and learning caused by the interactive video distance classroom equipment arrangement and (b) the dissatisfaction of instructors and students with the physical features. Given the expense of interactive video distance education classrooms, institutions need to understand the perceptions of those using such classrooms in order to improve existing and future classroom design.

The Application of Self-Organised Learning for Educators and Students in a Knowledge-Based Economy: A Reflective Experience

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Abstract: A technology-led knowledge-based economy will require workers to be equipped with new economy skills and dispositions for creating significant and relevant meaning out of the large chunks of transmitted data. In the spirit of building learning organizations, this paper proposes a two-pronged strategy of promoting self-organised learning (S-o-L), originally developed by Harri-Augstein and Thomas, amongst educators and students. As an enabling framework based on social constructivism, it offers educators engaged in action research an approach for managing and reflecting upon change through the use of thinking tools such as the Personal Learning Contract. For students who are expected to learn independently in situations requiring problem-solving skills, much akin to real life contexts, this paper also considers the application of Learning Plans as a tool for personal project management. We conclude that S-o-L promotes skillful critical thinking through a systems thinking process of continuous reflective learning.

1 Introduction

The wave of telecommunications advancement flooding the world with a massive overload of information has resulted in a new surge in educational reform. With the pressing demands of policy makers in directing system-wide institutional changes involving a continuous state of personal change-management re-organisation, educators are expected to improve teaching practices in the light of newly developed educational theory. Likewise, students face increasing pressures to be prepared as knowledge workers for the so-called new economy through developing new skills for critical and creative thinking as a means for problem solving using reflective technologies (Coombs, 2000). The key to coping in such an ever-changing environment is to encourage learners to be constantly learning and re-learning as Thomas and Harri-Augstein (1985) describe:

> the exponential rate of change in today's world is making ever-increasing demands of on human learning and today's thoughts will become the chains of tomorrow's mind unless we face the problems of re-learning and continuing to learn throughout our lives. Freedom to construct our personal destinies by creatively adapting to change requires an ever-increasing capacity for learning. To achieve this, learning has become a consciously growing process rather than a ubiquitous part of life (p. xxiii).

This paper reviews the principles of self-organised learning (S-o-L) developed by Harri-Augstein and Thomas and considers its value as an enabling framework for change-management and information management in a learning organization. Using case study samples based on an action research study that investigated the frustrations faced by school children in a local Singapore primary school using the World Wide Web as an information source, it also specifically considers the pedagogical value of conversational thinking tools in guiding the reflective process and how the technology can be used as an assistant to this kind of systems thinking.

2 Self-Organised Learning Builds Learning Organizations

Senge (1990) describes a learning organization as one "where people can continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together". The five disciplines crucial in building a learning organization are personal mastery, mental models, shared vision, team learning and systems thinking (p.1). These five disciplines are also subsumed in the definition of S-o-L.

S-o-L is based on the group learning theory of social constructivism as well as instructional design axioms that provide a practical set of thinking tools that enable systematic reflection on one's experience to construe personal learning. According to Harri-Augstein and Thomas (1991), all human learning within the S-o-L conversational paradigm is defined as the "conversational construction, reconstruction and exchange of personally significant, relevant and viable meanings with awareness and controlled purposiveness" (p.23).

Deriving S-o-L's "structures of meaning" is based upon George Kelly's (1955) Personal Construct Theory (PCT). From a psychological perspective of systems-based thinking, it states that individuals self-manage their inner reflective process, constructing knowledge and modelling concepts of the world experienced through a complex process of personal "hypothesis testing" between past and present experiences. In constructing personal constructs, the "personal scientist" adopts a holistic world-view, linking one's personal experience with societal influences and behaviours (Coombs and Smith, 1998). This attitude towards systems thinking is described by Senge et al (2000) as "a different way of looking at problems and goals not as isolated events but as components of large structures" (p.78). In order to achieve this ideal, Senge also describes mental models where assumptions and mindsets are suspended "so people can explore and talk about the differences and misunderstandings with minimal defensiveness", providing opportunities for creative paradigm shifts (p.67).

In S-o-L, a Learning Conversation of a dual nature is carried out by the "conversational individual". Two conversations exist; one from within our self, to our self, and another externally, with others (Thomas and Harri-Augstein, 1985). Coombs (1995) differentiates these two types of reflective learning psychological experiences as "inferential" and "referential" Learning Conversations. Thomas' and Harri-Augstein's notion of the conversational individual assumes "human beings as meaning, construing, negotiating and attributing

s personal learning as a form of conversational knowledge construction (p.20). To Senge et al. (2000), the essence of such social constructivism is much akin to team learning: "discipline of practices designed, over time, to get the people of a team thinking and acting together" (p.73). This results in the matching of one's individual perspectives with a common shared vision. He suggests that the most effective practice for team learning is that of the conversational dialogue, "a sustained collective inqui

experience in the immediate context, resulting in a "collective sensibility, in which the thoughts, emotions, and resulting actions belong not to one individual, but to all of them together" (p.75). Such an ideal is achieved if there exists a degree of personal mastery in acquiring a dual awareness of vision and reality and the thinking skills to mediate the differences. The role of schools and teachers in S-o-L environments is to create the social context where students have time to reflect and to be proficient and skilled in making the choices that will help one arrive at personal mastery in reconciling and coping with the differences experienced. Such self-mastery is at the heart of managing personal change.

S-o-L pedagogy is therefore a student-centred learning approach where one is responsible for one's own behaviour while managing one's own actions and directions through critical reflection (Coombs & Wong, 2000). This is achieved in both an individual and social group learning context. This conversational psychology provides both a pedagogical and systems thinking approach that fits into a social constructivist model of learning and explains knowledge construction through reflective elicitation and self-organisation of one's thinking experiences (Coombs & Smith, 1998 & 1999).

2.1 Self-Organised Learning as a Model of Action Research for Educators

An agenda of developing learning organizations justifies the case for the introduction of action research (AR) into schools. While researchers have often been regarded as impractical 'know-alls' of theory, who impose their opinions on practitioners without an appreciation of the *real* social context, there is a need for a change in this mindset. By recognizing the researcher as a *mutual stakeholder* and a genuine partner of the change-management process, resources can be shared and problems resolved more efficiently and effectively. This policy of the action researcher operating with equanimity within the workplace and identifying 'research questions' based upon mutually identified needs drawn from problems to be resolved within the social situation, was identified by Coombs (1995) as an AR process of ensuring "social parity". He recommended that *all* participatory AR studies within learning organizations implement this practice as both an ethical social policy and research methodology.

According to Elliot (1991), AR is "reflective practice which aims to improve the realization of process values" (p.51). AR gives systematic attention and validation to the importance of empirical data gathered from personal experience as a basis for reflecting upon how classroom practices can be improved. As such, the onus is on the practitioner to acknowledge the need for improvement and hence to research on changes implemented and experienced. By taking control of the research agenda, the teacher-as-action-researcher becomes responsible for both defining and implementing the acceptable quality of outcomes, i.e. stakeholding through task-management. Given how intense the pace of change is, and how our teachers rarely ever have the time to evaluate their own teaching, AR as reflective practice is a practical approach for the management of change and new information. Dewey (1933) describes the reflective teacher as "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusion to which it tends" (p.6). Schon (1983) similarly describes the participatory action researcher as one who is engaged in reflection-on-action, such that teachers' who have recently just left the classroom are immediately re-constructing and reconstruing events and actions as a professional act. Underlying these definitions of reflection is the notion of "conversational constructivism", where reflection on personal experience becomes a learning opportunity (Coombs & Smith, 1998).

More than just self-centred internal reflection, social constructivism also plays a role in S-o-L for AR. Through collaboration with the other stakeholders in the school environment, shared meaning is achieved and the ideas generated are more relevant to the social context at large. This sharing leads to increased creativity in the solutions designed, accompanied by increased ownership, and acceptance of outcomes. Professional partnerships like this ought to be promoted as essential forms of organizational social interaction and survival for coping with the ever-increasing number of change-management events resulting from the effects of globalisation upon societies around the world. Schools are not insulated from this globalisation process, as governments quickly respond to international league tables of educational results and instruct their education ministries to come-up with quick reform packages and implementation cycles. A good example is the recent Third International Maths and Science Study that placed the US unfavourably in the international league. This, amongst other reforms, has resulted in the Californian Department of Education rapidly bringing in new forms of testing in schools in a bid to improve results-based "standards", placing extra burdens on teachers and administrators.

The S-o-L individual organises one's reflections through "conversational tools" such as the Personal Learning Contract (PLC) and Purpose-Strategy-Outcome-Review (P-S-O-R) templates. These tools are an effective means for making sense of disparate pieces of data, as they offer an avenue to scaffold learning in a systematic reflective manner. With information organised, meaning making takes place as links are made and relationships formed between discrete ideas. From a critical evaluation of situations, the action researcher is more discerning when making decisions. Coombs (1995) describes such forms of knowledge creation, using S-o-L content-free technology to manage information, as Knowledge Elicitation Systems (KES).

2.2 Self-Organised Learning for the Student

S-o-L pedagogical resources offer conversational tools for the students' in the form of Learning Plans (LP). Coombs (2001 *in press*) describes a LP as a conversational tool that allows for the skills of critical thinking to be modelled through practical tasks simulating the real world. LPs offer a flexible, content-free technology allowing students to both scaffold and manage their own learning. This is possible as the LP design breaks learning events into small tasks and activities with opportunities for students to apply their understanding at regular reflective milestones. Student-centred scaffolding is workable as the LP defines discrete learning pathways that gain access to what Coombs defines as the principal resource "Learning Nodes". Teachers operating as Learning Coaches can negotiate LPs with students to arrive at customised solutions with the scope for self-directed learning (Coombs & Smith, 1998). LPs are thus a flexible project management critical thinking tool with built-in curriculum and assessment goals.

More than just chance-based discovery learning, there is systematic reflective problem solving occurring in a well-focused activities-based learning environment. The learning tasks making up the LP are designed as real-world simulations that play an important social function of helping the learner to personally identify with the abstract concept and model personal knowledge from the experiential event. Such a controlled reflective process gives *voice* to prior knowledge, designing experiential linkages between past and present learning, thus increasing meaning making to a greater depth of personal relevance. To support such student-centred learning, the "Learning Coach" guides and supports the learning process (Coombs, 1995). They help students come to an awareness of their problem solving skills necessary for independent learning and inculcate a positive attitude towards critical thinking through empowering student control of the curriculum tasks to be achieved.

From an information processing perspective, such a reflective learning approach has its basis in constructivism. There are many meanings and personal perspectives from which to experientially structure and frame the world and there is no single or correct meaning that learners should accept, no ultimate shared reality (Duffy and Jonassen, 1992). Situating cognitive experiences in socially authentic tasks and increasing transfer between in-school and out-of-school experiences is an educational goal described by Resnick, Levine and Teasley (1991) whereby the emphasis is not on the acquisition of knowledge, but rather on the learning of thinking process skills geared towards problem solving and meaning making in social situations requiring such skills. Put another way, such a curriculum philosophy provides transferable thinking skills.

3 Action Research through Self-Organised Learning

The key learning problem identified for this AR project at a local primary school was that the students had no idea of how to manage the large chunks of information resulting from their research using the World Wide Web. As such, they simply adopted a "cut and paste" mentality by copying chunks of information into their written reports. It was decided within the social context of the AR team that the key educational problem facing teachers was the students' lack of critical thinking ability to manage data. The school was interested in considering how these thinking skills could be developed, tested and finally, evaluated for implementation into the primary school social studies curriculum. Such a learning commitment can be articulated and self-managed by the action researcher through the use of a PLC that incorporates cycles of P-S-O-R reflection (See Figure 1).

	What is my purpose?	What became of my purpose?	Describe essential differences
Purpose	To develop a set of thinking skills to support research for project work resolving students' habit of adopting a "cut and paste" mentality.	To expose students to hands-on experiential learning such that they can hopefully learn in the long run to adopt a natural attitude and disposition for critical thinking/problem solving.	Rather than teach critical thinking skills out of context, an immersive approach was adopted. Rather than skills, it is attitudes and dispositions that matter; this increases transfer across disciplines and more importantly real world situations.
	What actions shall I take?	**What did I do?**	**Differences**
Strategy	Exploratory conversations with principal and teachers to further assess needs. Literature review. Preliminary workshop to impart skills to students. Reflective log. Follow-up conversations with school.	Further self-reflection and conversations with stakeholders Problem is not critical thinking skills, but the design of project work. 'Teachers' workshop to introduce them to PSOR and learning plans. Templates can also help teachers systematically reflect for evidences of critical thinking.	Increased the degree of partnership in the AR project by giving teachers' responsibility of imparting CT attitudes to students. This gave teachers ownership of the problem. With a vested interest in improving their own classroom practice, teachers identified the objectives and strategies suited for the class.
	How shall I judge my success?	**How well did I do?**	**Differences**
Outcome	Students should ideally be able to use tools independently, read information sources more carefully, and hence increasing the quality of project reports.	Learning plans have been acknowledged as a valuable tool to impart life skills for coping with changes. Greater acceptance and enthusiasm from both management and staff. Students also enjoy the engagement in discovery learning.	Students interest in working with LPs. A tool applicable across contexts especially to aid CBL, technology rich lessons. Semi-structured interviews and questionnaires were used.
		What were the strengths?	**What improvements are needed?**
Review		Teachers self-initiating the problem solving process. Teachers function as Learning Coaches. Teachers have acquired experience in using conversational tools to facilitate the reflective practice.	More time to engage teachers in further cycles of reflection and action. To encourage teachers to integrate LPs as a tool for teaching on a regular basis.

Figure 1: Personal Learning Contract

Learning Objectives
By the end of this workshop, you should be able to:
1. List examples of evaporation.
2. Infer that when water evaporates it goes into the air as water vapour.
3. Explain how wind affects the rate of evaporation.

Tasks 1 and 2 are to be completed with your partner. Complete Task 3 individually.

TASK 1: REVIEW OF CONCEPT
Collect the resource basket from the teacher's desk and take 20 minutes to complete Task 1.

Study the photographs;
Sample A: Drying of puddles of water
Sample B: Drying of clothes
Sample C: Drying of vegetables, fruit
Sample D: Drying of our skin after bath and perspiration
Sample E: Loss of water from aquariums/ponds

Record your answers in the worksheet attached.
2. Identify what's common amongst the photographs.
3. What process has taken place?
4. Next, put a drop of rubbing alcohol on your fingertip.
5. What has taken place?
6. Write your conclusion in the space provided.

TASK 2: FACTORS AFFECTING THE RATE OF EVAPORATION
Task 2 is an activity in which you will determine how wind will affect the rate of evaporation. You have 35 minutes to complete Task 2.

1. In the basket, you will find two handkerchiefs. How are they alike?
2. Wet the two handkerchiefs completely.
3. Hang the two handkerchiefs in the classroom on the line provided by your teacher.
4. Note the time on the clock and record this in the worksheet.
5. Use a fan to blow on one of the handkerchiefs for 10 minutes.
6. At the end of ten minutes, stop the fan. Record the time in your worksheet.
7. Feel the handkerchiefs and record your observations about the wetness of the two handkerchiefs.
8. Record the time.
9. Continue blowing at the same handkerchief for another 5 minutes.
10. Feel the handkerchiefs after 5 minutes. Record your observation.

- What do you think has taken place?
- Where has the water gone?
- Why do the two handkerchiefs feel different?
- What conclusions can you make?

TASK 3 BONUS ACTIVITY: USE OF CD-ROM
1. Complete the quiz in unit 3 of the CD-ROM.
2. Record the time you took to complete the quiz and your score in the worksheet

Figure 2: Learning Plan

The final cycle of reflection resulted in the identification of LPs (see Figure 2) as a potential tool to meet the AR goals. When the refined solution was presented to the school's Principal, it was accepted with much enthusiasm. The team felt that a general approach of teaching using real-life examples would be more effective in teaching information management. It was also felt that more than just critical thinking skills, it was *attitudes towards* critical thinking that should be imparted to students. Halpern (1997) describes these critical thinking attitudes as the willingness to plan, exhibiting flexibility, persistence, willingness to self-correct, mindfulness and seeking consensus. The acquisition of these attitudes should result in greater transfer of critical thinking across subject disciplines. It was also decided that the teachers themselves should be engaged in using this new technology and hence a workshop was organised for the Primary 5 teachers in March 2000 to introduce the pedagogical and practical aspects of designing and authoring their own LPs. The LPs designed by the teachers in accordance to their own classroom needs were implemented over a two-week time frame.

Evaluating and designing pedagogical tools and procedures for evidence through improved thinking dispositions is described by Halpern (1997) and can be based on the *general structures of meaning* heuristic offered by Harri-Augstein and Thomas (1991). The three-step critical thinking criteria suggested is (i) elicitation of items of meaning, (ii) the sorting of relationships and (iii) the display of final patterns (p.271). Following the analysis of the questionnaires completed by the students who had been introduced to LPs, it was found that the critical thinking dispositions of the students' had been enhanced. For example, a student with the willingness to plan said, *"I like lessons using learning plans because I can do what I plan"*, whilst flexibility is suggested by the remark, *"No need to listen to teacher and have freedom to think and do what we are thinking"*. A willingness to self-correct was fed back by: *"You can refer to the learning plan if you still don't understand"* and consensus-seeking illuminated as: *"We work in pairs so if we don't understand, we can help each other."*

4 Implications for Education

S-o-L clearly offers a comprehensive pedagogical framework for educators and policy makers who are considering school reform programs involving critical thinking scaffolds. As an approach to problem solving and learning, it new levels of professionalism can be reached. As Thomas and Harri-Augstein (1985) expound, the principles underlying S-o-L relies on the educator to be self-motivated, reflective, critical, flexible, creative and disciplined in the spirit of effecting positive educational change. Well-integrated AR can become a natural extension of the professional duties of an educator, a change which the Ministry of Education in Singapore has begun advancing. This is a change, which other education systems could also be looking into.

Being a content-free technology, where the methods are independent of the topic learnt, knowledge elicitation systems are intended for a wide educational audience. With its basis of drawing upon the specific content of each user's reflective experience as their own unique and necessary resources for personal growth and development, S-o-L should have wide appeal to all educators and instructional designers. As a systematic procedure for *constructively recruiting* resources into learning, S-o-L provides validity and reliability *via* the reduction of "personal prejudices, biasness, disruptive feelings and wilfu -o-L technology offers systematic thinking procedures "in which the personal meaning of the client can be collected, unadulterated by any need to simplify or translate it into a common or standardised language" (Thomas & Harri-Augstein, 1985, p.18). Such a thinking technology support for learners' is also espoused by Jonassen (1996), who describes pedagogical procedures for using computers in education as critical thinking "Mindtools". The use of the S-o-L derived PLC, P-S-O-R and LP can easily be integrated into administrative and curricular educational systems across all levels and cultures. They work best when presented in the form of computerised templates which are easily adaptable to the specific needs of each user's set of learning tasks (Coombs & Smith, 1999).

5 Conclusion

From the teachers' perspective, this AR project will contribute towards professional development in Singapore, for while AR is not a new field of educational research, it is an area that generally has not been widely implemented in Singapore's schools. It is timely that Singapore's Ministry of Education is now considering ways of actively promoting AR as an attempt to change the professional profile of the teacher. The classroom teacher is envisaged as a teaching professional engaged in active reflection, problem solving, and, more importantly, taking control of decision-making and risk-taking. Such a change in the professional development mindset is required if schools aspire to be learning organizations capable of embracing institutional change-management in an innovative manner (Senge, P. et al. 2000).

As a learning tool for students, LPs can be an aid to guide the student's research process. The introduction of LPs is a start towards imparting to students the essential life skills of information management through new pedagogical strategies to deliver critical and creative thinking. This will be especially suited for younger students who are overwhelmed by the open nature of starting research from scratch. The LP can, for example, complement the use of an encyclopaedia by providing guiding and critically reflective questions with focused instructions towards self-managing relevant aspects of the content. This is important as it eases students into the use of "reflective technology" through a user-friendly "critical thinking scaffold" (Coombs, 2000) and thereby avoids engendering attitudes of discontentment, or fear, when dealing with massive amounts of what appears to many as distracting and unrelated, disparate pieces of data.

Starting with a scenario of the educational challenges in the 21st century, this paper has attempted to craft a response to these new economy demands by highlighting the relevance of S-o-L for educators and students. S-o-L has the potential to empower learners and learning through building upon their confidence to take control of their own learning situations. In a borderless world, there exist many possibilities for information exchange and intellectual globalisation, and, as such, the pedagogical principle of social constructivism will remain of great value in any model of instructional design. Our schools and teachers must be prepared for this quest of implementing S-o-L pedagogy into the curriculum through team-based action research professional development.

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The Design and Implementation of a Web-Based Distance Learning System: Problems and Issues

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Abstract: The purpose of this study was to design and implement a Web-based distance learning system for foreign language instruction. Until recently, few Web-based instructional systems have been developed for secondary foreign language learning in Korea, mainly due to technical problems on Korean Windows and Web environments. These problems come from the lack of appropriate input and output solutions to the special characters with diacritics of European languages. This study addresses the problems that arise in the design and implementation of a Web-based distance learning system for foreign language education, suggests solutions to the problems, and discusses the issues related to the implementation of the system.

Introduction

As our society has been characterized by a shift towards the Age of Information, the computer and network technology has come to be widely available at every level of society. It has become the dominant technology of our age and has revolutionized our society. As evident in other social institutions, there has been a need of a new paradigm in educational and training contexts. The emerging paradigm, a "learning-focused paradigm," entails the characteristics that distinguish industrial-age and information-age educational systems (Kang & Kim, 1999; Lee et al., 1999; Reigeluth, 1999). The educational system based on a new paradigm supports learner-centered instructional contexts and fosters place-time-independent distance learning in a globally accessible, open system with diverse, multiple perspectives.

The goals of foreign language education include communicating with other people in a newly learned language and developing a better understanding of other cultures. It is an essential factor for foreign language instruction to present linguistic information of both verbal and non-verbal elements in rich contexts with hyperlinked multimedia so that various types of decoding and encoding processes of language learning can be made possible (e.g., Borras & Lafayette, 1994; Curtain, 1991; Oprandy, 1994; Oxford & Scarcella, 1994; Schitai, 1989). In recent years, the Internet has been increasingly utilized as an effective instructional tool for distance learning in foreign language education, since the Web can become a multimedia-based content provider and delivery medium for both verbal and non-verbal elements of communication with versatility and interconnectedness. In the Web-based distance learning process, a hypermedia-based instructional system with the attributes and resources of the World Wide Web is used to provide meaningful learning environments for the needs of individual learners (Clinch, 1999; Harasim et al., 1996; Hiltz, 1994; Khan, 1997; Kearsley, 1996; Lee et al., 1999; McManus, 1995; Owston, 1997; Ritchie & Hoffman, 1996). To this end, the present study attempted to design and implement a Web-based distance learning system for foreign language education.

The purpose of this study was to design and implement a Web-based distance learning system for foreign language instruction. Until recently, few Web-based instructional systems have been developed for secondary foreign language learning in Korea, mainly due to technical problems on Korean Windows and Web environments. These problems come from the lack of appropriate input and output solutions to the special characters with diacritics of European languages. This study adresses the problems that arise in the design and implementation of a Web-based distance learning system for froeign language education, suggests solutions to the problems, and discusses the issues related to the implementation of the system.

Input of Special Characters and Diacritics

Most European Languages contain diacritics or special characters such as é, à, ñ, ß and ð, in addition to using the Roman alphabet. Since the local code pages of those European characters are used to define Korean characters, the Korean versions of the operating systems can support neither their IME (Input Method Editor) nor APIs (Application Programming Interfaces), including displayed outputs and fonts. Moreover, each country tends to use its own keyboard on which the characters are displayed differently. To solve these problems, hence, the instructional system implemented in this study has redefined the code pages of European and Korean languages in the UTF-8 (Universal character set Transformation Format), and has recomposed twelve sub-sets of TrueType fonts. Input methods have also been developed to solve these problems so that special characters or diacritics can be easily entered with Korean/English 101 keyboards that are most widely used in Korea. A particular input editor using Active-X control has been developed to support European characters with diacritics as well as Korean characters for use in the instructional system.

The instructional system developed in this study makes it possible to type in special characters of sixteen European languages including Danish, Dutch, Finnish, French, German, Hungarian, Icelandic, Italian, Norwegian, Polish, Portuguese, Romanian, Slovenian, Spanish, Swedish, and Turkish. It can also support the Russian and Greek characters and the International Phonetic Alphabet by completely redefining the keyboard array. As shown in Table 1, only two or three keys are used to feed one character with diacritics. The symbols for the diacritics were cautiously chosen so that they were not already in use for existing meta-languages such as tags (<, >) or parentheses ((,), [,], {, }). The input system takes into account the order of 'alphabet + diacritics' as in handwriting, which is appropriate for human cognitive structure.

Table 1. Input examples of special characters and diacritics

Diacritics	Examples	Combination of key strokes
Acute	À	O + /
Cedilla	Ç	O + |
Circumflex	Â	O + ^
Diaeresis, umlaut, trema	Ã	O + "
Dot	-	O + *
Double Acute	Û	O + ;
Grave	À	O + \
Haèek or carom	Ã	O + #
Macron	Ç	O + _
Ogonek	¥	O + `
Ring	Å	O + @
Slash	Ø	O + %
Tilde	Ñ	O + ~

Learning Modules

For the purpose of this study, a Web-based distance learning system was designed and implemented for French language instruction. This instructional system appears to be one of the first Web-based distance learning systems for French language education in Korea. The instructional system consists of the learning modules and computer-mediated communication (CMC), as shown in Figure 1. The learning modules were designed to adapt to the learning needs of individual students. Students can explore and navigate the hypertext-based learning materials, designing their own instruction. Teachers and tutors can become facilitators in the learning process. The learning materials provide multimedia-based, situation-specific information to improve four main language skills (listening, speaking, reading, and writing) in foreign language instruction (Frommer, 1989). The learning materials can help enhance students' extra-linguistic as well as linguistic competence. The learning materials are composed of four modules: (1) listening ('Ecoutez-moi'), (2) speaking ('Je parle français'), (3) reading ('Lisons'), and (4) writing ('Je sais écrire').

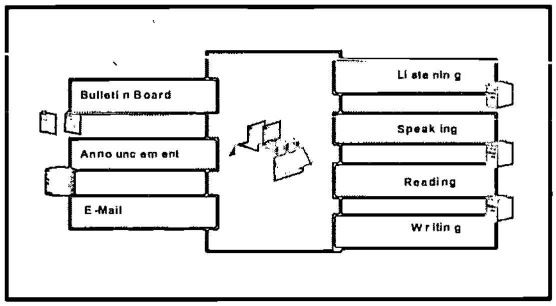

Figure 1. Overview of the Web-Based Instructional System

The listening module presents expressions in context with immediate text feedback to improve students' listening comprehension, as shown in Figure 2. Studies have indicated that listening skills in language learning and communication is important, especially at the early stages of foreign language instruction (Jakobsdottir & Hooper, 1995; Rubin, 1994). The speaking module, designed with an emphasis on conversational practice, asks questions based on given situations presented as a picture. It includes the pronunciation section in the beginning level, which presents French phonetic and phonological rules in relation to orthographic rules with text and sound examples and compares them with those of Korean language.

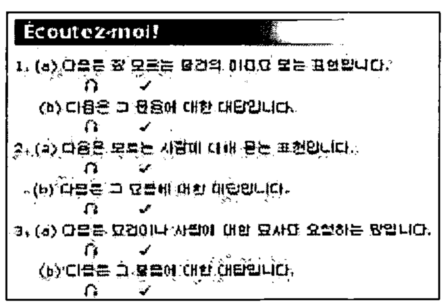

Figure 2. Example of the listening module

The reading module shows paragraphs in a variety of styles and includes interpretations and in-depth explanations regarding morphological, lexical, syntactical and semantic-pragmatic rules and expressions used in each sentence, as presented in Figures 3. The writing module enables students to gain pragmatic competence in their writing skills and provides questions related to context-based composition. Concerning the grammatical rules of the previously presented sentences, the learning modules provide charts, pictures, and examples as well as explanations about those points. Each module also provides question-and-answer sections in the forms of multiple-choice, fill-in-the-blank, or essay test. Students can answer the questions using the input editor mentioned above and then immediately receive feedback through the database structure. In addition, the learning modules provide an online bilingual dictionary developed for use in the learning process.

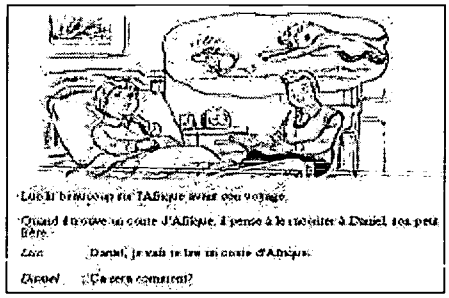

Figure 3. Example of the reading module

Computer-Mediated Communication

Research has shown that computer-mediated communication (CMC) has been recently used extensively in distance education to support electronic communications in various modes of interaction (e.g., Berge & Collins, 1995; Fetterman, 1996; Paulsen, 1995; Todd, 1996). Computer-mediated communication enables both synchronous (real-time) and asynchronous (non real-time) communication and supports interactions of one-alone, one-to-one, one-to-many, and many-to-many (Paulsen, 1995).

Since the instructional system of this study has been developed for distance learning, how to support more individualized learning process has become increasingly important. Throughout the development process of the instructional system, a great emphasis was put on computer-mediated communication. The instructional system implemented in this study, hence, provides Internet-based computer-mediated communication, as a useful tool for various modes of interactions among teachers, tutors, and students. Computer-mediated communication of the instructional system is composed of announcements, bulletin boards, and e-mails, as presented in Figure 4. The announcements include general instructions regarding navigation of the instructional system and show FAQ's (Frequently Asked Questions) on the learning materials or technical problems. The bulletin board deals with management-related interactions such as a school calendar and logistics. The e-mail allows for individual communications.

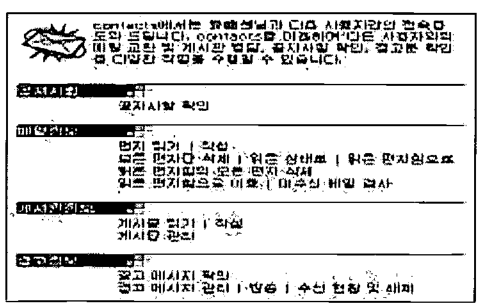

Figure 4. Computer-mediated communication

User Interface

In designing and developing the user interface of the instructional system, an emphasis was placed on user-friendliness and efficiency. Since the majority of distance learners are reported as novices in computer use (Han & Lee, 2000), a simple, intuitive design with a text-based menu, rather than a complicated design, was preferred. In addition, the instructional system utilizes well-designed TrueType fonts, which support Unicode's such as 'Lucida Sans Unicode,' 'Berdana,' and 'Times New Roman.' Although RGB color values technically allow for a variety of color, many computers in use at schools can still display only 16 colors due to the type of video display adapter they use. The basic color of the instructional system was carefully selected based on color-effectiveness studies (e.g., Moore, 1996; Pett & Wilson, 1996; Weinman & Heavin, 1996). Given current access speed to the Internet via modems or LANs (Local Area Networks) in schools, a minimum level of animation was used in order not to disorient students in the learning process (Jeong & Yoon, 1998).

The user interface was designed to differentially provide to each of the user groups, depending on the authorization status, since the user groups need different modes of interaction within and among the groups. For consistent and systematic delivery of information, any subsequent hyperlinked information is displayed on the same page. To this end, the interface was implemented using Active Server Page (Hillier & Mezick, 1998) and Dynamic-HTML (HyperText Markup Language) (Homer, 1997), which enables to present different types of multimedia learning materials on the same page. Figure 5 shows an example screen of the user interface of the instructional system.

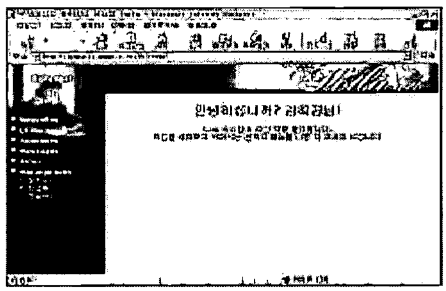

Figure 5. Example of the user interface

Conclusion

Until recently, few Web-based distance learning systems have been developed for secondary foreign language education in Korea, mainly due to technical problems on Korean Windows and Web environments. For the purpose of this study, a Web-based distance learning system was designed and developed for French language instruction. It appears to be one of the first Web-based instructional systems to provide solutions to the input and output problems that arise in the implementation of most European languages as well as French on Korean Windows and Web environments. The instructional system of this study was designed to provide a flexible, individualized, interactive, and efficient learning environment where students can actively participate in the learning process to improve their language skills through navigating the hyperlinked multimedia learning materials with interactions of computer-mediated communication among teachers, tutors, and students. The instructional system has been integrated into the curriculum of distance education and has been currently used in the foreign language courses.

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Gender and Learning Strategies within Cyberspace

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Abstract: It is a very recent phenomenon for gender differences to receive attention in the cyber-learning environment, even though research on Computer Mediated Communication (CMC) goes back to the 1970s, to an earlier stage in computer technology. The current study identified gender differences in learning strategies and in the relationships among those learning strategies, including interactions, information processing, textual encoding and decoding, sincerity, and persistence. The results provide valid evidence for the importance of considering gender differences in motivational and behavioral learning strategy components in the cyber-learning context.

Introduction

Distance education is moving into a new generation: Internet-based cyber education. Today, functions and advantages of the Internet will be further utilized for education, especially learner-centered education. Learner issues and, especially, learning strategies are significant factors for success in cyber education (Bonk & Dennen, 1999; Bopry, 1999; Willis, 1994; Smaldino, 1999; Simonson, 1999; Dille & Mezack, 1991; Lee, 2000; Lyman, 1998; Thomas & Bitter 1998). The importance of self-regulated learning strategies in academic performance and achievement has been well established in the traditional face-to-face environment (Dansereau, 1978; Weinstein, 1978; Gagné, 1985; Zimmerman & Martinez-Pons, 1986; Zimmerman & Martinez-Pons, 1988). But, few have been done in the multimedia context and even fewer in the cyber context.

The literature in distance education supports the idea that learner issues are critical factors for achievement and satisfaction levels in distance education (Bonk & Dennen, 1999; Bopry, 1999; Willis, 1994; Smaldino, 1999; Simonson, 1999; Dille & Mezack, 1991; Lee, 2000; Lyman, 1998; Thomas & Bitter 1998). Given the work and thoughts evident in this area, it is essential to put learners' characteristics at the forefront of the planning and implementation of cyber education. The goal of planning cyber education programs is to provide learning experiences and environments based on each learner's needs so as to 'makes the sum of each learner equivalent' (Simonson, 1999).

The most commonly discussed characteristics in the related studies include learners' experiences, learning styles and strategies, cultures and communities, social context, and affective and motivational domains in cyberspace. Burge (1993) found that learning strategies were important to choice-making, expression, group interaction, and the organization of information. Eastmond (1993) showed that learners in computer-conferencing-based courses employed strategies for dealing with multiple discussions, information overload, asynchronicity, textual ambiguity, processing of online information, and deciding what contributions to make. Lyman (1998) suggests that cyber learners need to develop six learning strategies called 'information literacy' in order to best benefit from the Internet, especially in a resource-based learning environment. Lyman identifies five such learning strategies: knowing when there is a need for information, identifying the information needed, locating the needed information, evaluating the information, organizing the information, and using the information effectively. Willis (1994) suggests that for adult learners to succeed in distance education they need tolerance for ambiguity, autonomy, and flexibility; and factors indicating failure include preference for a great deal of structure, face-to-face lectures, and the opportunity to interact with instructors.

In summary, cyberspace is heavily expected to be tremendously learner-centered. Learner-centered environments require learners to make decisions by themselves throughout the learning process and to have a high level of self-regulated learning abilities. For these reasons, it is critical for learners, in particular for novices, in a cyber-hypertext environment to acquire appropriate learning strategies. For learners who cannot manage effectively the complexity of the cyber communication environment, there may be a need for explicit modeling or scaffolding support. Nonetheless, relatively little attention to cyber learning strategies is found in the current literature.

It is a recent phenomenon for gender differences in cyberspace to receive any attention. Probably due to the short history of cyberspace within educational sectors, still little attention has been paid to gender differences in general and even less to gender differences in self-regulated learning strategies. Lack of learning strategies might be one of the main reasons why learners are hindered in their pursuits (Balajthy, 1990; Steinberg, 1989). If learners effectively control and regulate their own learning processes, the flexibility, openness, and wide array of choices of the cyber learning environment may serve them the best.

Therefore, this study sought to identify gender differences in motivational and behavioral learning strategies, seemingly the most widely demanded in the cyber learning environment. Those learning strategies include interaction, textual information encoding, textual information decoding, sincerity, and persistence. A second purpose of the current study is to examine and clarify gender differences in the relations among the five learning strategies.

Methods

The participants were 156 undergraduate students, 35 males and 121 females from a medium-sized university in Seoul, Korea. The participants were varied in terms of their academic backgrounds and years in their programs. All of the courses were integrated with a web-based instruction tool, UniverCampus. Cyber learning and instruction in this research was characterized by basically asynchronous, text-based, open, and learning-task-oriented space, and was combined with face-to-face classes.

Throughout the semester, the participants were encouraged to contact assistants and the professor as they needed. At the beginning of the semester, a one-hour long orientation covering how to use the online tool was offered. A 16-item survey was administered during the final week of the semester. The questionnaire was organized based on a factor analysis into five categories of interaction, textual information encoding, textual information decoding, sincerity, and persistence. Each item was designed with 7-point Likert scales, using values of 1 for "strongly agree" and 7 for "strongly disagree". Post-hoc, internal consistency reliabilities of the categories were measured with the following Cronbach's alphas: Interaction (.84), Textual information encoding (.83), Textual information decoding (.72), Sincerity (.81), and Persistence (.81). A t-test was computed for the questionnaires and 7-point Likert items with negative descriptions were reversed for convenient interpretation.

Results and Discussion

Interaction

Two questions were asked with respect to behavioral strategies for actively initiating issues and providing feedback to others in the cyber learning space. Regardless of gender, learners slightly skewed negatively in the interaction ratings. Meanwhile, significant differences were found between genders with regard to active feedback strategy ($t = -2.433$, $p < 0.05$) but not with regard to initiating discussions.

Males perceived themselves as more actively presenting feedback to others. This finding can be discussed in terms of the main features of the current research context, which are text-based, open, formal, and task-oriented. In this context, learners are expected to conduct open discussions on specific issues, rather than personal, individual, and social dialogues.

Earlier findings indicate that this environment is dominantly favorable to males (Refer to Kramarae & Taylor, 1991; Herring, 1994; Spender, 1995; Fishman, 1997; McDowell & Schuelke, 1998). In this context, female students would have relatively higher apprehension to communication (especially through textual encoding) than males. On the whole, female students were motivationally or behaviorally discouraged against posting opinions and providing feedback. Apprehension and discouragement would have seemingly negative effects on full or appropriate use of learning strategies required for success in the cyber communication system.

Textual Information Encoding

Two questionnaires were asked with respect to textual information encoding as one of information processing strategies. The results are presented in Table 2. Although both genders responded positive, there were highly significant gender differences in perceived difficulty ratings for presenting written ideas and opinions in cyberspace. Females experienced significantly more difficulties in online-written expression than males ($t = -2.457, p < 0.05$). There was the same pattern in the analysis of real life writing difficulty ratings ($t = -2.348, p < 0.05$).

Apprehension differences in textual encoding are consistent with the prior research (McDowell & Schuelke 1998; Fishman, 1997; Schellhas & Brenstein 1998). The current research revealed that apprehension of textual encoding in daily life was strongly related with apprehension of textual encoding in cyberspace (partial $\gamma = .70$, $p < .000$). The earlier and the current findings indicate that learner characteristics in real space are highly transferred into cyberspace or multimedia environment.

Textual Information Decoding

Five questionnaires were used to determine gender differences in textual information decoding. In general, males perceived themselves to have more behavioral strategies in overloaded textual information decoding than females. The results are presented in Table 3. When information was overloaded, females skipped significantly more participants' postings than males ($t = -2.457, p < 0.05$). Without considering overload, in contrast, there were no significant gender differences in the degree of reading ratings ($t < 1$). Yet, both genders skewed slightly negatively in the ratings. In addition, when textual messages were overloaded, females (mean score=4.33) tended to have more difficulties in selecting and appreciating them than males (mean score=3.8), albeit not at the 0.5 significant level ($t = -1.917, p = .057$).

The cyber-learning environment promotes many-to-many and multiple discussion, in which information is quickly piled up. Decoding (reading) texts is 'time consuming due to its textual ambiguity' (Mason, 1994), and overloaded textual information would put more psychological stress on females than on males. The results suggest that females would have less learning strategies for managing overloaded online information, and the heavily text-based learning environments like this may lead females to lower academic achievement.

Self-regulation: Sincerity

This study used five questions about sincere effort ratings including the items of which are presented in Table 4. The results indicated significant differences between genders in the degree of submission ratings consistent with instructions ($t = 2.598, p < 0.01$) and in the degree of submission ratings after a due date ($t = 2.00, p < 0.05$). Females submitted significantly more assignments consistent with instructors' directions than males. Meanwhile, males had more tendency to submit assignments after a due date than female students did. These two ratings were the only ones in which females out-performed males at or over the 0.5 significant level, among the learning strategies items discussed in the current study.

In general conditions, ignoring the factors of time management or consistency with instructions, however, the differences in sincerity ratings of the two genders did not reach an acceptable significance level (all ps > .35). For both genders, sincere efforts to participate in a required activity were very positively skewed.

The cyber-learning environment demands high learners' self-regulation (Keegan, 1990; Mason, 1994; Bonk & Dennen, 1999; Lee, 1999a; Lee, 1999b; Lee, 2000). Thus, self-regulated strategies such as sincere effort, diligence, and persistence are very important for learners to facilitate their learning process. The current study reveals that instructional intervention through required assignments or learning activities can function as affirmative facilitators of sincere self-requisition for both genders. Yet, females outperformed males in sincerity ratings in accuracy and punctuality.

Self-regulation: Persistence

Two items were employed to determine whether any differences existed between genders with respect to persistent behaviors to solve any instructional or logistical problems during the cyber learning process. The results are presented in Table 5. There were no significant differences between genders; both genders tended to be slightly persistent in learning under technical problems.

The Relations of Five Learning strategies

What are the relations among the five learning strategies with gender differences? For both genders, higher levels of textual decoding ($\gamma = .35$; $\gamma = .43$) and sincerity ($\gamma = .60$; $\gamma = .34$) were correlated with higher levels of interaction. In addition, for both genders, higher levels of textual encoding ($\gamma = .45$; $\gamma = .33$) were correlated with higher levels of textual decoding. Interestingly, however, persistence for both genders was not associated with any of the other learning strategies at the satisfying significance level. Textual decoding was not associated with sincerity.

The results indicated gender differences in the relations between interaction and textual encoding and between sincerity and textual encoding. For males, textual encoding was highly correlated with interaction ($\gamma = .50$) but not for females ($\gamma = .14$). For females, textual encoding was highly correlated with sincerity ($\gamma = .27$) but not for males ($\gamma = .20$).

Textual information decoding was strongly related to the skills for textual information encoding and interaction, independent of persistence. Both males and females who had less difficulties in textual decoding were more interactive in the cyber discussion. However, it was more strongly related for females. In a similar fashion, these learners were more likely to outperform in textual presentation; yet, the correlation was stronger for females. In addition, both genders that were sincere in learning participation were more interactive in the cyber discussion.

Although correlation data cannot address causality, it appears that the learners who are better in textual information decoding are those who are actively engaged in and can present ideas in cyber discussion. Accordingly, learners' skills in textual decoding are an important component to be considered for both females and males. In addition, the results imply that it is important for instructional designers or instructors to enhance both genders' textual information decoding strategies, because it may lead to more active engagement in cyber discussion.

Results of the current study provide some instructional implications. Improving females' textual information encoding strategies may lead to more use of sincere efforts in learning; improving males' ones may lead to the use of interaction strategies.

Implications for instructional design and research

The goal of this study was two fold. First, this study investigated gender differences in motivational and behavioral learning strategies in the Internet-based cyber-learning environment. Second, this study examined gender differences in the relations among learning strategies, including interaction, information processing–textual encoding and decoding, sincerity, and persistence. The results provide valid empirical evidence for the importance of considering gender differences in motivational and behavioral learning strategy components in the cyber-learning context. There are highly significant gender differences in the category of textual encoding strategies, in which males showed stronger behavioral and motivational learning strategies ($t = -1.810$, $p = .01$). And there are, to some extent, gender differences in the category of interaction ($t = -1.810$, $p = .07$) but not at the .05 significance level. The findings are not entirely surprising, since they replicate many of the existing findings from the areas of communication, linguistics and sociology, and so on.

Currently dominant modes of cyber courses demonstrate structures and functions in favor of males. Of greatest potential leading to gender inequality and favor of males in a cyber-learning environment are its text-based, public, and information overload natures. However, it should not be taken for granted; we have to move toward a gender-equal cyber-learning environment.

The results of the current study have implications for instructional design and research which might respond to learning strategies in favor of both genders. The following instructional interventions should be considered to overcome potentially negative impacts of those natures on specific genders.

Considering that females experienced more difficulties in thinking and expressing in a written form, an effective instructional strategy is to offer alternative interaction modes. Dialogue-like interaction such as real time chatting, audio learning resources, and verbal interactions should be used more substantially. Females' difficulties in public postings and interactions also should be considered in the design of learning activities. It is apparent that informal, social, or individualized learning and interaction opportunities may improve certain gender-oriented online learning environments. Instructional interventions for small group discussion and individualized learning materials should be embedded in cyber learning.

Moreover, because that females tend to experience difficulties in reading others' messages when especially overloaded, there is a need for the interface design which might help individual learners to search, organize, and present information in their own convenient way. Similarly, it is equally useful for mediators to regularly provide summary notes of shared information and ideas among learners. Besides all of the previous instructional interventions, one can teach explicit learning strategies to certain individuals and genders that, to some degree, lack study skills or embed them within a cyber program.

Some potential limitations of this study should be noted. The study population consisted of undergraduate students majoring in Education and minoring in Teacher certificate programs, which limits the generalizability of the results. Extending the population to various majors and colleges could produce different results. In addition, because the research context was very limited, it was not possible to investigate a wider array of online learning strategies. Finally, all the motivational and behavioral learning strategy variables were measured with self-report instrument; this study did not include qualitative data to confirm the ratings of interaction, information processing–textual encoding, information processing–textual decoding, sincerity and persistence. Extending the study to qualitative data could further support the results of the current research and have more in-depth implications.

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Cooperative Filtering System using Intelligent Agent
: A Case of Educational Portal Site

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Abstract: This paper is a study on the design and implementation of the cooperative filtering system using an intelligent agent for the educational portal systems. Generally educational portal sites have many addresses of homepage related education and e-learning system. Therefore, the portal site has a very difficult task with maintaining a consistent of linked site. In addition it is impossible that administrator personally examines all dead sites in searched education site and the index DB. Most portal site used intelligent agent for automated filtering. But filtering by agent brings overload on network and system. To solve this problem, we designed and implemented a mutual cooperative filtering system to filter off dead site using a mobile agent. This filtering system was applied to the educational portal system for elementary student and teacher. For viewing efficiency of this system, we made an experiment that compared a cooperative filtering agent system with a stationary filtering agent system.

Introduction

Web-based instructional homepages are used in many computer assistance medias and also the numbers of education sites are on the increase extremely. An extremely increase in number of homepage raises a question whether a student can search an appropriate homepage for learning. In case of finding learning contents using a general searching engines, the searched site can exist an irrelevant contents against a student's request. Moreover the result of searched content fell into learning confusion, because the contents are difficult to apply at learning intact. In order to overcome this problem, an education portal site was constructed to gather only the address of education homepages that had been made several times before. An advantage of education portal site is that content can be used correctly and rapidly in learning because searching site was well constructed for learning. In addition student can easily get a suitable contents and information. For providing the education site to student and teacher, the education portal system, called Korean Education Portal System(KEPS), was constructed on the EDUNET homepage by the KERIS and Inchon National University of Education.(http://210.102.100.38)

While walking past a type of the gathered homepage in KEPS, we can see that almost learning sites and contents made by a teacher and a private person. As a result, characteristic of the homepages have to be petty and is frequently updated. Because the education homepage can disappear easily, portal site faces difficulty to maintain consistency of the site's address. If a stored address of a portal site is not connected or the retrieval site is disappeared to user, then this portal site may bring discredit to student. In order to maintain consistency of portal, the administrator of portal site must validate all addresses of site. But this examination is impossible work that man completely manages and finds. Consequently, the filtering of dead sites can be process by an intelligent agent instead of human administrator.

A single agent needs comprehensive amount of time required for the filtering of a portal site. If a single agent examines a great many site addresses extremely, the filtering works may be inefficient or impossible. Because a mobile agent is possible with decentralization and a parallel processing, the filtering can be process effectively through a mobile agent(J. White, 1997). Accordingly, we designed and implemented a cooperative filtering system to filter off dead site using a mobile agent. For viewing efficiency of this system, we made an experiment that compared a cooperative filtering agent system with a single filtering system.

Related Works

The agent is a program with intelligent characteristics to help the users with the use of computers and take the user's place. The intelligent agent perceives any dynamic stimulation or condition and interprets the data collected for a solution to the problem and exercises reasoning for a final decision. It also acts to change the conditions within its environment in order to perform assigned duties(M. Wooldridge, 1995). Generally an agent divides a kind of two by the mobility, a stationary agent to be executed roles in single system, while the mobile agent is executed at various systems after moving through the networks. The research on an agent has been progressing by FIPA(www.fipa.org) and UMBC(http://agents.umbc.edu). And the research on the mobile agent has been studying many works by IBM and universities all over the world. The mobile agent has a specific characters compared with a stationary agent as reduction of the network load, the overcome of network latency, an encapsulation of protocols, asynchronously and autonomously execution, dynamically adaptation, naturally heterogeneous, robust and fault-tolerant and so on(Danny Lange 1998).

In the information retrieval, a filtering work ascertains the state of gathered site for the maintenance of data consistency. Generally, because the information of the web is changed frequently, a filtering job by human is an impossible or inefficient work. This filtering job can be processed by intelligent a computer program instead of a human. Such a program is called the web robot or an agent and searching site and portal site is certainly needed(R. Tolksdorf 1998). In case of examining many sites in the filtering work, if a single agent of a server processes filtering work, then it may be needed long time and overloading of a filtering server. The mobile agent has made possible cooperative and speedy filtering job from distribution and parallel processing(Ehab Al-Shaer1997). This paradigm about a mobile agent contains data sharing as well as resources sharing as SETI@home(the search for extraterritorial intelligence project) and information sharing on P2P.

Overview of Cooperative Filtering System

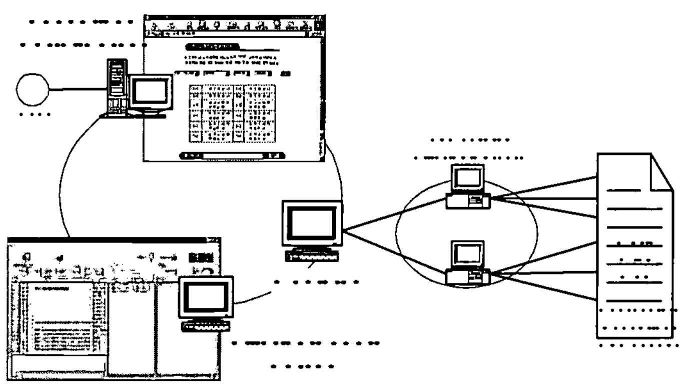

Figure 1. Overview of system

The overview of the KEPS system shows figure 1. The education portal system is consisted of four parts. These are the education portal server(EPS) and the filtering agent server(FAS), the temporary filtering server(TFS), and a mediator. For using educational portal service, user must be connected with the Portal web server. Gathered address of an educational homepage is supported searching service of an education contents to user through the Portal web server. The Portal web server has searching engine, site DB and a query processor. The filtering agent server has a stationary filtering agent and a cooperative mobile agent, error DB, a mobile agent server. Also the filtering agent server performs works as a creation and an allocation, a control, a gathering of the filtering mobile agent. For the mobile agent perform it's task fully, each server is installed the mobile agent server necessarily.

The temporary filtering servers are in existence out the KEPS system. In order to process a fast filtering work, the TFS have function of distributed and parallel processing. The number of TFS is not fixed but dynamic by amount of filtering job. Furthermore the TFS is used in temporary palace which mobile agent examines each a state of the registered site. At ordinary times, the TFS is not used usually for examining a state of the registered site. However the TFS can be only used when is requested by the mediator agent server. The mediator is situated between the filtering agent server and TFS, and acts as the role of mediation with the mobile agent and servers. All agents and agent servers must be registered in the mediator.

The detail structure of the KEPS System shows figure 2. The portal web server is consisted of searching engine and query processor, is shared the gathering DB of portal site. The searching engine provides searching service about education content and the query processor is shown the result searching at DB. The filtering agent server is consisted of inference engine and agent manager, error DB. The filtering system in filtering agent server has a stationary agent and a mobile agent for distribution and parallel working. A stationary agent examines the state of gathering site and the confirmation of HTML documents through HTTP connection. After a failure sites are saved at temporary error DB, these will be deleted from site DB of portal web server. A permanent deletion of fail sites is executed by inference engine of the filtering agent server.

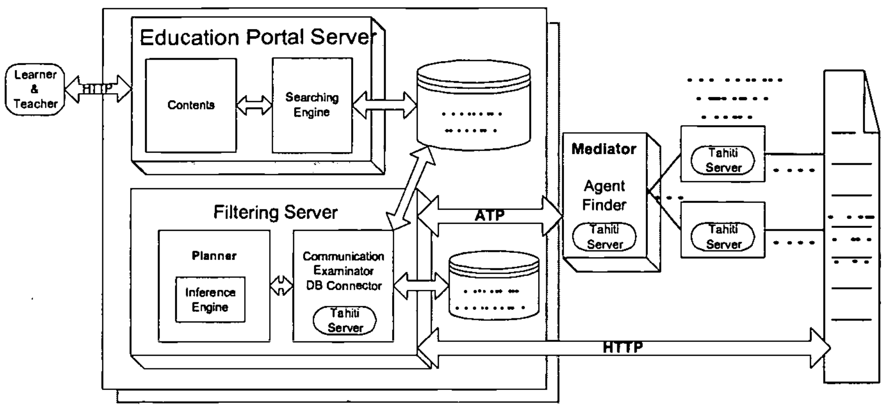

Figure 2. Structure of the KEPS system

Cooperative Work of Mobile Agent

When a filtering agent server is overloaded or the stationary filtering agent has difficulty processed by examination with many site, the filtering agent server requests to the mediator about information of the registered TFS. If the number of the TFS is lacking, the filtering agent server waits until the TFS becomes sufficient. Having sufficient number of the TFS, the mobile agent is created to divide as a suitable size of address by inference engine. And then the mobile agent has been created by a filtering agent server, will be cloned with suitable number. Each mobile agent is allocated a filtering work and will be dispatched to the TFS through the ATP(Agent Transfer Protocol). The mediator agent can grasp each work states of an agent by using the agent finder.

Each agent is moved to temporary filtering server and examines the allocated addresses of sites through HTTP. When a mobile agent is finished all checking of sites, it sends to the filtering agent server with the result of observation. If the job of the mobile agent is occurred some problem, filtering agent server creates a new mobile agent and re-dispatches to the TFS. All results gathers, result of examination saves at site DB and error DB. Finally, dispatching the agents retracted by the filtering agent. The job of filtering using the mobile agent has advantages that prevent an overloading of a single server and lessen filtering time by distribution and parallel processing. Because agents are not used stationary server but are dynamically used in other servers, all servers performed share resources of filtering system. Accordingly, each agent can do cooperative parallel processing using autonomous and society properties of agent.

Implementation of Cooperative Filtering System

The filtering agent system proposed in this study was implemented two types. The stationary filtering agent was implemented by using VC++ and CLIPS. Also the mobile filtering agent system proposed in this study was implemented using JAVA based Aglet API and JESS(Java Expert System Shell). Aglet is the java class library for that can easily design and implement all the properties of the mobile agent(Chang, D 1996). Moreover the Aglet provides with the Tahiti server and Agent finder for helping research of users.

The stationary filtering agent interacts with the mobile agent of Tahiti server based environment. Inference engine of the stationary filtering agent was used the CLIPS dynamic linked library and the mobile filtering agent system was used the JESS class library. The CLIPS and JESS are rule based inference engine and was used to infer planning and allocation of the mobile agent. SQL was used for the gathering DB of portal site. ODBC and JDBC were used to connect the filtering agent system and the gathering DB of site.

The stationary filtering agent was consisted of three parts mainly. The left screen of figure is represented list that the agent will examine site of DB. Also the center of screen is viewed results of a successful site and the right screen is represented results of a failure site.

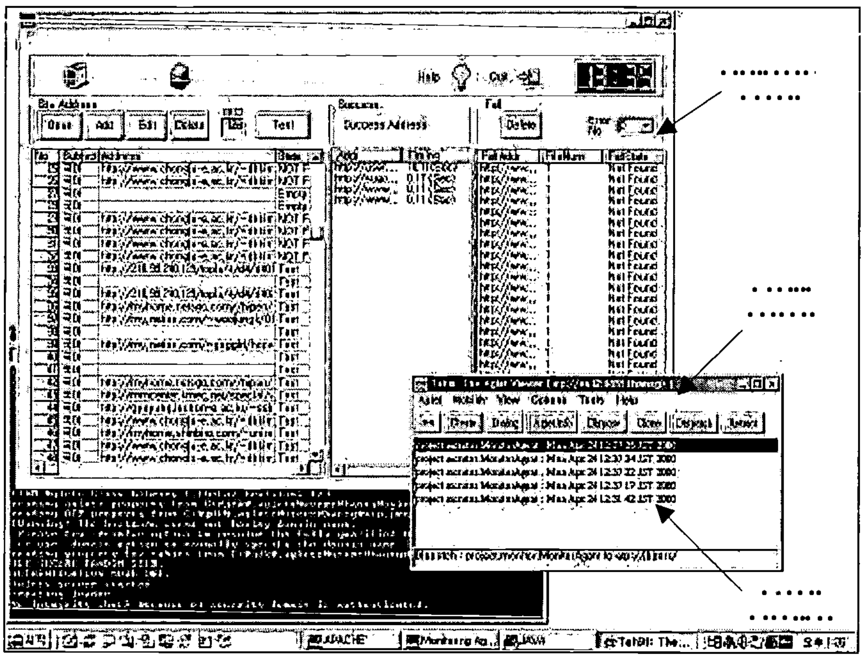

Figure 3. Interaction between stationary filtering agent and Tahiti server

Figure 3 is shown screen that the mobile filtering agent is examining each site with distribution and parallel processing. If the numbers of sites are many in existence, the stationary filtering agent executes the mobile agents to interact with the Tahiti server as followed image. Above window of figure is represented the stationary filtering agent. Black screen below is viewed that mobile agent sever is executed by the stationary filtering agent. Small screen below is shown the Aglet viewer. The Aglet viewer perform an important role as a creation, dialog, dispose, cloning, dispatching, retracting of a mobile agent.

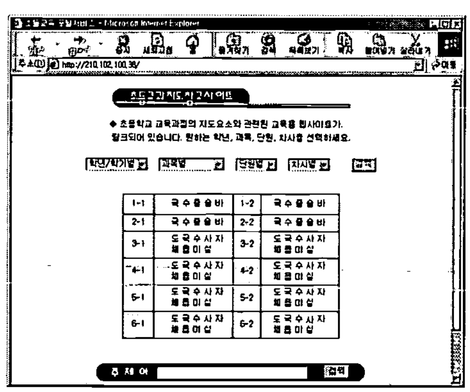

Figure 4. Interface of education portal site

To use the implemented filtering system in this study, we applied at the educational portal system and the KEPS system in the EDUNET site. Figure 4 is shown the searching screen of the web browser using KEPS system. This portal site in the EDUNET was constructed for the Korean elementary student and teacher. Also this site contains all contents about the curriculum of the Korean elementary school.

Experiment and Considerations

For examining the efficiency of the cooperative filtering system using the mobile agent, we compared and evaluated a filtering time of each agent system. A comparative objective is the filtering work time of single vs. cooperative mobile agents. Also, the estimative items are the single filtering agent and the three, seven filtering agents and the number of site 10,30,50,70,90,110,130,150,170,190. The experiment measures examination time of sites using a comparative and estimative items above. The estimative result is represented figure 5 with form of graph. The horizontal axis of graph is represented the number of site and the vertical axis of graph is represented filtering time of each agent.

In case of the number of an examine site is small, the result of experiment is viewed that the single stationary agent is faster speed of examination than the mobile filtering agent. Also, when mobile agent is dispatched to three servers, speed of examination is faster than is dispatched to seven servers. The reason is caused by overtime occurred because the many mobile agents are created, allocated, gathered.

However, the more the number of site increases, the faster the mobile filtering agent gets speed of checking than the single stationary agent. In particular, when the cooperative filtering system using many agents, experimental result is shown that a speed of examination is very fast. If a single stationary agent processes very many sites, the result of execution can be useless though the result is very accurate.

Consequently, the cooperative filtering agent can become higher execution speed by distributed and parallel processing and an overload of network by using a mobile agent can be decreased. If a server has an active environment of the mobile agent, the servers can be used with an active space of a searching agent and a filtering agent.

Number of site / Agent Type	10	30	50	70	90	110	130	150	170	190
Stationary Filtering Agent	42	137	201	261	374	412	518	592	645	743
Mobile Filtering Agent (3 Servers)	120	132	143	165	221	253	262	282	316	335
Mobile Filtering Agent (7 Servers)	130	121	124	122	148	143	147	183	186	182

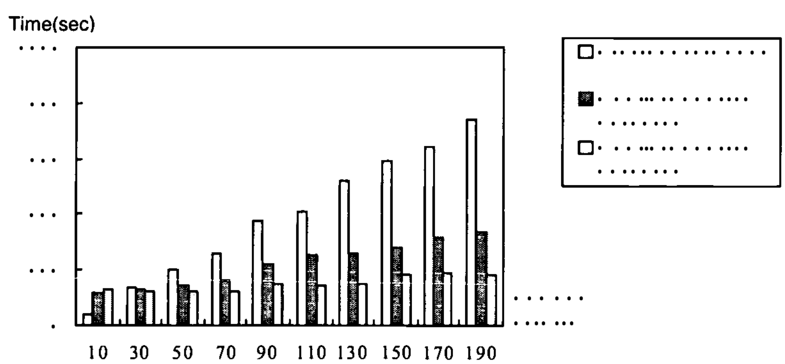

Figure 5. Result of filtering time

Conclusions

This study is on the efficiency of cooperative filtering agent using mobile agent for educational portal site. The filtering job has been getting difficulty processed by human. Thus, an intelligent agent can process the filtering of the portal site instead of human. A filtering work by using a single stationary agent needs long time for checking of many sites.

To overcome the problem in this study, the mobile agent is used in filtering job. The filtering job of educational portal site can be processed by collaborative method of decentralization and parallel using the mobile agent. The filtering system was implemented by using the Aglet and Tahiti server. This system could execute cooperative filtering job through an intelligent interaction between the stationary agent and a mobile agent. Also the KEPS system is possible with the mediation and the registration of agents by using the mediator agent between the filtering server and the temporary agent sever. The temporary agent sever is not fixed with the number but can be dynamically changed. Therefore all servers are by resources of filtering job and each server can execute its role by inference.

More studies are required on research that constructs knowledge base for inference engine of the mobile agent. For effective portal site constructed, future work needs researches not only intelligent filtering but also intelligent searching and gathering of educational information based on P2P. Also, to interact between the mobile agents, we will make a plan the research on KQML, language for sharing and exchange of knowledge between agent and agent.

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Remote Control Laboratory for Physics Experiments via Internet

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Because laboratory experiment in science education is essential for understanding the natural phenomena and principle related to a subject. Laboratory activity should be required even for distance learners providing vivid interaction between learners and nature. In this paper, we are proposing a noble experimental technique in physics education for distance learning and the regular school by introducing the remote control experimental system through Internet.

The Virtual Reality Science Museum of Kongju National University in Korea

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We will present our recent developments of the virtual reality science museum (VRSM) of Kongju National University in Korea. Our group works together to build the VRSM covering many scientific areas. The purposes of the VRSM are (1) the development of new concept of science museum for the 21C science education, (2) the contribution to the popularization in science literacy for citizens, and (3) the development of new teaching and learning methods in science education, etc.

A virtual reality science museum (VRMS) is a new concept of the educational system using VR interface, which brings together a 3D model of some real scientific situation and a virtually real visualization of the natural phenomena. And clients control the virtual world in terms of their scientific understanding. There are many virtual show-rooms such as the experience of virtual reality, the exploration of the space universe, the exploration of the earth and its' environment, the exploration of physical world, the exploration of materials, the exploration of life and human, the exploration of mathematics, and the exploration of high-technology, etc. The url address of VRMS is http://science.kongju.ac.kr/cyber_science/web/original/.

Model of Utilizing ICT in Teaching Information and Communication Ethics

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Abstract: Korean society is currently overwhelmed by the digital trend and the various deviation phenomena through the cyber space are getting more and more serious. In view of this fact, we are urgently required to provide Netizen with the information and communication ethics education. The purpose of this study is primarily to survey the teaching of information & communication ethics in various levels of educations in Korea, such as primary schools, middle & high schools, colleges and private level. We suggest a certain teaching model of the information & communication ethics utilizing the information and communication technology. And based on the basic teaching strategy, we suggest the specific procedures of the teaching. The teaching procedures are divided by three different stages: preparing, implementing and completing courses. And the implementing course is again divided into three stages; Before-class, In-class, and After-class. We specify the missions of the teachers and the learners for each stage.

Introduction

Internet is spreading rapidly beyond comparison with any other media in Korea. Unfortunately, however, it is bringing a lot of negative impacts on Netizen(citizen using network) as the business concept is being involved, deviating from the original positive aspect sharing useful information between and within Netizen, leading to serious social problems.

Only education makes it possible to reestablish social conscious minds for Netizen since it is closely related to each segment of social groups and influences respectively on whole society as a fundamental. The mood of computer education has been growing up because of the conformed presidential messages at the beginning of the year 2000. But, we easily neglect to deal with information & communication education to Netizen.

In this study, we are going to discuss the educational solutions of information & communication ethics. It will be helpful to activate its ethical educations. Especially, as we get along with large scales of information sources, we overview the efficient solutions utilizing the ICT which is one of the most important factors in our lives at this Knowledge and Information Age on teaching the information and communication ethics.

The Information & Communication Ethics Education in Korea

The State of Primary & Secondary Curriculum

In 1997, the 7th educational curriculum was officially announced in Korea. It emphasized primarily on fostering information literacy and information ethics education(The Koreas Ministry of Education 1998a, 1998b). Unfortunately, however, specific guidelines are not included on the information & communication education in curriculum. Only teaching & learning methods are described a little in curriculum.

The State of College Curriculum

Still there is no information & communication ethics class for college students in Korea. They merely teach some portions of information & communication ethics, such as 'protection policy for program', 'Information Society', and 'Information Ethics' in general Philosophy or Introductory Computer classes. Computer Science(CS) curriculum in Korea hasn't tried to select information & communication ethics officially in its field. There are various efforts to include ethical issues in CS curriculum with ACM(Huff, Charles & Martin, C. 1995, Martin, C. Dianne et al. 1996); it suggests many things to CS curriculum.

The Education Trend for Citizens from the private level

Information Communication Ethics Committee was organized in 1992 from the private level and it has been actively spreading a sound awareness about information & communication ethics until now. The committee's main activities are preventing gutter information's distribution, spreading information & communication ethics, researching more about information & communication ethics, activating international cooperation, supporting parents' guards for information, and so on(ICEC 2000).

Direction of Information & Communication Ethics Education

In the first place, education needs to spread and settle the awareness of information & communication ethics. It is the most solid way even though it doesn't come out any result right away. Information & communication ethics education needs to be proceeded in following directions.

Early Education of Information & Communication Ethics

As ICT(Information & Communication Technology) has rapidly spread and generalized, users of computer age groups are becoming younger. For this reason, elementary school curriculum has to be occupied information & communication ethics in its early stage as elementary school teaches general ethics in low grades. It's better to practice from elementary to high school consistently and without interruption.

Establishing College Lectures about Information & Communication Ethics

It is time for college students to establish their life goals and clear guidelines on their future. Therefore, students need to continue to take information & communication ethics education even after Primary & Secondary schools. Information & communication ethics education requires students' initiative participation, and active discussions between students. In addition, students should have opportunities to listen lectures from specialists, who are good at ICT and have various computer experiences, so that they can broaden their knowledge and experience more. According to Diane Crawford, executive editor of Communications of the ACM, there were 300 computer ethics courses in 1995 and an estimated 400 courses in 1996(Nancy J. Wahl 1999 quoted).

Integrating Curriculum & Developing Textbook

Curriculum is an important guideline providing teaching contents, teaching methods, and evaluation. Instructors depend on curriculum and textbook when they start teaching. Therefore, curriculum should include the contents of information & communication ethics quite obviously in any subject so that they can manage the lesson. Moreover, according to integrated curriculum, it is required to develop textbook which provides specific contents of teaching, teaching methods, and teaching strategies. It is desirable to be participated in this work those who are in the related fields, such as curriculum specialists, ethicists, computer experts, teachers, and so on.

Cases Focused Lecture with Discussion

Information & Communication Ethics has a practical features coming from cyber space. Therefore contents of education should be focused concrete cases happened before, and should cause leading attendance and critical thinking of learners. Cases focused education seems to have strong educational effects because students experienced them or has possibility in experiencing them. Learners can be suggested concrete issues, search cases about them, discuss each other about them, and they can internalize consciousness of Information & Communication Ethics through evaluation. For example, learners search regulations and cases through internet, newspaper, CD-ROM, library, encyclopedia, etc. about illegal software copy, and share information with other learners. And then they will have a correct understanding of illegal software copy through mutual critical discussion.

Instruction Utilizing ICT

Instruction utilizing ICT provides new possibility to traditional instruction. ICT enables divergent instruction free from traditional instruction and has changed the existing roles of teacher and student to new paradigm. Students can perform leading roles in searching information and solving problems using ICT because it is the source of knowledge and information. ICT requires spontaneous, creative, and critical thinking ability of learners.
The ultimate objectives of Information & Communication Ethics instruction is making learners have healthy ethical consciousness. We can't get desired effect of instruction if we emphasized one-sidedly only norms, netiquette, etc. because it decreases students' interest. The instruction method should be form that learners are able to aware consciousness of Information & Communication Ethics by themselves in process of instruction. Cooperative Learning and Problem Based Learning using ICT can be excellent instruction method.

Model of Utilizing ICT in Teaching Information & Communication Ethics

The ultimate purpose of information & communication ethics class is to help learners to have a healthy awareness of information & communication ethics. In the event teachers lead one-sided lesson, only focus on teaching regulation and netiquette, it causes boresome to learners, therefore, it doesn't bring any effectiveness.
However, as ICT has been increasing in power, it provides a new possibility in this traditional teaching. The ICT uses computer, internet, every kind of information equipment, multimedia, and so forth in order to format, transact, analyze, apply and search information. The ICT enables students-centered classroom and transform roles between teachers and students. We suggest following teaching strategy and model that are from utilizing ICT in teaching information & communication ethics.

Basic Teaching Strategy

Utilizing Internet

Internet is an useful tool to increase the teaching effectiveness of information & communication ethics. Learners can easily find various multimedia resources through search engines and plenty of web data. They discuss and work on the project with other learners from different areas or countries by using e-mail, chatting, bulletin board, and news group. Moreover, they can receive advice from specialists outside. In addition to it, internet is also used as an appropriate tool which shows negative situations of cyber space.
Eric Roberts(1998) suggested a case of utilizing internet technology in teaching ethics. As he applied internet technology in teaching CS201 Computer Ethics class, he received positive results.

Utilizing Video

A well organized and systematic ethical video tape can be more useful than a instructor's lecture. One thing important is to find a video tape with appropriate theme for class. Teachers need to put efforts to find suitable videos through various media and contemplate to select one in advance. They also need to have full knowledge of video so that they can lead any perspective of discussion during the class. Kevin(2000) used a video aids in a Computer Ethics class. He suggested price, educational theme, and contents of video, such as whistle blowing, software privacy, freedom of speech, and safety-critical software he used for his lecture in South Florida. He also proposed a class model exercise from his paper.

Case Study-Small Group Discussion

Small group discussions brings effectiveness more than teacher-centered classroom(traditional way of teaching) in information & communication ethics class where talks about social issues. Information & communication ethics is similar to the practical ethics dealing with the various problems in cyber space. Therefore, lessons need to be focused on the real cases, a spontaneous participation of students, and guide them to have the thought of criticism. The tradition way of having a small group discussion class is to divide groups, and develop the discussion in prearranged time with the theme. After that each group presents their results. Using internet discussion can be continued even after class. Therefore, if a theme requires a long period of time of discussion, it's better to have internet discussion simultaneously. Tom Jewett(1996) emphasized that a careful group organization is the core of succeeding in small group discussion and suggested various strategies for organizing groups.

Model of Teaching Utilizing the ICT

The teaching model of utilizing ICT in this study is a model of mingling internet with video in a small group discussion classroom. Students at second class schools and colleges are subject for this study. This course focuses on applying internet and video in proper periods. The ICT can be an useful teaching tool not only in 'In-class', but also in 'Before-class' and 'After-class'. It is important for a teacher to determine timing for applying the ICT and the sorts of the ICT. They also need to do continual monitoring in order to find out effectiveness of applying results.
This teaching model is divided into course preparation, course implementation and course completion. Each course is described as follow.

Step1: Course Preparation

In this stage, there are three things which teachers must do.
First of all, teachers need to understand students' background, tendency, and their opinions to reflect the whole course. It can be done by surveying and analyzing results. On-line and Off-line surveys can be conducted appropriately. Followings are showing contents of survey questionnaires.
- Subjects' background: grade, age, sex, using computer hours a day, period of using computer
- Ability to utilize computer - Percentage of daily usage of computer - Deviation from and harmful experiences through cyber space - Awareness of traditional ethics vs. Awareness of information & communication ethics
- Theme wants to be included in course

The theme for lesson can be selected based on various backgrounds of students. Also, it can be reflected in organizing groups. Following topics are potential themes for lesson.
- General information & communication ethics - Trespass of privacy - Addicting to internet/computer
- Infringement of intellectual possession - Distribution of unhealthy information - Hacking
- Unhealthy intercourse through media - Responsibility of the Computer Professional

Second, teachers collect, analyze and classify varieties of teaching and learning resources. They search, analyze, classify concepts, knowledges and cases about theme for lesson through internet, books, encyclopedia, newspapers, and CD-ROM; and then, they improve and store them. Besides, they download or purchase some videos(including streaming type) about computing and social issues through internet and other broadcasting media.
Third, teachers prepare bulletin board for announcement, teaching-learning resources, submitting assignment, and discussion. The board for announcement is only for teachers to post up information. The board for submitting assignment is where students freely upload but, only teachers have the authority to download.

Step 2: Course Implementation

In the basis of course preparation, proceeds the course in real at this stage. Each class module which composes the course is subdivided into three stages: Before-class, In-class, After-class. Before-class is to prepare necessary things before a real lesson. In-class is the stage when real teaching is proceeded. After-class is for evaluating the lesson and preparing for next lesson. Each stage is rotating. Followings are specifically described of each stage.

(1) Before-class
First, teachers need to announce reading assignment, next class theme, issues of discussion, and other assignments through internet bulletin board. Then, based on the analysis of survey, they organize groups and assign each member's roles. Roles of members can be group leaders and representatives etc. If teacher wants to use video in-

class, they need to watch the video several times in order to analyze the contents, and select additional discussion topics.
Second, learners need to read carefully for the class, research cases through internet, and write down their opinions about discussion issues.

(2) In-class

First, teachers take for 5 to 10 minutes to explain about reasons for choosing the topic and basic concepts and knowledge. When dividing the class into small groups, follow the announcement from 'Before-class' stage. Depending on situations, teachers can rearrange group members and their roles. They fix In-class time for about 50 minutes and announce portions of each time to students.
Second, when planning to use video, teachers watch the video with students. Teachers stop playing the video when providing discussion issues. Let students have time to think about the issues for about one minute. Then, guide them to participate in discussion by asking questions or suggesting discussion issues.
Third, if they do not to plan to use video, proceed to group discussions right away. When suggesting discussion issue, follow the announcement from 'Before-class' stage. It is not necessary to have same issue for each group. Group members are participated in discussion with prepared notes from Before-class stage. At this time, teachers often participate in each group's discussion and controls controversy. In other words, they activate the discussion atmosphere. It is also suitable for having discussion for 15 to 20 minutes.
Fourth, provide 5 minutes to finish up the discussion and summarize. After that, students present results of discussion and teachers give them some comments. Before finishing the class, announce about After-class and assignment.
Fifth, if discussion is not finished in a restricted time, postpone the discussion to 'After-class' step.

(3) After-class

First, if discussion is not completed in In-class, teachers arrange the due and have students notify the opinions on internet discussion bulletin. If due-time is over, let students upload discussion results by group as well as assignment.
Second, conduct satisfaction survey of students about discussion. It is convenient to have on-line survey; and there are two ways of filling out. One is downloading the survey then fill out. The other is filling out on-line right way. The contents of survey include appropriateness of discussion issue, gaining through discussion, and satisfaction about group members.
Third, based on the satisfaction of discussion, choose next theme & issue, and arrange group members. Sometimes, discussion doesn't go well because group members are not harmonized with each other. So, it is needed to consider about Tom Jewett's(1996) strategy of organizing group.
Fourth, teachers need to consider various teaching methods according to theme of lesson besides discussion such as role-play, problem solving, and so on.
Fifth, proceed to Before-class stage. If any articles in Before-class is overlap with After-class, exclude them.

Step 3: Course Completion

Completing course, as the last stage of module, diagnose whole courses, synthesize contents and then publish it. In this stage, following are specifically proceeded.
First, after learners collect and organize their projects(assignment, contents of discussion, and so on), publish it on web by groups. The projects, which will be on web, can be good examples for teaching and learning materials to teachers and students later. Especially, reading and criticizing discussed contents about social issues of computing provides a basic philosophy to students to build up their own opinions and ethical values of information & communication.
Second, conduct a course evaluation to students. The questionnaires like theme of lesson, appropriateness of discussion topics, selection of group members, and appropriateness of dividing roles. In In-class stage, appropriateness of time portion, spontaneous participation of students, and appropriateness of utilizing ICT(applying period, kind, content, technical mistake) should be included in evaluation.
Third, do survey about effects and influences on students' awareness of information & communication ethics and tendency of using ICT through the course. It is convenient to use on-line survey system, and its results necessary to be announced on-line. Results of survey can become good sources to measure effectiveness and quality of course because the goal for this course is to have a healthy awareness of information & communication ethics and tendency of utilization among learners.
Fourth, Write an essay about completing this course. Students need to write their general opinions, which couldn't deal in the survey, about this course and things to be improved for the next learners.
Figure 1. is described when summarizing and organizing the above teaching model.

Step1:Course Preparation	Step2: Course Implementation		Step3:Course Completion
- Understanding the Learners' background, tendency and opinion - Selecting theme for class - Collecting, analyzing, classifying teaching & learning materials - Searching, downloading, purchasing videos - Opening internet bulletin board (rooms for announcement, teaching & learning resources, assignment, discussion)	Before-class	- Instructor: announcing lesson Information, organizing groups, assigning roles to each member, analyzing contents of video - Learner: reading announcement, researching cases, preparing discussion	- Collecting & synthesizing projects by group, web publishing - Evaluation for course process - Investigating change of awareness of information & communication ethics and variation of using ICT - Writing an essay about completing this course
	In-class	- Introduction (5-10 min.) - Dividing into small groups - Developing discussion by using video or by group (15-20 min.) - Summarizing discussion (5 min.), Presenting & comments (remaining time) - Announcing after-class & assignment	
	After-class	- Uploading results of discussion - Investigating satisfaction of discussion - Selecting theme & discussion topic for next class - Rearranging group members - Leading back to before-class stage	

Figure 1: Model Flow of Utilizing ICT in Teaching Information & Communication Ethics

Conclusion

This paper investigates mainly the status and plan of information & communication ethics education in Korea, model of utilizing ICT in teaching information & communication ethics. Presently, Korea is experiencing an ethical crisis in information & communication fields. We only hope that our promoting education plans and teaching methods activate information & communication ethics education in Korea.

This developed teaching model will be applied in real teaching fields later on. Verifying validity of this instructing model is an important subject to secure reliance. From this standpoint, we are planning to refine this model more accurately, and then apply to students in Korea National University of Education who major in Computer Education at the second semester in 2001. The next goal of our study is to make a perfect teaching model through rectifying problems which will be derived from the real classrooms.

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Technology Impact on Roles of Instructor and Students–Case Studies

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Abstract: The paper reports research conducted in an Instructional Technology course in which the instructor changed roles of an instructor and students. As a facilitator, the teacher guided the learners through the learning process and encouraged the students to be active in their learning. Data collection relied on class observations, interviews, and surveys. The results revealed that the new teaching methods and role of an instructor motivated students, fostered students' active, meaningful, and constructive learning, encouraged students' critical thinking skills, increased students' confidence, and had positive impact on students' learning.

Introduction

What is a teacher? Who is the teacher? Answers to these questions have been changing in the past few years due to technology advancement. Years ago, a teacher was the main information giver and center of a classroom. Lately modern technology has been shifting the education paradigm and providing students with information from a variety of resources via various channels. Consequently a teacher is no longer the center of a classroom.

According to the report released by the National Council of Accreditation of Teacher Education (NCATE) in September of 1997, teachers should develop a new understanding, new attitude, new approach, and new role (NCATE, 1997). Tom Carroll, director of Preparing Tomorrow's Teachers to Use Technology (PT3) grants of the US Department of Education, vividly described the changing role of teachers at the annual convention of Society for Information Technology and Teacher Education (SITE) 2000.

Carroll (2000) advocated that a teacher should take the role of a learner. A teacher is an expert learner while a student is a novice learner. Novice learners may become expert learners as time progresses. As an expert learner, the teacher should facilitate learning for novice learners and let them become instructional resource providers. Creating a learning community that consists of expert learners, novice learners, parents, and members who may foster the learning process, a teacher's responsibility is to facilitate interaction and learning within the learning community and to further expand the community by involving members of other communities.

Hence learning no longer refers to learning from a teacher. A student may learn from other students or any member of the community. A student who does not know one area may be expert in another area. Thus a student may be a receiver at one time while he (she) may be a provider another time. A student may also self-learn from available resources, for example, the Internet. Learning becomes multifaceted and dynamic, and resources become essential in the learning process.

In addition to Carroll, Oliver (2000), an invited speaker at World Conference of Educational Multimedia, Hypermedia, and Telecommunications (EDMEDIA), also supported the idea of using students as instructional resource providers. In his speech, he further explained how he treated his students as resource providers and how his students contributed to the teaching materials. Similar ideas were echoed at two presentations at the convention, Leh (2000) and Santema & Genang (2000). The author of the paper was one of the presenters and was pleasantly surprised to see the idea simultaneously spring up on three different continents, North America (the USA, Leh), Europe (Netherlands, Santema & Genang), and Australia (Oliver). This notion might be an indicator of a current global educational trend.

In this paper, the author will share her experience why the role of instructors in Instructional Technology has to change. She then will describe how she played the role of a facilitator and encouraged her students as educational resource providers in an Instructional Technology course. She will also report her students' opinions towards their learning in the course.

The Need for the Changing Role

The author is a university professor who teaches technology credential and graduate courses in Instructional Technology at the College of Education of a public university in the USA. The students of the course were K12 schoolteachers working on their master's degree at the university. Due to state mandate, her students had to integrate technology into their classroom. In addition, because they were master's students in Instructional Technology, they were also expected to help their colleagues in their schools to employ technology. These two forces generated their need to study use of technology, especially a variety of computer-based software applications and existing technology resources.

How could the author successfully and effectively help her students? She realized that technology advancement had changed how people learned and altered the role of the instructor. She could no longer be an information giver but had to become a learner learning with her students. For example, while she was a student, she learned HyperCard, a commonly used multimedia authoring program during that time. When she became an instructor, HyperCard was considered to be an out-of-date program and most people no longer used the program. Similarly, while she was a student, only professionals developed webpages. Now webpage development has become common knowledge and a necessary skill for many people. She could not depend on what she learned in school but had to learn new technology by herself when she entered the field. Likewise, her students would face the same challenges. They had to become self-learners of technology.

Technology integration requires people's knowledge and expertise of subject areas. The author might be an expert of integrating technology into one subject area, like second language learning, but might not know how to effectively integrate technology into another subject area, for example, science. As a result, the author had to learn with her students who were experts of their subject areas.

Due to the two facts mentioned above, the author changed her role to be a facilitator and hoped to set a good teaching example for her students. She encouraged her students as instructional resource providers and trained them to be self-learners. She prepared a learning environment in which students could learn by themselves and from each other. The computer applications they learned in her classes might be obsolete one day; however, the learning skills, she hoped, might be transferred and applied to new learning experiences. Illustrated below are her experiences with teaching one of the graduate courses, "Advanced Computer Applications in Education".

Students: Resource Providers and Self-Learners

The goal of the course "Advanced Computer Applications in Education" was to familiarize students with a variety of authoring multimedia software programs. Since this was the only course directly dealing with such applications in the academic program, the author structured the course as a multimedia survey course in which students studied a variety of applications rather than focused on a specific computer program.

She assessed students' skills at the beginning of the course. On a survey, students identified their skills of using the following seven computer-based application software: Webpage development tool, HyperStudio, PowerPoint, PhotoShop, Premier, Authorware, and Director. The students circled one of the following—"don't know", "good", "very good", and "excellent"—which best described their skill level.

The author reported the survey results in class. She intended to help the students use the information to complete their course assignments: developing a HyperStudio project, creating a webpage, integrating PowerPoint in instruction, and offering a technology training session. Course assignments emphasized integrating technology into content areas, independent learning, and learning from each other. Described below is how the students learned from each other in the "Technology Training" assignment.

For the assignment, the students selected their team members (no more than three members in a team). Each team chose and learned one of the software applications mentioned above. Overview of software and step-by-step instruction of using some of the software were illustrated in a course textbook. Benefits of using such a book in a multimedia course will be described later.

After selecting the software program, the students constructed a training plan for a 60 to 90 minute training session. In the training session, they were supposed to teach their classmates the use of the application software they selected. The training plan had to contain (1) assessment, (2) time length, (3) content outline, (4) evaluation, and (5) training materials like handouts or evaluation sheet if applicable. They met with the author to discuss their training. They had to be prepared to answer questions like their trainees' prerequisite skills, what they would cover in the training, which criteria they used to decide on the content in the training, and how they would evaluate the success of their training session. The students were aware that they could ask for help from the instructor (the author) at any point of time.

Finally they delivered the training to the entire class. The author observed the class and recorded classroom interaction. She also took notes how the trainers could make the training better. After the training, the author first asked the trainers to self-evaluate their training. She then asked the trainees to critique the training session by providing good points and suggestions for improvement. She asked the trainees to provide oral input in class so that the trainers could receive instant feedback and response. She conducted the discussion and concluded with her own critiques. The trainers also received written feedback afterwards from the trainees and the instructor.

Evaluation and Opinions of Students

During the quarter, the author observed the class and interviewed students about their learning experiences in the course. At the end of the quarter, the author interviewed the students and also had them fill in a survey expressing their opinions about the course. The responses were analyzed and categorized. The results revealed that the teaching methods used in the course were deemed to be successful.

The teaching methods highly motivated the students. The students were enthusiastic about choosing a training topic and being actively involved in the learning process. Some of them chose software they were familiar with but more than half of them selected software that they knew little about. When asked why they selected the software foreign to them, the students answered that this would be a good opportunity for them to learn new skills. One said, "I wanted to learn this software for a while. Selecting this topic may push me to learn it." They learned beyond the textbook. Two of them rented a videotape on Macromedia Director. Three of them bought a book and together studied Adobe PhotoShop. They mentioned that they enjoyed learning with their partners. They also expressed their frustration when they explored software. Despite the frustration, they cherished the learning experience and thought that they learned a lot from their peers and other resources, not only from the instructor.

The teaching methods generated students' meaningful, active, and constructive learning. For the training plan, the students constructed their own instrument to assess the trainee's skills, decided on training content, and determined how to evaluate their training. They mentioned that instructional design models, for example Dick and Carey's model, made much more sense when they went through the process. They expressed that they spent much time on the course, much more than what they spent on a regular course. However, they liked the experience. They felt that they were the masters of their learning and felt sense of ownership. They mentioned that this learning experience would influence how they learn and how they teach in the future. They would search for resources that could foster their learning, and the instructor would only be one of the resources. They would also try to play the role of a facilitator rather than an information giver in their classrooms when appropriate.

The teaching methods encouraged the students to think critically. The author required the students to critique their classmates' training sessions. She noticed that the students could easily say, "you did a great job!" Nevertheless, they had difficulty in addressing points of improving a training session. By requiring the students to specify good points and provide recommendations for improvement, they practiced to think critically. At the end of the quarter, the author noticed the improvement that the students made on critique.

The teaching methods increased the students' self-confidence. Before taking the course, the students often complained that they did not know how to use certain software, for example, webpage development tool, because the instructors did not teach them. The students seemed to count on the instructors and did not feel comfortable of learning by themselves. At the end of the course, the students expressed that the course increased their confidence in learning technology on their own. They mentioned that, if they could learn software with their partners and successfully provide training to their classmates in this course, they should be able to do the same elsewhere. They became comfortable of being self-learners.

The students also benefited from one of the textbooks used in the multimedia course. Many instructors could not include advanced multimedia software in their courses because institutions could not afford the expensive software. The textbook offered a possible solution to the problem that educators and students often encountered. The book included a CD of recent multimedia software—MacroMedia Authorware, MacroMedia Director, MacroMedia SoundEdit 16, Adobe PhotoShop, and Adobe Premiere—and step-by-step instruction on the use of the software. The advantage of such a book was that users could explore and learn the software at low cost, approximately $40 US dollars. They could also independently practice the software. The disadvantage was that saving of files was restricted. Several companies published books similar to the book mentioned above. Because of the opportunity of exploring a variety of advanced multimedia software at low cost, the author highly recommends using such a book to make students learning possible.

Conclusion

Technology advancement is shifting our education paradigm. The role of the instructor is changing from an information-giver to a facilitator. Students no longer passively receive information but may be instructional resources in class. Given opportunities, they may be self-learners and self-trainers.

In a multimedia course, the instructor employed teaching methods allowing her to be a facilitator and her students to be self-learners. It was found that the course motivated students, fostered students' active, meaningful, and constructive learning, encouraged students' critical thinking skills, and increased students' confidence. Class observations and students' feedback revealed that the new teaching methods and role of an instructor had positive impact on students' learning.

As a university professor in Instructional Technology, the author might have experienced the education paradigm shift and its impact on the role of an instructor earlier or faster than instructors of other subject areas might. However, the changing role is a trend. Every instructor should be open to the idea and explore the possibility and experiment with the opportunity.

As NCATE stated in 1997, teachers need to develop a new understanding, new attitude, new approach, and new role. Every instructor should be open to the changes and further create a learning community in which instructors, students, and community members may contribute, benefit, and generate meaningful learning experiences. One can only look forward to participating in the dynamic learning and expect its positive impact on our society.

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Interaction in Online Courses – Case Studies

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Abstract: The paper reports action research on online courses conducted in 2000. The goal of the research was to investigate students' opinions toward online courses and to examine the need of converting more courses of the academic program to online courses. Data collection relied on online messages, observations, and surveys. The results revealed that students and the instructor were all in favor of online courses. Interaction and online community greatly contributes to the success of an online course.

Introduction

Technology advancement is changing our society and shifting our educational paradigm. In the last few years, the number of online courses has increased dramatically, and offering online courses is currently a trend in education. Some educators have high regards for online courses. They offer opportunities to people who cannot receive education otherwise due to large distance between home and school. Some view it as an alternative that provides learners with options of learning. Some even expect virtual classrooms to be the future of education. Meanwhile, other professionals doubt the value of such education and question its quality.

Due to in its infancy, people interpret the expression "online course" differently. Some consider courses containing online features like synchronous or asynchronous communication to be online courses while others define online courses based on the frequency of physical meetings between instructors and students. In this paper, an online course refers to a course in which an instructor uses online features and only meets his/her students for half or less than half of the usually scheduled meeting time during a semester (quarter).

The paper reports action research on online courses conducted in 2000. The author is associate professor of Instructional Technology at a state university. The goal of the research was to investigate students' opinions toward online courses and to examine the need of converting more courses of the academic program to online courses.

Background and pilot study

In summer 1999, the author's university first offered grants that encouraged faculty to convert traditional courses to online courses. The author received the grant and converted one of her graduate courses to an online course. The participants of the study were the students in the course. They were in-service teachers who were pursuing their Master's degree at the university, and they never took an online course before. They met four times throughout the quarter, at the beginning, in the middle, and at the end. Data collection relied on online messages, observations, and surveys.

The results indicated that students were in favor of an online course. The students felt that they spent more time on course preparation and that they learned more in an online course. They wished that more online courses would be offered in the academic program and they preferred an online course over a traditional course.

The study

Based on the preliminary results, the author converted two additional traditional courses to online courses. The characteristics of the participants of these courses were similar to the participants of the pilot study. The author employed similar research methods. Data collection relied on online messages, observation, and survey. The survey, containing 10 Likert scale (1-4) questions and two open-ended questions, was conducted at the end of the courses. The questions were guided to examine the following points: (1) Compared to a traditional class, did students feel that they learned as much as, or even more, in the online course? (2) Compared to a traditional class, did students feel that they spent as much as, or even more, time preparing for the web-based class? (3) Compared to a traditional class, did students feel that they were motivated as much as, or even more, in learning in this course? (4) While taking the course, did students have sufficient access to the instructor? (5) While taking the course, did students have sufficient interaction with other students in this course? (6) Given the choice between traditional courses and web-based courses, did students prefer a web-based course if the course content were suitable for a web-based course? (7) Did students wish that more on-line courses were offered in the master program? (8) Would students enjoy taking another on-line course? (9) Were students concerned about the quality of web-based or online courses? (10) How many sessions in which the teacher and the students meet are appropriate for an on-line course? (11) Did students like the delivery method of the web-based course? (12) What were benefits and barriers of an online course?

The results revealed that the students favored online courses. The table below reports students' opinions.

	1st	2nd	Mean
Learn more	3.08	3.46	3.27
Spent more time	3.51	3.58	3.54
More motivated	3.30	3.52	3.41
Access to instructor	3.58	3.39	3.48
Interaction with students	3.06	3.22	3.14
Prefer WB course	3.40	3.68	3.54
Wish more WB courses in program	3.40	3.55	3.48
Enjoy taking another WB course	3.58	3.55	3.56
Concerned about quality of WB course	2.05	1.64	1.85
Like the delivery method	3.20	3.52	3.36

Table 1: Students' responses to the questions posted in the survey at the end of the quarter. For each question the mean for the 1st class, for the 2nd class, and the combined mean are given. The scale ranged from 1 to 4 with 4 meaning full agreement with the statement. WB = web-based.

Students listed several benefits of an online course. The schedule was flexible. They could work at any time and at any place. Since the participants were full-time in-service teachers, the author felt that these comments were very understandable. She had noticed in earlier traditional classes that the students often came to class tired, sometimes without having eaten dinner, and that they occasionally had to miss class because of commitments at school, for example, meetings with parents. The learning conditions of a traditional class were therefore not beneficial for these students. The responses of the participants show that an online course may allow students to choose their best learning conditions for their learning. The participants also mentioned that the online course saved them gas and time on commuting. They also expressed that they had more access to instructor and fellow students. They felt that meeting three to four times was appropriate for online courses.

Still, barriers exist in an online course. The participants missed face-to-face communication. Students with low technology skills felt pressured and anxious. Despite these barriers, students expressed that they would still choose an online course if they were given an option.

In general, students and the author were all in favor of online courses. Interaction and online community greatly contributes to the success of an online course. Instructors should employ a variety of strategies to build up and nurture an online community. The new delivery method, online courses, has its potential and may greatly benefit students' learning.

The Continuous Education Solution for a Country Wide Telecommunication Company

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Abstract: Competition among companies has put up a challenge regarding training and development of human resources. In a country-wide company this challenge takes into account constant trainee traveling back and forth, so, generating costs. This paper presents a telecommunication development program that uses top of the available technology to broadcast synchronous classes, over a system with full motion images in real time. It uses a transmission rate as low as 2 Mbps, easily available almost everywhere, allowing training at remote sites with all of its advantages.

Introduction

Actually there are many education methodologies based upon new technologies, but a lot of them without satisfactory results evidences. The lack of knowledge about new applied education technologies and methodologies is one of the main problems among professionals who are not being prepared to use those tools to be competitive in this new globalized world.

Considering new education methods, associated to new technologies, one of the greatest challenges posted to instructors is keeping people motivated and using distance learning tools for actualization, focusing in the company business.

A decade ago, there were the first attempts in distance learning as a corporate tool [5], which means using various methods to reach and teach people who are widely dispersed geographically.

In practice, how is it possible ? What is the technology that can actually be counted on ? How is it implemented ? What methodology could be used for a Telecommunication Company environment ?

Methodology

This work refers to, as it is seen, the best-implemented solution until today in a Brazilian Telecommunication Company, that is seeking for continuous education for all of its employees scattered all over Brazilian ten states. The methodology used for this system, counts on WEBTV resources, chat-room, a Teleducation system with full audio and video interactivity, which allows the participant a total interactive environment with the instructor, minimizing the discomfort caused by the non presential situation.

As a solution for those challenges it was sought one that could put together management instruments, top of technology, new distance learning methodologies, allowing organizing culture dissemination and valorization of the enterprise human capital. PEN BrT, which is Brasil Telecom′s Extension Program is a technical and institutional knowledge-recycling program, focused in training employees on technical and administrative areas, wherever the professionals are, and they are spread out all over the Country.

The program issues were selected to provide a basic formation oriented to the Company's core business and the main departments internal processes, searching the improvement of quality service benchmarks. At the end of the program, the participant is supposed to have a clearer idea of each activity importance in the company's general context, reinforcing the value of cooperative work among involved areas.

The employees qualifying matrix, which was developed under training consultants orientation and their managers, showed training necessity.

According to the philosophy that the best Brasil Telecom′s company business specialists are their own employees [6], they themselves conduct the classes. This methodology increased competitive advantage that derived from having a well-trained workforce that is up-to-date on the entire latest trends, collaborating with one another and sharing information throughout the company. The classes are filmed, recorded and broadcasted through the auditorium's television system.

Technology

The Teleducation system implemented at Brasil Telecom uses an audio and video network exclusively for training [1]. It is based on compressed video using a MPEG-2 algorithm that allows showing VHS quality images, in real time and using a bandwidth equivalent to an E1 channel at 2Mbps. This low transmission rate allows using the public telecommunication network for this task. This bit rate is nowadays easily available and the backbone access can be made through a variety of means. It can be pointed out, as examples, coaxial cable, HDSL modems and twisted pair.

Distance Learning System

For those students who do not have a TV reception point nearby, it is possible to participate in classes through the WebTV system, since the web connection has a bandwidth larger than 300 KBPS with the main server so having an excellent audio and video quality. Through the WebTV class, students can watch the instructor, presentation slides, interacting with others participants and making questions through a chat-room

For distance learning classes, the interactivity with the instructor happens by e-mail, phone call and a chat-room provided in the course home page [2]. An instructor assistant receives questions and forward them to the instructor during classes. At the beginning of each class, presential participants receive the training material which was made by the instructor in advance. For distance online learning participants, the slides can be downloaded directly through the PEN home page – http://www.ade.crt.net.br/pen , for watching, printing, or online consulting during the class as well as afterwards. Recorded classes remain stored at the Company's library for future references. Participants who could not watch a class can request the video tape through an on-line library service. The video will reach the participant desk in less than three days, for home watching. After this, he proceeds to the PEN home page to fill out the on-line evaluation and reaction forms for attendance registration in a training database [3]. Questions will be answered by e-mail or phone call directly by the instructor, who is a company employee too, during work time. Distance learners fill out the registration participation form directly on the PEN site. There is a suggestion box, where the students can leave messages for the organizing team who manages the program.

Conclusions

The results obtained up to this date can be considered satisfactory; some questions have been pointed out such as new technology equipment handling and a little delay pertaining to the information flow in this system. With some practice instructor and students were able to overcome these characteristics of communication. Through the reaction and opinion evaluation and interviews with students and their managers, it was indicated that this teaching methodology has reached an efficiency of 82 percent considered through the question tasks applied under the PEN web page after classes and acceptance of 98 percent measured by a reaction evaluation . The low cost associated to commuting and also, the fact that the employee does not leave his post to go to classes, contribute to validate the investment in this methodology.

Actually, the on-line learners can, not only access their studies from remote locations using multimedia, but they can also build online communities [4], swapping questions and answers with their tutors, and fellow students via e-mail and a chat-room. This online learning methodology can add up to presential learning to build a successful knowledge management system and using technology to leverage the intellectual capital of the entirc company, which in turn, leads to increased productivity, shorter time to access new knowledge to the company, and a superior competitive advantage.

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ITCOLE Project - Designing Innovative Technology for Collaborative Learning and Knowledge Building

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Abstract: The purpose of this paper is to describe pedagogical background and design rationale of ITCOLE (Innovative Technology for Collaborative Learning) software. The ITCOLE software is a highly scalable and easy to use modular environment that supports students' joint efforts to build knowledge together, whether they are primary, secondary, or older students. The central metaphor of the ITCOLE system is that of shared electronic workspaces which students and teachers use for asynchronous and synchronous collaboration. The system will provide tools for community building as well as include awareness tools that help users to manage their joint knowledge building by providing real-time information on various aspects of collaboration. It is intended that the ITCOLE software will become available free of charge and mostly under open source terms for educational institutions. A downloadable pilot version of the ITCOLE server software under title Future Learning Environment 2 (Fle2) with some of the basic functionality is currently available (http//: fle2.uiah.fi).

Introduction

According to international assessments, innovative learning technology based on the new information and communication technology (ICT) promises to lead to a new decade of the learning revolution (Roschelle & Pea, 1999; Pea, Means, Hsi, Tinker, Bransford, Brophy, Linn, Roschelle, & Songer, 1999). Collaborative knowledge building is one of the most promising innovations to increase quality of education with the help of modern collaborative technology. This pedagogical approach emphasizes the importance of engaging students and teachers in coordinated efforts to build new knowledge and to solve problems together (see Dillenbourg, Baker, Blaye, & O'Malley, 1996; Scardamalia & Bereiter, 1994). Several empirical experiments offer evidence that collaborative technology designed according to innovative pedagogical ideas facilitates higher-level cognitive and social interaction and deeper understanding (Pea et. al., 1999).

The key objective of the present project is the design and development of a modular knowledge-building environment (working title, the ITCOLE software) that supports students' joint efforts to build knowledge together, whether they are primary, secondary, or older students. The system will be designed to provide tools to facilitate the development of the students' skills of collaborating, engaging in various networked activities, solving increasingly complex problems in different domains of knowledge, and working productively with knowledge. The central metaphor of the ITCOLE system is that of shared electronic workspaces which students and teachers use for collaboration. Such workspaces are provided in a number of different ways since the functionality and the interface of the system will be derived from pedagogical considerations and can be adapted to the different school environments and contexts as well as used in conjunction with other pieces of software.

Even if there are hundreds of networked learning environments available, most of the available applications are not designed to facilitate in- depth learning or genuine collaboration between students (Stahl, 1999; Stahl, Hoadley, Slotta, Guzdial, & Suthers, 1999; Roschelle & Pea, 1999). Most of these systems have been designed to manage and deliver study materials or provide tools only for unstructured chat-like discussion rather than facilitate advancement of knowledge and understanding. From these environments, *knowledge-building environments* differ substantially; the latter, from the beginning, were designed to facilitate collaborative knowledge building within a local or virtual learning community (Scardamalia & Bereiter, 1994). Characteristic of knowledge building is to go beyond individual learning by pursuing together students' own questions and problems of understanding, generating, elaborating and discussing students' own explanations for the problems being addressed. An engagement in knowledge building focus on articulating, elaborating, and extending knowledge objects created by the participants (Bereiter, 1999). Various innovative tools and facilities are to be developed into the ITCOLE system that enable the users to construct, illustrate, share, analyze and synthesize their understanding while building knowledge together. Moreover, ITCOLE software will be an awareness-oriented collaboration system that provides users real-time information on several aspects of collaboration and helps them to manage the process of knowledge production and build their social community.

Extensive studies in authentic school environments reveal that practices of knowledge building have not yet been disseminated to European schools; teachers and students are currently not using the new technology intensively as a tool of learning (Lehtinen, Sinko. & Hakkarainen, in press). To successfully promote educational use of the new learning technologies, and at the same time implement new pedagogical and cognitive practices of learning and instruction, appears to demand the utmost of both teachers and students (Lipponen, 1999). The problem is that technical tools do not themselves provide teachers with adequate models of pedagogically meaningful ways of using them in various pedagogical situations. Educational researchers need to further crystallize and concretize pedagogical models of collaborative learning and knowledge building; implement these principles in highly scalable and easy to use learning environments; and make these environments accessible to teachers and educational institutions (Lehtinen et al, in press).

The project focuses on crossing boundaries between software developers, pedagogical researchers, and the users of knowledge-building technology – teachers and students. It represents a plan to integrate in an innovative way software development with pedagogical research and intensive field testing. The present project is based on a contention that through co-evolution of the technical tools and pedagogical practices, solutions are likely to emerge that really contribute on pedagogical change at school.

Description of the ITCOLE software

The research and development project of ITCOLE software is a part of European Community's Information Society Technologies (IST, Schools of Tomorrow) program 2000-2002. The design principles will be specified by piloting of the first working prototype of ITCOLE software as well as the participants' benchmarking experiences of other pieces of collaborative technology (CSILE, Future Learning Environment, Knowledge Forum, Telecommunicado, Virtual Web School, WorkMates and so on). Many challenges of designing ITCOLE software's user interface has been preliminarily solved in the design of Future Learning Environments (see Leinonen, Raami, Mielonen, Hakkarainen, & Muukkonen, 1999). A downloadable pilot version of the ITCOLE server software under title Future Learning Environment 2 with some of the basic functionality is currently available (http//: fle2.uiah.fi). The Fle2 server software has been developed in the Nordic Nordunet2 project (http://fle2.uiah.fi/project_plan.html). The Fle2 server software itself works on Unix/Linux systems, but for end-users (students, tutors and administrators) it is totally cross platform, usable with any computer or other device (palmtops, mobile phones), for which there is a HTML 3.2 compatible webbrowser and Internet connection. Although only some aspects of the learning environment have an adequate technical implementation, this environment can be used to evaluate and test pedagogical characteristics of ITCOLE software in different educational settings. The pilot studies will allow developers of ITCOLE software to go beyond current understanding of CSCL design principles and creating a next-generation pedagogical design for ITCOLE. In order to facilitate scaling up of good pedagogical practices of using innovative learning technology, it is intended that the ITCOLE software will become available free of charge and mostly under open source terms for educational institutions.

The specification of the ITCOLE System is focused on providing a shared multi-user environment to carry out computer supported collaborative learning. The system will be accessed through the Internet (TCP/IP) with any HTTP/HTML compliant browser such as Microsoft Internet Explorer or Netscape Navigator so that users normally will not have to install any software locally. In this way, access to the system will be platform independent and it will be usable across Microsoft Windows, Macintosh, Unix, Linux, TV Set-Top Box (Internet on TV), and palmtops, e.g., Nokia Communicator or Windows CE systems. (The system functionality is implemented through extensions to servers, primarily Web servers.) Thereby, it will provide seamless support for co-operation in heterogeneous environments often typical of educational institutions. The environment will contain several tools:

Virtual WebTop module (with folders and wastebasket). In the virtual WebTops the users may create documents, bring documents from the www and upload documents from local disks. With the Webtops the users may store and share these documents with fellow users. The Webtops may also contain several small educational applications (Java applets), such as calculator, simulations.

The Knowledge Building module facilitates between-user interaction and provides a means for conducting multiple discussions simultaneously within a course. Notes posted to the database are labeled with a 'Category of Inquiry' reflecting a step in inquiry process.

The Jam Session module encourages free flow of ideas and allows experimentation with different ways of representing knowledge. The Jam Session is a shared environment for collaborative construction of digital artifacts.

Meeting Rooms is an avatar world where avatars (pupil, tutors, and teachers) can immerse themselves In a 3-D experience and use the collaborative multi-user applications (whiteboards, chat, presenters and so on).

The Library module is designed to store, publish, and browse different learning materials (see the Tutorware) and student's works.

The ITCOLE software will be designed to provide external structures that help a student to participate in expert-like processing of knowledge without the increasing cognitive processing load. This kind of external support provided during the process of inquiry appears to enable students to solve more complicated problems than they would otherwise be able to do.

- Participation in in-depth learning will be facilitated by ITCOLE software's system for entering thoughts and ideas: the ITCOLE environment guides (scaffolds) the users in categorizing their computer entries and cognitive activity in a way that corresponds to fundamental aspects of inquiry learning; for example, Problem, Working Theory, New Scientific Information, and Comment. Furthermore, several sets of scaffolds will be designed for assisting learning of different subject domains (e.g., sciences and humanities) and specific purposes of a study project.

- ITCOLE will provide tools for students to record and visually represent their activities as they participate in inquiry learning. By using the tool, teachers and students can track and reflect on the progress of a project together as well as plan how to go ahead.

- A further challenge is to design such a kind of interface that helps the users to manage the knowledge they are producing (Muukkonen, Lakkala, & Hakkarainen, 1999). Frequently, relatively large number of messages in a learning environment's database makes it very difficult for the users to follow lines of argument or advancement of ideas. An important challenge of ITCOLE is to design tools that help to represent progress of discussions by graphical means, such as reaching milestones, reflecting activity, highlighting chosen items or summarizing prior work.

Design Objectives of the ITCOLE Software

The objective of the Interface Design is to build, for the ITCOLE system, a pedagogical interface for educational use. This objective can further be divided into three main aims: scalability, usefulness and usability. The three aims for interface design for the ITCOLE system are as follows:

1. Building a working interface that scales to various client platforms representing 80% or more of those used in typical educational, home and work environments (n.b. a set of minimum requirements for a client are a html standard capable browser, on-line internet connection and typical input/output device combination). This ensures universal access for different user/browser configurations.

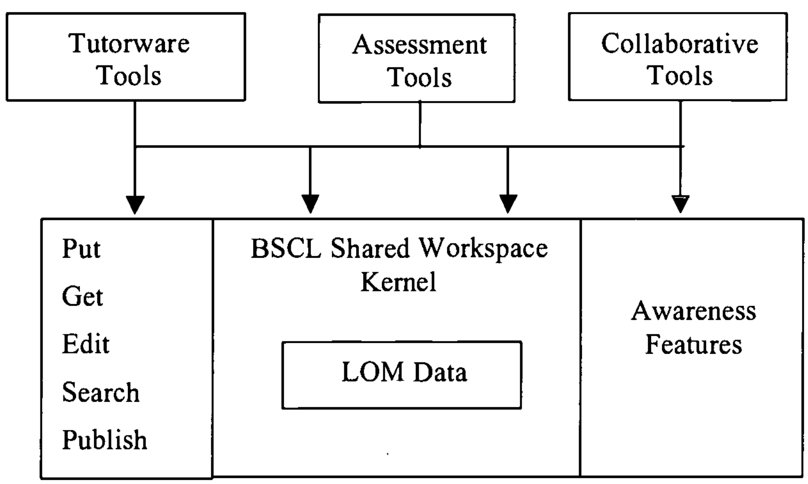
2. Incorporating a full set of features to enable collaborative knowledge building over the Internet into the interface, and coupling that with the functionality of the System implementation. This ensures the usefulness of the system for the major target groups in the field of collaboration.

3. The interface design process will place a strong emphasis on creating user-friendly and attractive graphical design and a graphical style, which is flexible and customizable by the user. This ensures that the level of usability in the system is high enough to support and sustain actual learning situations in a typical school environment.

For the development of the various components, strong emphasis will be put on modularity, so that it is possible to compile individual components for the various application scenarios to be used for testing and evaluation. In terms of increasing content sharing and future co-operation among different partners, the platform specifications will enable us to remove technical barriers of collaboration between applications. This objective will be achieved by adapting powerful standards, such as XML.

The ITCOLE System Architecture

Shared workspaces are the primary means of collaboration to be provided by the ITCOLE system kernel that relies partially on the BSCW system kernel (see http://bscw.gmd.de). The shared workspaces contain the persistent objects, which are needed for or created by the collaboration processes and support the construction and reconstruction of collaborative processes within specific work groups. The overall system architecture is shown in the following figure.



Objects in the workspaces can be accessed and manipulated, e.g., users may upload, download, edit or publish information. Around this kernel will be a set of additional features and tools, in particular tutorware, collaboration tools, assessment tools and comprehensive awareness features as described below.

Shared Workspaces

The primary features built into the shared workspace component of the ITCOLE system are as follows:

- The system allows the joint production of multimedia information in distributed environments. The system will provide tools for the users to collaboratively create, develop, discuss, and publish (hyper-) documents, or more generally, knowledge.

- The system provides information about what the individual persons of a group have done or are currently doing with respect to the collaboration processes supported by the workspaces. Towards this end, the system will provide comprehensive information about activities within workspaces, capturing various types of activities (events) and using various ways of promoting these events to recipients.

- Besides the textual representation of information, the system will provide graphical representations, e.g., for visualizing cross-relations between documents or lines of arguments in discussions, shown in varying stages of complexity, providing features such as "zooming in/out" of details.

- The system will support the publication of the results of collaboration processes, i.e., a read-only copy of (parts of) a workspace will be anonymously accessible over the Internet.

- The system will include components for organizing and managing the collaborative learning process similar to features found in workflow systems, e.g., the appointment of (onc or more) moderators for particular tasks, the time scheduling of tasks, and the allocation of duties.

Synchronous collaboration tools

The shared workspaces are primarily targeted for asynchronous modcs of collaboration; cognitive research as well as practical experience indicate that this form of collaboration provides the best support for extended and sustained working with shared ideas and knowledge objects in the context of a study project. Frequently, however, synchronous collaboration and co-operation is also needed to coordinate efforts of participants or members of a virtual team as well as to support building of a social community within the virtual learning environment. Synchronous communication provides a means for participants, who may not know each other very well beforehand, to interact socially, learn about each other, and engage in social bonding, thus creating the sense of community needed for engaging in intensive knowledge building. Applications as whiteboards, presenters, and chats are important elements for the communication within a group of people. These applications are based on the concept of data transmission to all collaborators. Combinations of these applications can result in a powerful tool with all the advantages of each single application. The following applications will be integrated in the ITCOLE tools:

- **Whiteboards** allow users to draw in a shared area, which can be visualized by all collaborators simultaneously.
- **Presenters** (or presentation software) facilitate the transmission of sequential images to all participants, for example, the presentation by slide show or a sequence of HTML pages. In addition, these tools must contain features that permit the highlighting of particular objects.
- **Chats** permit the written communication between all participants of a study group. They must indicate the name of the user that wrote the message, so other user can know who is talking.

To simulate conversational meeting, real-time applications must include features that offer characteristics similar to such meetings, for example presence awareness and activity awareness is the sense of the presence and general activity of group members. For instance, it is very important that a whiteboard, a chat or a presenter show the list of the actual collaborators. The tools for synchronous communication can be located in avatar-world. In general the scene represents a Meeting Room which avatars (pupil, tutors and teachers) can immerse themselves in a 3-D experience and use the applications (whiteboards, chat, presenters, and so on) available in the Meeting Room. Also some external tools, such as the Virtual Room Videoconferencing System (http://vrvs.cern.ch/) developed in CERN can be embedded to the Avatar-world.

Assessment Tools and Tutorware

In addition to the previous features which are directed towards collaborative learning environments, the ITCOLE system will also support more instruction based learning scenarios. Assessment tools will allow self-evaluation of students with respect to their learning progress and will enable feedback betwccn students and teachers in this process. The assessment tools will be built on top of the awareness system and thus create a suitable infrastructure for progress tracking and learning improvements based on feedback information. These tools will use technologies developed in the field of artificial intelligence for the identification of students who are not actively participating, or who produce only fragmentary, episodic notes, instead of sustained dialogues of knowledge building with their fellow students. The assessment tools function simultaneously as a means for the tutor or teacher to monitor participation of students, to identify students and discussion that do not appear to advance, and to detect groups that are not sufficiently interacting or communicating among themselves.

Teaching courses are usually a collection of individual learning modules which have to be traversed by the students in a particular order. **Tutorware** will be used to create such courses materials to the system's Library. The tutorware to be developed will allow the adaptation to the requirements and interests of each individual student, depending on progress and performance during the visualization of the contents, i.e., the content will be made up both of the information that will be presented to the pupil in each single learning module and of the control mechanisms that tell the system how to guide the student individually through the courses. Tutorware will also support teachers in collecting and creating educational objects like simulations, problem-solving tasks or other teaching materials available on the Internet or through other resources.

Pedagogical Evaluation and Testing

In advanced pedagogical practices, the use of information and communication technology becomes an integrated part of the whole learning environment and the culture of learning. As such, technology is used to build up social structures that encourage learning and reflective discourse, and to help students and teachers gain knowledge as well as to deepen their understanding of different domains (Dillenbourg et. al., 1996). The evaluation process focuses on assessing how the ITCOLE software specifically facilitates learning in various educational settings, European countries and educational cultures. Field tests focus on developing and analyzing innovative ways of using ITCOLE software for facilitating in-depth learning from elementary to high-school level education. Case studies will be used to assess ITCOLE software's technical as well as pedagogical usability and functioning. The case studies will be carried out by setting up pilot versions of ITCOLE software in several classrooms in each participating country to be used alone or in conjunction with other pieces of software. Results of the field tests will continually provide feedback for the on-going design and development of ITCOLE software. The second part of field test involve experiments in scaling up networked learning, i.e., the investigators will examine and demonstrate, in collaboration with national school authorities, to what extent innovative models of networked inquiry learning can be scaled up beyond individual well-supported experiments across normal schools and teachers and students. The scaling-up experiments will involve a relatively large number of primary and secondary schools, several teachers from each school, and hundreds of students in several participating countries.

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Student Directed Generation of Word Clusters with "Hikari": Utilizing WordNet in an Intelligent Vocabulary Tutoring System for Adults Learning English on the Web

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Introduction

Adult students of English working to acquire vocabulary beyond the lower-intermediate levels can be well served by Intelligent Tutoring Systems (ITSs) that offer both broad coverage and principled approaches to the knowledge domain, contemporary systems that facilitate personalized learning through guided exploration while providing required information, measuring performance, and monitoring progress (Levy, 1997). The need that such complex and flexible systems have for sufficiently rich and structured databases of English vocabulary poses a major challenge to their would-be designers, however, and the challenge is especially daunting in the case of applications intended for deployment over the web, where high loads and unpredictable user demands necessitate the adoption of extraordinarily large and fast databases.

"Hikari" is a web-based ITS for use in English language vocabulary study that addresses this challenge by incorporating the WordNet electronic lexical database. The product of over a decade of collaboration by cognitive scientists at Princeton University and elsewhere, WordNet is a freely available "electronic dictionary" that remains, to date, a resource surprisingly underutilized by educators involved with English language instruction despite its clear and impressive potential: In its present version, WordNet contains over 168,000 English words, each linked to detailed information about word senses and frequency. More importantly, a word's location within a variety of interconnected semantic networks can be quickly recovered by computer-based queries against WordNet.[1]

As discussed below, one of the most rewarding ways of exploiting WordNet for computer-assisted language instruction may be to draw upon not only its vast lexical scope, but its unparalleled richness of quickly accessible relational data. The "Hikari" project pursues this approach at present by offering students the tools with which to run specialized queries against WordNet. Building upon a key word determined by the student, "Hikari" encourages learners to discover a variety of semantically related words and word groups for themselves, prompting students to compose study lists of word "clusters" of particular personal interest.[2] Because these clusters are based upon WordNet relationships, relationships which are themselves derived from widely accepted findings in cognitive psychology and psycholinguistics, the composition of word clusters tends to reflect adult cognitive structures.

From a pedagogical point of view, the development of "Hikari" is premised upon the theory that such clusters will readily lend themselves to assimilation by their student creators. The project is also conducted with the expectation that, because clusters originate in key terms of special relevance to the student users, vocabulary acquisition will be accelerated by a heightened level of learner involvement and attention.

Pedagogical Considerations

In recent years, computer-supported learning environments have been designed so as to provide guidance and to add limited structure to the learning process, offering students tools rather then predetermined curricula (De Corte, 1996). "Hikari" has been designed in this spirit. At the same time, "Hikari" seeks to accommodate adult learners by taking into account their special (i.e. non-childlike) cognitive standing. While all learners must accommodate new materials to preexisting conceptual structures, adult students of non-native languages bring an especially rich conceptual apparatus to the task of acquiring new vocabulary (Coady and Huckin, 1997). (In contrast, a child's conceptual structures are relatively underdeveloped.) Unlike both children and adult students approaching new subject matter, adult language learners are often masters of the concepts for which they lack only the foreign-language words. This pre-existing structure, then, can be exploited by supplying such learners with words organized by adult conceptual relations.

Equally important, adult language learners are often interested in learning the language of a particular area of knowledge, such as that of economics, politics, medicine, or law. In a traditional classroom all of the class members are typically asked to use the same text book or other resource, so that students beyond the early stages of language study who do not enjoy the luxury of choosing from highly-specialized courses must work through vocabulary that is either irrelevant or, at best, of secondary importance to them. In contrast, an ITS combined with a broad and deep lexical database such as WordNet allows these students to generate word lists that closely match their needs and interests, promoting more efficient, productive, and satisfying study.

Running Queries Against WordNet

WordNet and its categorical relationships can be efficiently searched by means of browsers supplied with the database, custom software that makes use of the APIs also provided, or utilities developed by third parties.[3] "Hikari" processes queries on behalf of students by first soliciting key words from them via custom ASP pages available over the web. The heart of the system lies in the algorithms, implemented as COM objects in Visual Basic, that generate a series of queries against WordNet and return results to the student users.[4] Students then choose from among the result sets the word clusters they would like to add to their permanent study lists, and "Hikari" then takes care of presenting students with periodic quizzes and reviews based on those lists and on performance on past quizzes (if any).

In its present phase of development "Hikari" only allows for the creation of noun clusters, returning terms linked to any given key word by relations of hypernymy and hyponymy. The goal for the near future is to broaden the choice of parts of speech and vary the search algorithms, moving through a series of refinements that will optimize the search "menu" available to students with various learning preferences or aptitudes. Searches could be extended, in principle, to include queries returning term + antonym pairs for students who tend to think antithetically, searches that center on basic concepts, searches that isolate cause-effect relationships, and so on.

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[1] As of February, 2001 the WordNet homepage's URL was: http://www.cogsci.princeton.edu/~wn/

[2] See Fellbaum, 1998, for a complete review of the WordNet relational categories referred to here and of others.

[3] See the WordNet homepage for a very helpful guide to third party tools and projects.

[4] Once generated, queries are run against WordNet database records via a COM object utility supplied with the "WordNet TreeWalk" created by Bernard Bou.

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Exploring Roles for Intelligent Agents in a Language Learning MOO

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The free-form, collaborative, highly interactive and user-directed quality of the MOO gives it much of its pedagogical value. However, these qualities can become liabilities for educational MOOs because learners run the risk of distraction, of wandering in a chaotic information space, and of receiving and repeating misinformation.

As teachers cannot be made available at all times to all MOO users, there arises a role for software agents that can assist human teachers by continuously monitoring student activity, selectively providing information from database stores, administering diagnostics, and productively engaging students. One of the chief challenges in the development of such intelligent tutors lies in designing and deploying them so that they complement (or construct) teaching that incorporates sound instructional designs.

The "Conversational", "Administrative", "Knowledge", and "Secret" agents discussed in this presentation may help bring foreign language educational MOOs into greater harmony with sound instructional design principles for computer assisted learning.

Course Material Model in A&O Learning Environment

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Abstract: One of the problematic issues in the content development for learning environments is the process of importing various types of course material into the environment. This article describes a method for importing material into the A&O open learning environment by introducing a material model for metadata recognised by the environment. The structure of metadata in A&O material model is defined and encoded using XML (Extensible Markup Language) vocabulary. To motivate our work, we briefly introduce basic ideas of structured documents and reflect our work with some learning standards related to this field. Finally, we illustrate our work with a simple example of using the material model in the A&O learning environment.

Introduction

The article discusses the problems in producing interactive learning material to learning environments. As an example, we introduce the material model designed for the A&O learning environment. A&O is a learning environment produced in the Open Learning Environment (OLE) project in the Hypermedia Laboratory of the Tampere University of Technology. The main features of the A&O learning environment are: possibility to accommodate any number of courses and their materials, user identification, tools to assist the learning e.g. communication and constructive tools, and connectivity to databanks. Technically, A&O is mainly a Java technology based distributed application. [Pohjolainen, S., et al. 2000]

In the first chapter we discuss about different ways of creating learning material to WWW-based learning environments and define the context to which the A&O material model design was based on. Then we introduce the concept of structured documents and XML (Extensible Markup Language), and the notion of metadata which constitutes a big part in the A&O material model. We also take a look at some learning-related standards that can have great affect on the evolution of the learning material production. We describe the A&O material model with some examples and definitions. Finally there we draw some conclusions about producing learning material and the A&O material model.

Constructing Interactive Learning Material

There are many ways in constructing learning material to various learning environments in the World Wide Web. Some people like to use HTML (Hyper Text Markup Language) while others prefer traditional publishing programs to create PDF-files (Portable Data Format). There is also a possibility of defining rigorously typed documents by using XML or SGML (Standard Generalized Markup Language) like Solvig Norman [2000] has done in Open Learning Agency. In addition, what would be the correct way to produce interactive elements such as exercises and various other constructive tools? Faced with a bundle of pedagogical questions to consider in creating learning material, it seems that we should be able to use the tool that we feel most comfortable with. Of course, sometimes we have to make compromises in favouring our own and the learners' convenience. For example, the technical constraints imply that we can't use very large pictures even if they would be easy to produce and pedagogically appropriate. However, this is something we must all live with.

Fortunately, some of these restrictions can be hidden, simply by choosing the right tools. Selecting to use a specific tool, however, tends to limit our possibilities to import learning material into learning environments. This is not really the fault of the learning environment; there simply exists almost uncountable number of different kind of formats to multimedia documents to deal with. Although some of these formats are very suitable in describing the material, not all of them provide the right kind of information, e.g., to be used as a basis for the search engines of learning environments. Even if the format did contain the appropriate information, e.g., based on a global standard, there is the risk that it would eventually be a limitation for producing material utilising the latest technology. This implies a need for two levels of standardisation.

Structured Documents

The idea of describing the structure of course material presupposes the concept of a structured document. To put it simply, structured document is a text document consisting of two kinds of characters: data and markup. Markup is mainly used to organise content into hierarchical element structures. The ultimate goal is to provide a unique and simple syntax for representing relations between different types of elements in a document. The approach of structured documents is usually used for two reasons: to describe abstract data structures and to separate the content of documents from their appearance.

The first major mechanism for describing and writing classes of structured documents was SGML (Standard Generalised Markup Language). SGML received the status of an ISO standard in 1986. SGML is not a markup language itself but a metalanguage; an open-ended industry level standard for defining logically structured information. The key idea of SGML is to provide standard means for the construction of hardware and software independent document encoding schemas, called SGML applications. The most famous SGML application is by no doubt HTML. The complexity of SGML, and the success of the simplicity of HTML, led to the development of a markup language that would combine the best parts of both worlds in a modern networked computer environment. This work culminated in XML (Extensible Markup Language) 1.0 recommendation published by W3C (World Wide Web Consortium) in 1998 [W3C, online]. XML provides both a metalanguage for describing document classes consisting of logical element structures and an actual markup syntax for writing documents. The basic idea is to markup text documents into logical element structures in a specific machine-readable form. It is also possible to declare a type (including the vocabulary of documents) for an XML document, providing a basis for automated validation of the logical structure of documents. The meaning of logical XML structures is not stated in XML, but can be globally fixed using Namespaces names prohibiting collisions of names of different applications.

As such, XML 1.0 is sufficient only for very abstract tasks such as describing data exchange formats between applications. Other practical applications of XML require also, e.g., agreements of specific vocabularies. With this in mind, W3C introduces a whole family of XML-related standards, including XML Namespaces, XML Schema, XLink, and XSL (some of which have not received a status of W3C recommendation yet).

Metadata

In principle, standardising all document encoding using specific document schemas and vocabularies would provide a powerful way to promote interoperability of documents, e.g., for transferring educational content between learning systems with different architectures. In reality, however, this is too much for a requirement since majority of authors wants to produce their material with a wide range of different techniques, aimed to radically different Web client configurations. Fortunately, from the practical point of view, the question whether the internal structure of documents can be formalised and interpreted by different learning systems or not, is not as important as the question whether meaningful descriptions of documents can be shared and successfully applied among them. This is where standardised formats of metadata come into the picture.

As the term puts it, metadata is information about data. The basic idea is to provide short, informative, and a useful description of a large amount of related information whose internal structure is too complicated or even irrelevant to be used as such. Most metadata structures deal with taxonomic systems characterising information some sort of queries in mind. Given an application, the question what is good metadata, is answered by evaluating the intended usage of it. For instance, considering educational course material, a good metadata description might provide a standard format for stating the topics of the material, the intended organisation of the material when taught as a course, and the list of exercises or quizzes prepared for each topic.

Learning-related Standards versus Reality

There are two major levels of standardisation of metadata to be considered. First, the intent and format of metadata within a specific learning system (say, A&O), and second, the intent and format of metadata between two or more different systems (say, between A&O and WebCT). The application area of the former is to provide a mechanism, e.g., for uploading diversified course material into a specific learning system, while the latter deals with interoperability standards, e.g., transporting course material between different learning system architectures.

It might be tempting to assume that an ideal solution would automatically combine these two objectives in a form of a universal learning standard. Unfortunately unified standardisation only comes with a price, either by accepting overwhelming complexity of such a standard, or allowing oversimplifications in descriptions of learning objects and concepts. We will not address this issue further here; for a more detailed discussion about the pitfalls of "fossilisation", see, e.g., (Robson, 2000). Of these two levels of metadata standardisation, we shall first consider the latter more general case, and then return to the first, in which this article will mainly be focused on.

It is obvious that in order a metadata format independent from learning systems to be applicable, it must be both well standardised and agreed among vendors of different (major) learning systems. Without a mutual commitment and a concrete specification, the abstract idea of metadata doesn't carry too far. This implies that an influential forum for developers and system vendors is required. At the time of writing, there exists several groups promoting learning technology standards. According to [Robson, 2000], general interoperability standards are developed by IEEE LTSC, the IMS project, and ADL. Standard development is done, e.g., in IMS, Ariadne, Gestalt, and AICC. These organisations have actively participated in the development of LOM (Learning Object Metadata), developed by the IEEE learning technology standards committee [IEEE, online]. LOM aims providing an abstract data model for describing educational material. Abstract LOM is implemented via LOM bindings, concrete implementations of data structures proposed by it, e.g., using XML document schemas.

There are, of course, general metadata standards applicable also to describing learning material. A good example of a general approach towards a practical metadata standard is W3C's RDF (Resource Description Framework) candidate recommendation (see, e.g. [W3C, online]). According to the specification, "...RDF is a foundation for processing metadata; it provides interoperability between applications that exchange machine-understandable information on the Web." In principle, provided that a suitable vocabulary is agreed upon, RDF provides a way to describe any Web resource from the viewpoint of learning in the same fashion that LOM would do. Another example of a suitable general metadata system is Dublin Core metadata, a short and concise set of properties developed for classifying Internet resources [Dublin Core Metadata Initiative, online].

However, from the viewpoint of a specific learning system, interoperability standards come with at least two major shortcomings. First, much of the standardisation work is still experimental or under development, and second, the standards do not necessarily provide support for the information that is crucial for the specific features of the learning system at hand. A practical learning system is faced with the evident problem of content production that can't be postponed until the grand standards are settled. In order to be able to upload content here and now, some proprietary format for accepting material is needed.

There are two basic approaches for solving this problem. The first solution is to define, introduce, and essentially fix, a range of authoring tools allowed in the authoring process. The second is to define an exact model for the core structure of the material, acting as an interface between the learning system and the process of content production. In this article, we're promoting the latter line of working since we believe that it has three major advantages to offer. First, it gives authors freedom of using any tool appropriate, as long as material is described correctly via the material model. Second, the complexity and behaviour of the material is not unnecessarily constrained; material may contain components outside the scope of the model, as long as the learning system doesn't have to be aware of them. Third, provided that the mode is rich enough, rigorous modelling of the material creates a concrete basis for future applications of interoperability standards.

The Material Model in A&O

The new A&O material model was designed in team-work in the Hypermedia Laboratory in the Tampere University of Technology by the authors of this article and the other members of the A&O technical development team: Tuukka Arola and Vesa-Matti Hartikainen.

The Realisation of the A&O Material Model Project

The main reason for designing a new course learning material model for A&O was the fact that the old model was only implemented to work with one specific tool which didn't quite meet the new requirements set by material authors [Nykänen 1999]. The new model was designed to be as open and general as possible because there seemed to be quite large number of tools for creating material for the WWW-environment, none of which being significantly better than the other. The decision about selecting the authoring tool was left to the author, and the material model was designed so the author could use his or her favourite authoring tool, bearing in mind that the material produced will be accessed via the WWW. We also wanted to leave room for the considerations of the upcoming standards concerning learning environments and the material.

The A&O learning environment provides many useful services for the learning material, for example, the annotation tool which allows the learner to write and attach notes to certain places in the material. One of the main concerns in the design of the material model was that we wanted to create an easy way for authors to take advantage of the services of the A&O while developing the material. Another major reason for the new material model was the awareness of the increasing need for security in the Internet. The previous implementation didn't explicitly favoured storing course material in a protected and private storage. However, if security issues are not taken care of, course material in a public directory accessible through the Internet to anyone knowing where to look for it. The new model allows situating the material to a private directory in the file system of the server and the material is only accessible to a user when he or she is actually using the system with right privileges. This is achieved by using Java Servlets as gatekeepers for all the material. The identification of the user is done with the comparison of the cookies, client IP-addresses (Internet Protocol), and active user sessions.

The Material Description Document

The A&O material model is based on the idea of collecting metadata from the material and the author. We decided to describe the material with an additional description document, in a similar manner to some proposed interactive learning material standards. The metadata or description document uses the vocabulary listed in Table 1 to describe the course and the material as generally as possible (from the viewpoint of the learning system).

Table 1. The terms defining the structure of the A&O material model.

Course	The term course refers to the actual course, metadata of which we are describing. One course description element contains general information about the course such as name, code and description, authors, and material.
Author	The term author refers to the producer of the material. In addition to the personal information, author element may contain, e.g., contact and copyright information.
Material	The material is the learning material as a whole. It contains general information about the material and it's presentation and components.
Component	The component term refers to one material topic or a page. It contains general information about the topic, keywords and relations to other components, and references to meaningful subcomponents.
Subcomponent	Subcomponents are smaller bits of learning data identified by the model, for example the image files linked to a HTML page.
Tool	The tool elements describe course dependent tools that can be accessed through an URL (Universal Resource Locator).
Relation	The relation element models an actual relation between two components. The relation includes information about the target of the relation and information about the type and meaning of the

	relation.

Logical structure of the description document providing metadata of a course is defined using an XML document type definition, which, in our case, is stored in a file COURSE.DTD. COURSE.DTD defines the metadata document in a form easy to interpret and validate. The ability to validate metadata descriptions implies that the correctness of the created description documents (and hence the approximate correctness of the material itself) can be checked before importing course material to A&O.

Writing complicated XML documents by hand is tedious. This is mind, we have created a visual tool called MaterialDescriptor that analyses the given concrete material and asks all the predictable right questions from the author. MaterialDescriptor visualises the material as a tree of components and subcomponents, with the intention of easy description and construction of the metadata.

Example

Listing 1 provides an example of using the COURSE document type. The course material described in the example is a simplified description of the Matrix Calculation course held in Tampere University of Technology, Autumn 2000. Due to lack of page space we included only two examples of components in the description. In practice, the components would occupy a major part of the document. Note that the second component is actually a PDF-document, the structure of which can not be interpreted as an XML or HTML document as such.

Listing 1. Example of an A&O material description document.

```
<?xml version="1.0"?>
<!DOCTYPE COURSE SYSTEM "COURSE.DTD">
<COURSE>
  <COURSENAME>Matrix Calculation</COURSENAME>
  <COURSENUMBER>73109</COURSENUMBER>
  <COURSEDESC>The introductory part of the Matrix Calculation course.</COURSEDESC>
  <AUTHORS>
    <AUTHOR>
      <AUTHORNAME>John Doe</AUTHORNAME>
      <CONTACTINFO>
        <EMAIL>john.doe@tut.fi</EMAIL>
        <PHONE>111-1111</PHONE>
        <ADDRESS>Joe's Street 1, 11111 FINLAND</ADDRESS>
        <HOMEPAGE>http://www.tut.fi/~jdoe</HOMEPAGE>
      </CONTACTINFO>
      <COPYRIGHT>Freeware</COPYRIGHT>
      <ORG>Tampere University of Technology</ORG>
    </AUTHOR>
  </AUTHORS>
  <MATERIAL LANG="UK">
    <FRAMESET URL="frames.html" DOCWINDOW="doc" MENUWINDOW="menu" TOOLWINDOW="_new"
        EXTRAWINDOW="_new" />
    <CONTENT>
      <FRONTPAGE RELATIVEURL="frontpage.html" />
      <CURRICULUM RELATIVEURL="curriculum.html" />
      <COMPONENT RELATIVEURL="vector.html" PARENTURL="" TYPE="html" ELEMENTENCODING="NOELEMENTS">
        <HEADER>Vector</HEADER>
        <COMPDESC>Defines the concept of the vector</COMPDESC>
        <KEYWORDS>
          <KEYWORD>vector</KEYWORD>
          <KEYWORD>definition</KEYWORD>
        </KEYWORDS>
        <CREATIONDATE>2/12/2000</CREATIONDATE>
        <RELATIONS>
          <RELATION TO="matrix.html" DESC="" TYPE="prerequisite" />
        </RELATIONS>
      </COMPONENT>
      <COMPONENT RELATIVEURL="matrix.pdf" PARENTURL="" TYPE="pdf" ELEMENTENCODING="NOTMARKED">
        <HEADER>Matrix</HEADER>
        <COMPDESC>Defines the concept of the matrix</COMPDESC>
        <CREATIONDATE>2/13/2000</CREATIONDATE>
      </COMPONENT>
    </CONTENT>
  </MATERIAL>
  <TOOLS>
    <TOOL URL="http://www.tut.fi/minMaple" NAME="MinMaple" DESC=""
        HELPURL="http://www.tut.fi/minMaple/help.html" />
  </TOOLS>
</COURSE>
```

Conclusions

The A&O material model defines an open and effective method to describe learning material. In a world where authoring tools and document formats are developing fast, we feel that the openness of the material and the format independence of the model are very important. The key point is to separate the metadata from the actual material formats of material used in learning environments. This separation has other advantages as well. For instance, it enables editing the course material after importing it to the learning environment, allowing adding information to the description document without having to change the existing learning environment. Using XML in describing and encoding description documents makes it also possible to effectively reuse metadata in a form of interoperability standards in the future. This can be achieved, e.g., with appropriate XSL transformations, one for each interoperability standard or document type. The material model introduced in this article is actually used in developing content for the A&O learning environment. Future experiences will evaluate our work in revealing the hidden gaps and gems of design. The initial work, however, seems promising.

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From the Catalyst Web Site to Internet 2: Scaling Innovative Teaching with Technology through Partnerships

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Abstract: The Educational Technology Development Group at the University of Washington creates and manages innovative projects that integrate teaching with technology. Through a network of collaborative partnerships with campus teaching practitioners—learning, technology, and teaching research centers, libraries, and departments—the group leverages resources and spreads promising practices throughout the university. From this unique position as the intermediary between educators and technical support staff, the group is able to facilitate diverse projects from the Web-based Catalyst Initiative which supports innovation in teaching through technology for all UW faculty to managing and facilitating a cutting-edge distance learning projects that utilize Internet 2 connectivity.

Partnerships as a Support Strategy

In 1994, three top-level administrators at the University of Washington were charged by the Provost to "do something about technology." They redirected resources from their respective units and worked with faculty to launch a small pilot project to provide 65 freshmen with laptops and training in technology and information literacy. Collaborating with other faculty, librarians, technologists, and students, they quickly moved beyond this initial pilot, rounding up more partners and gathering resources from wherever they could to focus on bringing technology into the service of teaching and learning in a more systematic way through the Center for Teaching, Learning and Technology (CTLT), established in 1996.

The CTLT served as a drop-in center where faculty could work and receive one-to-one assistance in a uniform and familiar environment of standard software and hardware. The Center tailored custom solutions to faculty needs, often working closely with support staff from a client's home department. Staff also gave frequent workshops on basic applications and technology skills. This support model required significant staff time and created the expectation of continued, intensive support (for relatively few clients). By 1998, drop-in visits to the CTLT had increased dramatically, seriously taxing staff resources. At the same time, however, the absolute number of instructors assisted by CTLT staff was relatively small, a few hundred *early adopters* over the course of the academic year. The need to expand support to a much wider audience—and to do so without a major infusion of new staff or relocation to a larger facility—was clear. How to do so was not.

At this point, staff entered into an intense period of assessment and wide ranging conversations with the major partners behind the CTLT, campus stakeholders, faculty focus groups, and campus support staff.[1]

What emerged from these conversations was a clear set of requirements for supporting *wary adopters*: (1) the initial foray into educational technology must be smooth and easy; (2) flexibility is critical to meet the both the changing needs of instructors as well as evolving technologies; and (3) campus-wide, scalable resources are a must. Not only did these conversations forge a consensus among campus educators about what needed to be done, but the new support framework that resulted—the Catalyst Initiative—explicitly met the needs expressed by faculty, librarians, instructors, and teaching assistants.

What has proven critical to UW's success in supporting educational technology is that all the units that should have been shaping technology integration were shaping technology integration. The initial partnership established an ethos of multi-unit, results-oriented collaboration that has persisted, producing a support strategy owned by all the players.[2] This intense collaboration also resulted in the creation of a permanent staff for the CTLT, now called the Education Technology Development Group, who understands the needs of faculty and the units on campus with a stake in teaching with technology. Ed-Tech staff is thus perfectly situated to arrange collaborations and bridge gaps between educators and other units on campus. This position as an intermediary and a change agent has allowed Ed-Tech staff to not only develop a scalable support strategy for all UW professors—the Catalyst Initiative—but to participate in high level experiments that push the boundaries of innovation.

The Catalyst Initiative

By now all institutions of higher education are grappling with instructional technologies, in part spurred by the explosive growth of Internet technologies in everyday life. To support technology in teaching, many campuses have established a faculty technology center, offered training to interested educators, supported faculty technology projects and the transformation of particular courses, and/or implemented off-the-shelf courseware. These efforts have generally targeted *early adopters* who are eager and willing to teach themselves how to use and implement new technologies. Most support staff, however, now face the challenge of moving beyond the small core of *early adopters* to the *wary adopters*, the vast majority of faculty who look for easy ways to bring technology into their teaching but are unwilling to match the time commitment of the pioneers.

As noted in a recent National Learning Infrastructure Initiative white paper,[3] this second wave of *wary adopters* shares a commitment to quality learning with the *early adopters* but is much more risk averse and unwilling to experiment or invest significant amounts of time to integrate technology. Moreover, there is no magic-bullet solution that will meet the needs of all or even most *wary adopters*. To reach its own second wave of *wary adopters*, the University of Washington chose to forego courseware or unitary solutions in favor of a support strategy, the Catalyst Initiative, grounded in partnerships and collaboration with campus teaching practitioners—learning, technology, and teaching research centers, libraries, and departments. Just 18 months old, the Catalyst Web site is widely used by UW faculty. On an average day, approximately 600 instructors use the original content on Catalyst to help them integrate technology with their teaching. Over 1400 instructors have created 3620 implementations of Catalyst Web tools; and this fall, more than 12,000 students have used Catalyst Web tools as a part of some learning activity. Clearly, the Catalyst Initiative has helped reach *wary adopters*.

Scaling Innovation through the Catalyst Initiative

The concept was simple: provide examples, promote good teaching practices, build technology skills, and make technology easy for instructors to use. These are the tenets of the three-tiered Catalyst Initiative, a support framework that provides anytime-anywhere resources via the Catalyst Web site.[4] Catalyst places good teaching and student learning at the forefront, treating technology as a means to these ends. The resources on the Catalyst Web site shape and inform the other two tiers of the Catalyst Initiative: redesigned workshops and one-on-one consulting delivered through the CTLT. This interlocking support strategy ensures that campus educators receive clear, consistent help for integrating technology into their teaching.

A great deal has been written about the creation of the Catalyst Web site,[5] but it is worth reemphasizing here that its homegrown content is built solely through collaborative partnerships with campus teaching practitioners—learning, technology, and teaching research centers, libraries, departments, and faculty. A look at the six major content categories on Catalyst makes clear the close connections to campus practitioners:

- *Profiles* tell the stories of educators who are using technology in teaching—the challenges they face, the pitfalls they encounter, and the successes they achieve. This section allows faculty who use technology to share what they are learning and doing with their colleagues from across campus, breaking through traditional disciplinary boundaries.

- *Teaching* lets instructors explore the ways that technology can help achieve specific teaching and learning goals. These pages were created input from teaching research centers and point faculty to these centers.

- *Action Plans* are "road maps" for particular tasks, such as creating a class web site or setting up electronic discussion. Many of these draw on existing campus computing resources or rely on information gathered from technology centers.

- *How-to* pages take users step-by-step through specific tasks needed to make technology work. The range of applications covered here mirrors the range of applications available in the many different computing environments throughout UW. Indeed, numerous *How-to* documents were created in collaboration with department of unit support staff.

- *Learning* offers information on CTLT workshops and other campus activities related to teaching with technology.

- *Web Tools* is a gateway to Web-based software and also links to innovative uses of Catalyst Web tools by UW educators, again helping to spread good practice beyond disciplinary boundaries.

These resources easily meet the three requirements for supporting *wary adopters*. First, the varied stories of teaching with technology, the step-by-step instructions, and the best practices make an educator's initial foray into educational technology smooth and easy. Second, Catalyst is extremely flexible; faculty needs and wants vary markedly across departments, disciplines, and course types, but Catalyst allows them to pick and choose support options that suite their environment and needs. Finally, Catalyst is a campus-wide resource, available 24-7, which scales local solutions throughout the campus teaching community.

Excellent support resources and exciting teaching practices using technology are found all across campus. Very few people, however, have knowledge of resources and practices beyond their own departments. The Catalyst Initiative was created exactly to make these resources and practices visible, scaling innovation across campus through collaborative partnerships. Not only does this strategy leverage resources, but it also forges both a sense of ownership and a measure of comfort with educational technology among faculty and support staff who come to see themselves in the offerings on Catalyst.

Co-Branding Innovation through Catalyst

Last February, the Catalyst Initiative celebrated its first anniversary, having survived initial growing pains to produce some very formidable gains in campus technology support.[6] Ed-Technology Development staff was now ready to make use of use the results-oriented, multi-unit collaborative ethos critical to the formation of Catalyst to help grow the initiative. Co-branding efforts focused on formalizing existing but piecemeal partnerships with campus teaching practitioners—learning, technology, and teaching research centers, libraries, departments, and faculty—to generate new ideas, content, and tools for the Catalyst Web site. Resources and materials generated from these partnerships are placed on Catalyst and co-branded, giving credit to the partners who helped create them.

Co-branding allows staff to maintain current and innovative resources on Catalyst, while alleviating the burden of generating new materials whole cloth. Among the most notable results of these co-branding partnerships are:

- *MyClass:* C&C has recently created *MyUW*, a personalized Web portal for UW students and is working on portals to meet the needs of each segment of the UW community. C&C is currently working with the Ed-Tech Development Group to create *MyClass*, the personalized teaching portal for UW instructors. This portal will integrate Catalyst Tools with course and student information systems, online grading capabilities, and applications that let instructors post content directly to the Web. In part, *MyClass* is designed to reach *wary adopters*, bringing useful Web-based course administration tools together with a simple interface for creating online course materials.

- *CONTENT*: With its Digital Initiatives Program, UW Libraries is building an online multimedia collection that showcases print, photograph and textual materials through the *CONTENT* digital asset management system developed at UW's Center for Information Systems Optimization (CISO). Librarians, working with scholars who wish to digitize their own materials, design the individual *CONTENT* databases within the Digital Initiatives collection. The CTLT now houses two *CONTENT* digitization and acquisition stations, and the Ed-Tech Development Group is working with CISO staff to create instructions and support materials which, once housed on Catalyst, will permit faculty to create *CONTENT* databases themselves.

- *Task Consultant*: This Catalyst Web Tool, currently being co-developed with the School of Library and Information Science (SLIS), meets a need frequently voiced by faculty—how to guide students in the formation of research papers and projects. Building on a core strength of the SLIS program, models for information problem solving, the interactive *Task Consultant* will help students sharpen research topics, structure arguments, determine appropriate levels bibliographic information, and create a project timelines.

- *Turning Your Course into an Online Course*: This new workshop series, co-developed with Educational Outreach, aims to help faculty create courses that have distance-learning or online components. After the first series of workshop materials, Ed-Tech Development staff will transform workshop materials into new Catalyst content, making these resources available to all instructors.

Not only do these partnerships lead to new Catalyst resources and Web Tools, but they also scale resources that might otherwise remain underutilized, like *CONTENT*, or spark exciting new campus-wide developments in educational technology such as *MyClass*.

Partnering to Push the Limits with Internet 2

The Ed-Tech Development Group's understanding of faculty technology needs and its position as an intermediary among a network of partners also allow it to provide technical and pedagogical support for innovative projects that create a new generation of technologies to be used by *wary adopters* for teaching. In September of 2000, the group began facilitating a variety of distance learning projects that utilize Internet 2 broadband connectivity. These partnerships were arranged by the office of the Provost and included key players from Computing and Communications, the organization that creates and maintains the campus technology infrastructure, UWTV, the campus television station, and representatives from various academic departments.

The first of these projects is the creation of a $5 million distance-learning classroom for case-based, synchronous learning, currently under development by the UW School of Public Affairs. The classroom will use video, sound, document cameras, and simulations to connect students to expert speakers from all over the country while facilitating the group interactions of case-based learning. In the initial needs assessment phase, staff determined that the project leaders in Public Affairs had a mastery of both the subject matter and teaching methods but required additional support in design, planning, and assessment of the needed technologies. After an initial meeting, Ed-Tech staff has played a key role in documenting the process of building the classroom and facilitating a series of pedagogical experiments that will help solidify the curriculum design. Ed-Tech staff has also continued its traditional intermediary role by inviting participation from other partners. To provide research about distance learning and develop an assessment strategy, the Program for Educational Transformation Through Technology (PETTT) and the Office of Education Assessment have now joined the effort.

Ultimately, the campus teaching and learning community will benefit from these projects. Initial lessons from the Public Affairs experience are already being carried by Ed-Tech staff to a new synchronous, distance-learning project where students in Seattle will learn the Hawaiian language from instructors and native-speakers based in Hawaii. Once distilled, all of the lessons from these pilot projects will be disseminated as teaching guides and how-to resources via Catalyst, helping *wary adopters* move from asynchronous to synchronous uses of technology for teaching. These partnerships will allow us to share experiences and findings with other institutions connected to the Internet 2 network, and will help us create recommendations for equipment and standards while reporting on best practices.

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[1] For a detailed explanation of this period see: Mark Donovan & Scott Macklin, 1998. *One Size Doesn't Fit All: Designing Scaleable, Client-Centered Support for Technology in Teaching.* Paper presented at Cause98: The Networked Academy in Seattle. http://www.educause.edu/ir/library/html/cnc9846/cnc9846.html

[2] Indeed, this partnership has been so successful that it received the 2000 EDUCAUSE Award for Systemic Progress in Teaching and Learning.

[3] Paul Hagner, 2000. *Interesting Practices and Best Systems in Faculty Engagement and Support.* http://www.educause.edu/nlii/meetings/nliifs03/bestpract.pdf

[4] http://www.catalyst.washington.edu

[5] Mark Donovan & Scott Macklin, 1999. *The Catalyst Project: Supporting Faculty Uses of the Web with the Web.* Cause/Effect 22(#3). http://www.educause.edu/ir/library/html/cem9934.html
Mark Donovan, 1999. *Rethinking Faculty Support.* Technology Source (September/October). http://horizon.unc.edu/TS/development/1999-09.asp

[6] The first-year results of the Catalyst Initiative are detailed in the Catalyst Report 2000: http://depts.washington.edu/catalyst/2000_report.pdf

An E-Learning Essential IT Skills Course

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Can technology be effectively used in the classroom to deliver consistently high quality training while reducing the costs of faculty and administration? The College of Business at Colorado State University has designed and implemented an on-screen e-learning and assessment Essential IT Skills classroom model that achieves the goal of consistent delivery with reduced costs. The course utilizes existing industry e-learning and assessment software as the primary delivery vehicle, and employs CIS students as the classroom learning mentors. This course covers the topics of: Basic IT Concepts, Operating Environments, the Internet and Search Engines, Wordprocessing, Spreadsheets, and Presentation Graphics.

Generating Personalized Documents Using a Presentation Planner

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The ActiveMath Learning Environment in a Nutshell

ActiveMath (Melis et al., 2001) is a web-based learning environment that dynamically generates interactive mathematical courses adapted to the learners' goals, preferences, capabilities and knowledge. ActiveMath is realized as a client-server web-architecture that can be accessed using standard web-browsers. When learners use the system for the first time, they have to complete a registration form in which they indicate their preferences and abilities and may estimate their mastery levels of the course's domain knowledge. From this information, an inspectable *user model* is generated which is constantly updated when the learner acts in the course. The learner can choose between predefined courses (defined by a teacher) or let the system generate a new course according to the *goal concepts* (mathematical definitions and assertions) and the *scenario* the learner chooses. One possible scenario is *exam preparation* in which only the mathematical definitions of concepts and corresponding exercises are provided. Another scenario is the *guided tour* in which complementary information such as motivating texts, examples and elaborations etc. is selected.

ActiveMath integrates mathematical service systems. Currently, these are Computer Algebra Systems (CAS) and the proof planner of ΩMEGA (Melis & Siekmann, 1999). They can be called to demonstrate an example, to interactively solve an exercise, and to take over certain routine tasks.

The learning material is encoded in the XML-based knowledge representation language `OMDoc` (Kohlhase, 2001). `OMDoc` encodes mathematical objects and items such as definitions, theorems, proof methods, proofs, examples, exercises, and remarks. Each item has its own meta-data that can contain additional information such as dependencies or pedagogical data, e.g., difficulty level or abstractness level of an exercise.

A demo of the ActiveMath system is available at `http://www.mathweb.org/activemath/demo`.

The Presentation Planner

The central component of ActiveMath is the presentation planner. It is responsible for generating a personalized course in a three-stage process:

(1) Retrieval of content. Starting from the goal concepts chosen by the user, all concepts they depend upon and corresponding additional items (e.g., elaborations, examples for a concept) are collected recursively from the knowledge base. This process uses the dependency metadata information contained in the `OMDoc` representation. The result of this retrieval is a collection of all concepts and information that the user needs to learn in order to understand the goal concepts.

(2) Applying pedagogical knowledge. Then, the collection of content items is processed according to the information in the user model and in the pedagogical module. This results in a personalized instructional graph of the learning material. This process is detailed below.

(3) Linearization. Then, the instructional graph is linearized.

The result of the presentation planning is a linearized instructional graph whose nodes are `OMDoc` items. This collection is eventually transformed by XSL-transformations into HTML pages.

Applying Pedagogical Knowledge

The goal of the application of pedagogical knowledge is to select from and transform the collection of items that was gathered in the first stage of presentation planning into learning material. ACTIVEMATH employs pedagogical information represented in pedagogical rules. It evaluates the rules with the expert system shell JESS (Friedman-Hill, 2000). The rules consist of a *condition* and an *action* part. The condition part of a rule specifies the conditions that have to be fulfilled for the rule to be applied, the action part specifies the actions to be taken when the rule is applied.

The presentation planner employs the pedagogical rules to decide: (1) which information should be presented on a page; (2) in which order this information should appear on a single page; (3) how many exercises and examples should be presented and how difficult they should be; (4) whether or not to include exercises and examples that make use of a particular service system. Since the work with service systems requires a certain minimal familiarity with the systems, ACTIVEMATH presents those exercises only if the capability is confirmed. Moreover, pedagogical rules may restrict the available functionalities of a service system. For instance, a student learning about integration and derivation should not use a CAS to solve his exercises completely, whereas using the CAS as a calculator for auxiliary calculation is acceptable.

The application of pedagogical rules works as follows. First, information about the learner retrieved from the user model (e. g. what kind of service system the learner can use) is entered as facts into JESS' knowledge base together with the OMDoc items (annotated with the learner's mastery level) collected in the first stage of presentation planning, her goals, and the chosen scenario. Then the rules are evaluated. This results in adding new facts in the knowledge base and eventually generating the sorted lists of items the pages of the course will consist of. In the following, we provide examples of pedagogical rules for two different types of decisions. The rule

```
(defrule PatternForExamPrep
   (scenario ExamPrep) => (assert (definitions assertions methods exercises)))
```

determines the kind of items and in which order they will appear on the course pages, here for the case that the learner has selected to prepare for an exam (indicated by the fact `(scenario ExamPrep)`). When this rule fires, then the facts `(definition ... exercise)` are asserted, i.e., added to JESS' knowledge base. This implies that these items will appear on a page in the specified order.

In turn, these facts will make other rules fire, e.g., those choosing exercises with an appropriate difficulty level:

```
(defrule RequireAppropriateExercise
   (exercise)
   (definition (name ?definition) (userKnowledge ?user-knowledge))
   (test (< ?user-knowledge 0.3))
   =>(assert  (choose-exercise-for  ?definition (0.3 0.5 0.7))))
```

This rules determines that if exercises should be presented at all (indicated by `(exercises)`) and if there exists a definition d in the knowledge base of JESS, then d's name is bound to the variable `?definition` and the learner's knowledge of d is bound to `?user-knowledge`. JESS allows to specify Boolean functions (indicated by `test`) that are evaluated and whose value determines whether a rule fires or not. The above rule fires when the learner's knowledge is less than 0.3. Then the fact `(choose-exercise-for ?definition (0.3 0.5 0.7))` is inserted into JESS' knowledge base and this triggers the selection of examples for d with difficulty levels 0.3, 0.5, and 0.7 in a row.

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Trends in Computer Education and Training

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Abstract: Technology is changing every aspect of our lives. We now access information instantly on multimedia CD-ROMs and via the Internet that less than five year ago would have taken hours of research. We use computers for communication, analysis, learning and entertainment. Our children and students are growing up in a world where they will live a computer dependent lifestyle. Technology itself is changing at a tremendous rate, and one industry that has to keep up with this pace is IT training industry. The Computer Education and Training are one of the main national objectives, keeping in view the rising need for quality computer professionals. A nation must develop new ways to educate this ever-changing work force by developing the best technologies to meet the unique needs of educators, students, professionals and support academic achievement. A strong partnership between educators and technology innovators is essential to achieve this. The age of information introduces new demands and requires reorganization. To reorganize the working methodology is to reorganize the process of learning.

Education Components:

Computer education is very imperative today because of the advances in technology and the sophistication and complexity of our society. No one can survive if they lack the skill of knowledge to deal with today's problems. Only a dynamic and progressive education system will produce a competent informed citizen, who is capable of realizing his/her full potential in the new world that awaits.
The three broad technology trends are:

- Networking
- Application development
- Internet / Web technologies.

A gamut of comprehensive computer courses to provide training in these trends related to Software, Hardware and Networking are available throughout the country. The outcome of any IT training Institute is to churn out good quality professionals who are ready to deal with the latest technologies of the world. In Universities and Educational Institutions, providing the technology infrastructure, increasing the access to technology, and integrating the technology into the classrooms can produce skilled professionals who can substitute the demand for human resource in IT.

Communication is the essence of all our interactions. Due to the enormous development in technology, computer has become an essential tool for communications. Communication is multidimensional and it has become richer today due to the addition of video, sound and animation. Multimedia communication which started as an authoring and presentation system allowed people to create and deliver matter, which created a good experience by the end user.

Multimedia

Multimedia technologies empower professors to create interactive and exploratory classroom experiences. The integration of text, voice, photography and animation offers a revolution in the art of instruction and the joy of learning. Audio, Video technologies enable the students and teachers to use the learning technologies of today (Speech, Video conferencing etc.) from the convenience of single location on their desktop. Electronic courseware has also become a reality, including CD-ROM textbooks and customized electronic textbooks developed by professors in on-campus labs. Internet and Intranet technologies enable students, teachers and educators to communicate, collaborate and create media rich content using digital media in new and powerful ways. Internet also provides access to incredibly vast information resource and offers a course of communication opportunities including the ability to publish work and participate in worldwide collaborative projects. Publishing on Internet or setting up a local Intranet at campus wide level is easy and affordable.

Distributed Learning

Distributed learning environment is an extension of a classroom where people with common learning interest engage in conversations, sharing of information and work together anywhere and anytime. Mobile computing technology can motivate learners to explore, create and communicate out in the field as well as inside the classroom. This model supports lifelong learning and requirement of knowledge workers in global economy that places a premium on information access.

Internet

The Internet offers all of us possibilities to expand our horizons, pursue our dreams and create a truly interactive community of learners in e-classrooms. The objective of the e-class room is to eliminate the barriers of time and distance. Students are able to hold on-line threaded discussion with their team members in addition to having access to their class files 24 hours a day.

E-learning

E-learning centers that provide interactive web-based training are coming up fast that offers training for technical certifications, web development and other professional courses. Virtual universities are set up that connect student's world wide to the training they need and provides search for authorized training resources.

Training:

Every walk of our life is marked by penetration of the computers and its applications. This has lead to the increased demand for training in computers for all. The industries are also facing these challenges everyday. Even small and medium industries need to be modernized with the latest computers and their applications for speedy operations and customer satisfaction. So there is the necessity to train the employees of the industries too. The banking sector is also revamping their system to provide easier and faster transactions with computers. Efforts are taken to replace staff with young computer trained employees.

Institutions

These days there is a mushrooming of software training institutions in India. These institutions offer regular training on software and also certified training programs that provide self study training and certification the industry needs - whether that is with Microsoft, Novell, Sun, Cisco or other certifying. These centers need to be committed to always be on the leading edge of new computer environment training products.

If computer training Institutions have to do well they need to concentrate on the following issues:

- Provide quality product to the customers at a price that is within reach of most computer professionals.
- Committed to always be on the leading edge of new computer environment training technology and products.
- Strive to provide training programs & tutorials that far exceed the expectations of our customers with 100% customers' satisfaction
- Mission to include practical applications of real world and give up-to-date training.
- Provide training that extends opportunities to students by offering certificate programs, comprehensive enough to enable graduates to qualify for careers in their field of study.

These are the key elements in educating and improving the lives of our society and in specific the student community today. Continued success rests with our commitment to offering individual attention, intensive hands on training and intensive career support services.

Conclusion

What we aspire today is a global community of learners who view technology as the means through which we transcend any barrier - including geographical, temporal and physical limitations, to acquire, enjoy and provide unlimited education opportunities and information access. Several technologies and products are available that has enhanced today's learning opportunities.

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TEOREMA (TEaching Online pRoject for Economic Mathematics)

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Abstract: We present a project for an introductory course in Mathematics (the so called pre-course).The pre-course is designed for first year students of economic faculties, in order to provide them of the necessary basic mathematical tools, preliminary to take Calculus I. Even more important is the use of the pre-course for last year high school students willing to apply to economic faculties, so they could "anticipate" conveniently their mathematical background. The innovation of the project is the framework in which the project originates: this is the first step toward a homogeneous formative offer in the field of economics in North Italy and tries to establish a link between high school and University.

The project TEOREMA

The Italian university system is undergoing a radical change with the introduction of credits, as it has been done in the majority of the other European countries. The credits evaluate, based on time-units, the work really done by the student towards the exam preparation and thus, in their assessment, one has also to give due importance to the "homework" study as well as to other learning activities completed outside the classroom.
In this context, we have developed TEOREMA for an on-line Mathematics preparatory course: it is an innovative tool not so much for its technological aspects but rather because it is the first Italian project of university teaching which will be applied by the major universities of Lombardia, a northern Italian region.
This project is mainly aimed at freshmen (or students who wish to enroll for the first time) in our Economics Faculties. Its main objective is to give the basic skills and preliminary knowledge necessary to benefit from the attendance of the regular course of Calculus I. The admission to the Calculus I Course will be subject to an evaluation test to be taken at the end of the preparatory course.
It should be noticed that almost all the universities adhering to the project offer similar preparatory courses, but very often a problem with the timing arises. These prep-courses are generally given very early in the calendar, long before the beginning of the regular academic year; therefore, many students either may not have finished their enrolment phase or they may not attend classes on a regular basis. The access to the preparatory on-line course directly from one's home may remove these discrepancies.
The extension of the on-line preparatory course to the last year Secondary School (Senior High School) students could bring even more remarkable results. In this way, the Secondary School students could verify, and if

necessary, complete or supplement their mathematics knowledge in the perspective of a future enrolment in an Economic Faculty, thus anticipating the mathematical requirements needed to successfully profit from the Calculus I Course.

The contents of the traditional mathematics preparatory course are standardised. This peculiarity has contributed to make the same preparatory course a well-gauged tool to be applied to many Faculties.

The basic topics of the preparatory course – whose knowledge should be considered as a necessary pre-requisite for all students who want to enroll in an Economics Faculty – are derived both from the contents of the current preparatory course offered by the Faculties participating in the project as well as from the Mathematics Syllabus published by UMI (Association of Italian Mathematicians). The contents include: *Mathematical logic,* Set theory, Arithmetic, Elementary Algebra, Analytical Geometry, *Trigonometry,* Functions (*).

Some of the partecipants do not share the subjects in italics. The asterisk indicates a subject that is covered in Calculus I Courses. Therefore, it is not a real pre-requisite.

TEOREMA is based on the co-operation among the Departments of the following northern Italian economic faculties and CILEA:

University of Bergamo http://www.unibg.it (E. Allevi)
Bocconi - Milano http://www.uni-bocconi.it (M. Cigola)
University of Milano- Bicocca http://www.unimib.it (S. Stefani, R.Pini, G. Carcano)
Catholic University of Sacred Heart of Milano - http://www.unicatt.it (M. Bianchi, F. Vassallo)
State University of Brescia http://www.unibs.it (A. Torriero)
University of Pavia http://www.unipv.it (G. Giorgi, E. Caprari)
LIUC, Castellanza http://www.liuc.it (C. Rossignoli, A. Lissoni)
University of Insubria http://www.uninsubria.it (A. Guerraggio)

CILEA (Consorzio Interuniversitario Lombardo per l'Elaborazione Automatica, http://www.cilea.it), a neutral institution which provides computer services to the Lombard universities, will supply general coordination services, site administration and all the technical skills required to develop, set up and put online the final course prototype. CILEA is connected to GARR backbone with a 6 Mb/s direct connection. TEOREMA works on a NT4.0 platform, Pentium III 500 Mhz 512 Mb RAM dedicated server. This machine is connected to a switched LAN at 100 Mb/s speed.

Student profiles and course structure

This course is addressed to two different kinds of students: the High School's last year students who are interested, and perhaps wish to enroll, to an Economic Faculty and the Freshmen, students of the first year of one the Economic Faculties involved in this project. Therefore, from the very beginning, the entire project contents are conceptually divided into two parts: a common, public (or semi-public) one for the first kind of students and a more specific one, tailored upon the needs of the specific Economic Faculty and restricted to its students.

This double target reflects on all the aspects of our course. Regarding the way to connect to it, we suppose users will access its public part mostly via domestic dialup connections, whereas for the ones already enrolled to university courses, from dedicated PCs in some computer rooms, getting of course a better quality of service.

The course is conceived according to the following modules: *Self-learning, Self-evaluation, Tutoring.*

Self-learning: it will exploit to the utmost the characteristics of the tool. In particular it will be based on a standard hypertext, animations and algorithms. Periodical live sessions will be performed by an audio or video conference (once a week or twice a month).

Self-evaluation: to give a student a way to measure his/her progress, the course will propose self evaluation tests for each topic, to be completed in a given time. The more common technique used will be a multiple choice quiz, randomly chosen in appropriate database. At request, a complete explained solution of the test will be given. The student's course history is tracked down in a central server database.

Tutoring: this service is offered solely to the students who have access to the customised Web sites of each university. This will be done at least via syncronous moderated chat-room with the teacher as a moderator. Asyncronous tutoring will be offered via standard e-mail, for longer and maybe more complex questions and answers. A forum will allow students to ask questions on the course topics and to find or give answers to the questions raised by other students. A many times answered question goes immediately into a FAQ list, maintained by the forum administrators and available at once to every forum member. Finally, a mailing list is a simple way for the teachers or course authors or administrators to get in touch with all the students via a single message. Free and partially checked chat is always available to students to openly discuss at any time and on any subject either related or not related to the course.

Software packages

After a thorough review of standard available software, we have turned to Learning Space V4 (by Lotus) for the framework, the course structure and the tracking system (Windows SQL Server 7.0 data base). For the authoring part we have chosen Toolbook Instructor (by Click2Learn) for text and HTML as a text editor. Both packages are able to communicate via AICC public CMI Standards.

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MathCAL and Its Database Design

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Abstract: MathCAL is a tutoring system designed for learners to practice mathematical problem solving. It is capable of offering guidance and proposing remedial tutorials automatically. MathCAL uses Petri-nets as its knowledge representation model. The static domain knowledge as well as a learner's dynamic problem-solving steps in each interactive session is represented as Petri-nets, which may be used effectively for diagnosing a learner's problem-solving difficulties. The database maintained by MathCAL is consulted to decide on a suitable guidance for the learner. Math problems, solution paths and learners are three major entity sets modeled by the database. This paper describes the implementation details of MathCAL's database and its distinctive features.

Introduction

MathCAL has been designed for learners to practice mathematical problem solving. In our previous papers (Lin et al. 1999, Lin et al. 2000a, Lin et al. 2000b) we have described the functions provided by MathCAL, its design considerations, system architecture, knowledge representation scheme, and its diagnostic mechanism. In this paper we focus mainly on MathCAL's database design.

To use MathCAL, a user first logs onto the system with a Java-enabled WWW browser. MathCAL may be operated in two different modes: *the practicing mode* or *the editing mode*. The practicing mode is for students to practice problem solving, and the editing mode is for teachers to insert or edit a problem set and input expert knowledge pertaining to solving the problem.

In the practicing mode, the student begins an interactive session with MathCAL by selecting a problem from the system's test bank. S/he should first analyze the problem statement to identify the given conditions embedded in the statement, and then enter those conditions to the system by selecting appropriate objects from the *input condition* menu. An insert window associated with each *input condition* object will pop up for the student to assign values to related attributes of the object. For example, a student may select the *circle* object and fill in the coordinates of the center of the circle, the measure of its radius, etc., or s/he may select the *line segment* object and assign A and C as the names of the two end points and 12.5 as its length. With the initially given conditions properly entered, the student may then proceed with the problem-solving procedure step by step.

As in ordinary mathematical problem solving, a student needs to search his/her knowledge base for some mathematical concept and rule that can be applied to the currently known conditions and use it to transform the problem from the current state to a state closer to the desired solution state. In MathCAL we have identified the concepts and rules related to a certain topic and collected them into a set of *transitions*, and these transitions are organized as a pull-down menu for easy selection by the user. Each transition has its corresponding *input* and *output arguments*. The input arguments are the necessary conditions for firing a transition and the output arguments are the results to be generated by the transition when it is fired.

The user provides the input arguments by ticking the appropriate items from the set of current known conditions shown on the screen. The system will reject a user's request for firing a transition if the input arguments ticked by the user are incorrect. This ensures that the users know what a concept or a rule, as embodied in a transition, is really about and discourages them from trying blindly. Firing a transition results in addition of new facts, as represented by the output arguments, to the set of known conditions. This *select-and-fire* step repeats until the desired result is derived. A user's thought process is truthfully reflected in this sequence of select-and-fire steps, as such it is considered the most useful data on which the system may base its analysis about a user's comprehension level and problem-solving difficulties. MathCAL records this sequence by constructing and storing a corresponding Petri-net dynamically. In MathCAL's database, we also store all possible solution paths about each problem. Therefore, when the user requests system's help in the middle of solving a problem, MathCAL is capable of providing expert guidance by matching the learner's partial solution path with all possible solution paths about that particular problem. A closest match is identified and used to guide the user through.

The editing mode is provided for teachers to insert new problems into MathCAL's test bank. Besides typing in the problem statement, the user may choose to illustrate the statement with a graph by importing a separate file containing the graph. The teacher then informs the system of one or more solutions about the problem by activating the practicing mode and solving the problem using each different method. The problem-solving procedures demonstrated by the teacher will then be automatically recorded by the system and stored as the correct solution paths. While the teacher is demonstrating a problem-solving procedure, the editor also allows the teacher to enter guiding message associated with each step. These guiding messages will be used in providing feedback to users when they ask for help with a particular problem. It is possible that a teacher may enter a new problem which requires the use of some transitions that are not already included in our set of transitions. Under such circumstances, the system kernel need be modified to incorporate the new transitions.

To capitalize on the communication capabilities made possible by the Internet, MathCAL also implements both the chat function for synchronous communication among on-line users and the e-mail function for asynchronous communication. That is, a user may ask for human help instead of requesting system guidance. Petri-net representation also plays an important role in this respect because it allows efficient transmission of a user's current problem-solving status to the helper side. With the Petri-net representation of a user's problem-solving procedure, MathCAL is able to transmit the Petri-net and use it to re-produce user's screen mage at the helper side. This considerably reduces the amount of data transmitted.

MathCAL's functions as described above are realized with the help of a well-designed database module. In the following section we present the schema of our database and elaborate on how we model such important *entity sets* as math problems, problem solutions, problem-solving procedures, and the learners. Specifically, we present the *entity-relationship diagrams* (Date 1995) to show the details of our database design. We then summarize MathCAL's distinctive features, which is followed by our concluding remarks.

MathCAL's Database Design

Modeling Mathematical Problems

A typical mathematical problem consists of the problem statement and possibly a geometric graph which illustrates the problem. In addition to this basic information, MathCAL also stores the following attributes about a problem: (a) *ID*: a unique ID to identify a problem in the database, (b) *Difficulty level*: an integer (1 to 5) to indicate how difficult a problem is, and (c) *Attribute*: remarks about a problem. (Fig. 1) shows the entity set of the math problems.

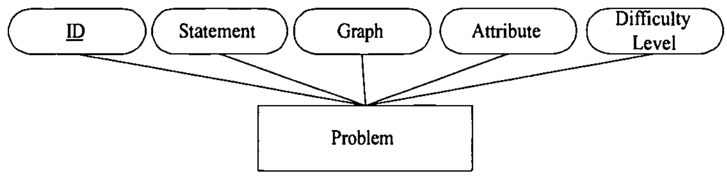

Figure 1: The entity set of math problems

Modeling Problem Solutions

As mentioned previously, MathCAL uses Petri-nets as its knowledge representation scheme. Both the static domain knowledge and the dynamic problem-solving procedures are represented as Petri-nets. There are three essential symbols in a Petri-net graph, which are *transitions*, *tokens* and *places* (Peterson 1981). Each *transition* represents a mathematical concept or rule, e.g., the 180 rule, the Pythagorean theorem, etc. *Places* represent facts, which are input conditions for a transition. The outputs resulted from execution of a transition are also places. For example, a problem statement may contain a number of given facts, including, say *"a tangent touched a circle at point C"* and *"the diameter of the circle is AB with a measure of 26."* These facts will be modeled as places by MathCAL. A transition may be fired only when its input places are all *enabled*. Tokens are usually used to indicate whether a place is *enabled*. However, tokens need not be modeled explicitly in MathCAL's implementation because all places as considered *enabled*. That is, if there exists an arc from a place to a transition and the transition accepts the place as its input conditions, then the place is automatically treated as *enabled*. In the following we focus on how we model *places*, *transitions* and *arcs* in our database.

The Entity Set of Places

There are three attributes associated with each *Place* entity: *Place_ID*: a unique ID to identify a place, *Statement*: the meaning of this place, e.g., "the diameter of a circle," and *Value*: the value of this place if any, e.g., 26 (the measure of the diameter). (Fig. 2) shows the entity set of the math problems. The underlined attribute represents the key.

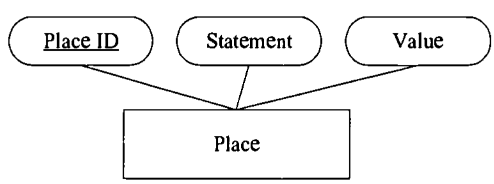

Figure 2: The entity set of places

The Entity Set of Transitions

We model the transition entity with two attributes: *Transition ID*: a unique ID to identify a transition, and *Description*: A description for this Transition. The diagram for this entity set is similar to the previous two figures and is skipped to conserve space.

The Entity Set of Solution Paths

The entity-relationship diagram of (Fig. 3) illustrates how we model the data involved in a mathematical problem-solving process using the place entities and the transition entities defined above. As shown in (Fig. 3), each *solution* entity has a unique ID for identification. Since each solution path typically consists of a number of problem-solving steps, there is another entity set called *solving-step* which has a *many-to-one* relationship with *solution*. It also has a *many-to-one* relationship with the *transition* entity set, indicating that each *solving-step* is mapped to one *transition* and that every *transition* entity may map to one or more *solving-steps*. In terms of object-oriented design (Booch 1994), the *transition* entity set corresponds to a class, whereas a solving step is one of its instances. Relationships *Input* and *Output* mean that every solving step may have one or more *place* entities as its input and also one or more *place* entities as its output. A *place* is an instance of the *place-type* class, as indicated by the *is-a* relationship between them.

There also needs to be special mechanism for determining if a rule may be fired at a certain step. For example, transition *T1* can be fired only if places *P1* and *P2* are present. We thus create a *satisfy* relationship between *transition* and *place type* to record this type of information. It is a *many-to-many* relationship, meaning that each *transition* requires the presence of one or more *places* in order to be fired, whereas a *place* may be used for firing several different transitions.

T1	Given the three sides of an isosceles triangle, find the top vertex of the triangle.

P1'	Three line segments
P2	The top vertex of an isosceles triangle

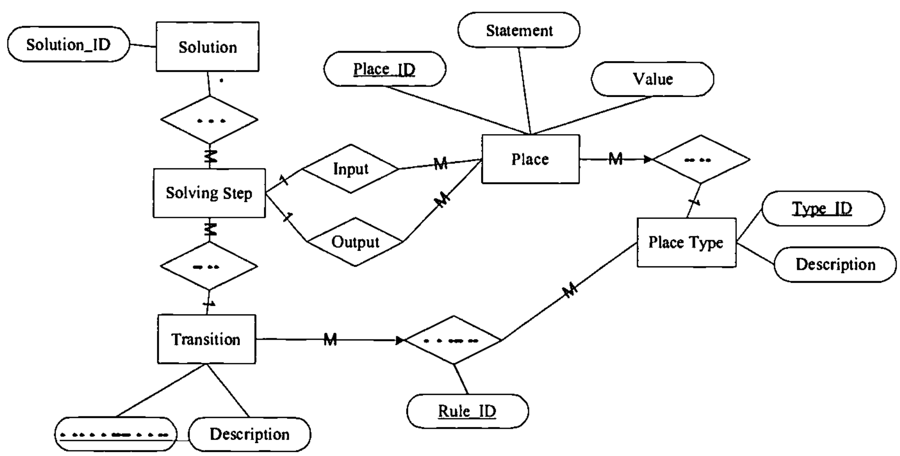

Figure 3: Mathematical problem solving modeled as an entity-relationship diagram

Modeling Learners

In order to identify each learner and also to maintain information about his/her learning history, MathCAL requires a login process and keeps a record for each leaner. The record includes (a) *Full name*: a user's full name, (b) *Username* (c) *Password*, (d) *Attributes*: additional information about the user, and (e) *E-mail*. Such data is used by MathCAL in such situations as:

(1) when MathCAL is requested to suggest tutorial and/or exercise problems appropriate to a learner's comprehension level;
(2) when MathCAL attempts to guide a learner by reminding him of some previous experiences that the learner has which are related to his current problem-solving activities; and
(3) when a learner requests help from other users by activating system-supported synchronous or asynchronous communication functions.

The Database as a Whole

The three entity sets described above may now be put together to construct MathCAL's database module. Two more relationships, *provide* and *has*, has been added to indicate that a problem may have more than one solution paths associated with it, and that a learner may provide new solution path for a given problem. The entity-relationship diagram of (Fig. 4) shows the complete model of

MathCAL's database system.

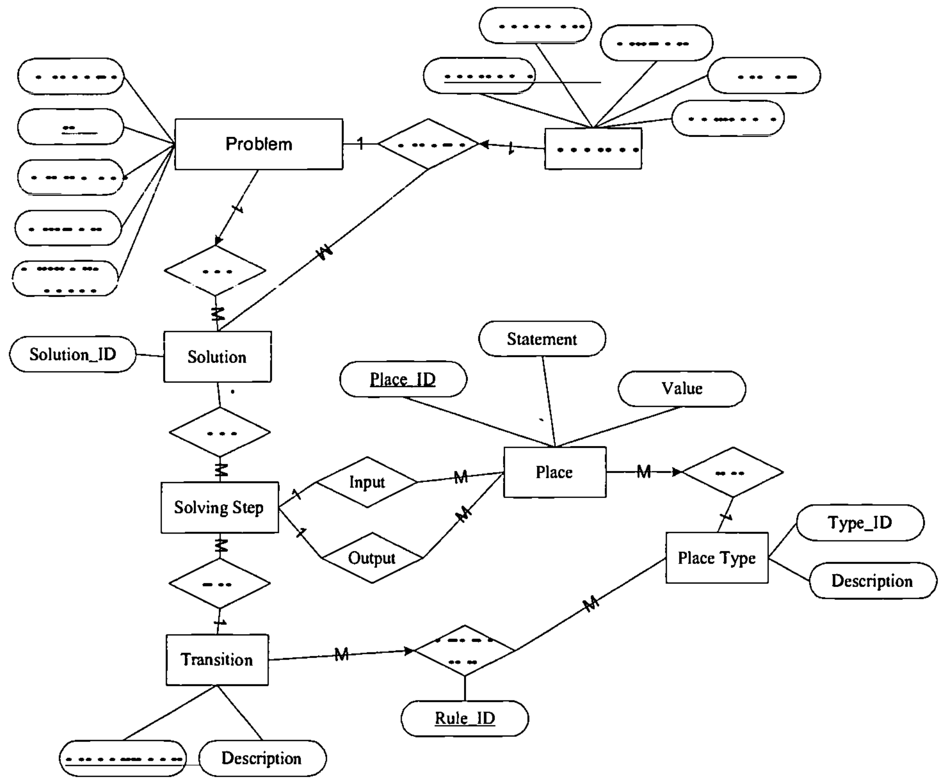

Figure 4: MathCAL's data model

MathCAL's Distinctive Features

MathCAL, as it is currently implemented, exhibits the following distinctive features:

(1) MathCAL's step-by-step recording of a user's problem-solving procedure reflects the user's thought process. With the availability of this handy information, the system need not employ complex mechanisms to *guess* where the user has got stuck when he requests system's help.

(2) MathCAL's student module maintains a separate record for each user. In addition to such static data as user names, the passwords, e-mail addresses, etc., it stores a user's profile as well as his learning history, including which problems the user has solved before, which transition rules he has used before, the user's comprehension level as determined by the system based on his past performance, etc. Such information is useful for MathCAL to make correct diagnoses and prescribe suitable corrective measures.

(3) MathCAL has been designed in such a way that it is capable of updating the solution procedures about a problem. That is, if a user solves a problem successfully but the solving procedure is unknown to the system, MathCAL will add the new solution path to its database dynamically. Furthermore, as mentioned before, MathCAL allows users to add new problems to its test bank. The solution path(s) of each new problem need be provided to the system at the same time.

(4) With MathCAL as a learning aid, users can concentrate on the application of concepts and rules during problem solving without being distracted by tedious computation. This also makes it possible for MathCAL to be used as an effective teaching aid in the classroom to demonstrate problem-solving procedures to the students.

(5) Whenever MathCAL establishes a communication channel between a helper and a learner, it allows them to *look at* the work of each other. Namely, their screen displays are synchronized.

Such synchronization allows the helper to see the steps performed by the learner up to that point. The helper can also demonstrate to the learner how to solve the problem from that step on. Similarly, when a learner sends an e-mail message to another user asking for help with the problem, MathCAL transcribes the learner's problem-solving process from the Petri-net representation into text form and attaches it to the e-mail message automatically. This relieves the learner of the burden of lengthy explanation in describing his problem-solving difficulties.

(6) MathCAL provides a number of auxiliary tools to enhance its user-friendliness. For examples, there is a *notepad* function for users to makc remarks about a particular problem, which may later provide useful hints to the user when he tries to solve a similar problem. In addition, as a visualization aid to users, MathCAL also implements a Petri-net graph generator which can dynamically generate a Petri-net graph corresponding to a user's problem-solving process.

(7) The current version of MathCAL has been designed to solve trigonometric problems, but the system model underlying MathCAL's implementation can certainly be cnhanced to solve problems of other topics. More importantly, the same model is not limited to solving mathematical problems. It can be used to model problem solving in any knowledge domain.

Conclusion

In this paper we describe how a user may interact with MathCAL to practice mathematical problem solving. We especially elaborate on MathCAL's database design and summarize MathCAL's distinctive features. Interested readers may refer to our previous papers (Lin et al. 1999, Lin et al. 2000a, Lin et al. 2000b) for other details about MathCAL. A working prototype of the Chinese version of MathCAL has been implemented using Java. Due to space limitation, we were unable to provide screen dumps of MathCAL in this paper. The prototype has proved that the Petri-net representation model supplemented by a carefully designed database does enable the system to exhibit a certain degree of intelligence in offering guidance to the learners. We are currently undergoing major design rework to bring a *cleaner* system structure to MathCAL and to improve its user-friendliness.

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A Network Learning Environment to Support Control Engineering Learning

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Abstract: This paper presents some findings of a study conducted on the Control Engineering Laboratory at the Univcrsity of Oulu. The study concerns analysis of enquiries and exam results of a control engineering course that deals with experiment design. Since 1994 new learning methods were taken into use on the course. Projects, collaborative learning, hypermedia and WWW were used to support lectures. The results of enquiries and the exams show that the new methods were adopted well among the students. The students who used the network learning environment passed the course as well as the students before. The exam results have improved from the beginning.

Introduction

Traditionally lectures and exercises of control engineering courses were carried out both in classrooms and laboratories. Along the traditional methods, hypermedia, network learning and other new methods were taken into use on the control engineering courses in 90's. Student feedback was collected when the new methods were taken into use. Special interest has been focused on the course Control Engineering Course II. Both open and closed, LCProfiler (Unknown, 2001), web environments has been utilised on the course.

The Study

An aim of the study was to find answers how the new methods affected to the motivation of the students. Moreover, an answer to the question if the students concerned the course important and interesting was looked for. In addition, grades of the students in the exams were studied in order to find out how the students learned on the course.

The data for the study was collected from the student feedback sheets. Additional data concerning the use of web in years 1999 and 2000 was collected using a questionnaire along the normal feedback. The grades given in exams from year 1993 to 2000 were analysed and frequency distributions were plotted. An average grade distribution was also calculated. The comparative presentations can be seen in Figures 1 and 2. Figure 1 shows the frequency distribution of courses lectured in years 1993 (no new methods used) and 2000 (new methods used.) In the Figure 2 the grade distributions of an average and the course in the year 2000 are presented.

Findings

Fails have decreased from the year 1993 to the year 2000. This can be seen in both figures. Moreover, the amount of higher grades has increased. If the students on the course in year 2000 are compared with the average year, the difference in the distributions can be seen in Figure 2. The students performed as well (or better) than the average. The development from the year 1993 when conventional learning methods were used is very clear, sec Figure 1. The percentage of fails is lower and the percentage of highest grade is higher.

The effect of network learning environment to the learningmotivation was twofold, some considered the new methods motivating some did not. The following sample comments represents the attitudes. "Nice addition, but does not affect very much on learning" and an opposite comment "New things increases the interest."

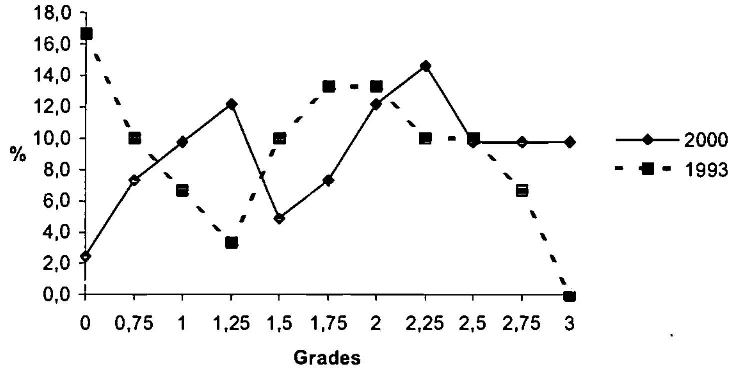

Figure 1: Frequency distributions of the grades of years 1993 and 2000.

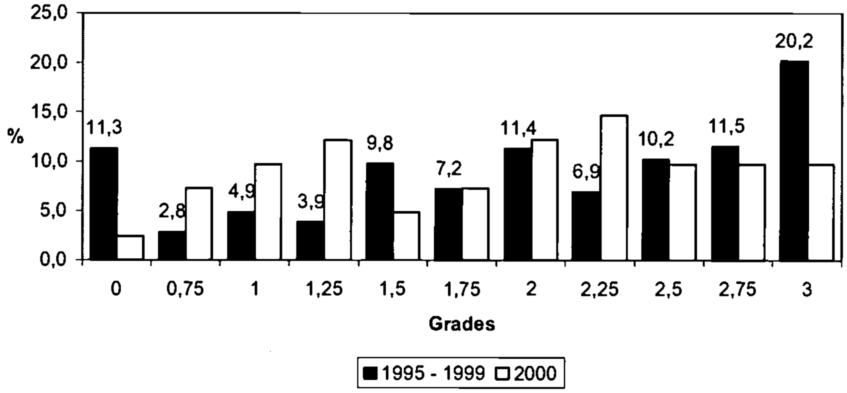

Figure 2: Frequency distributions of the average year and year 2000.

Conclusions

The use of new methods on the course have affected to the performance of the students: the amount of fails have decreased and the amount of higher grades in the exam has increased. The affection of the Web cannot be seen in the results because several factors have been changed at the same time. Although, the use of web is one of the main factors on the course.There is also a variation between the courses (Jaako 2000)., therefore additional studies will be needed. More data from a longer period will be needed. Besides, a change be it positive or negative, can affect positively to the results.

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Middle School Students as Multimedia Designers: A Look at Their Cognitive Skills Development

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Abstract: In this research, we examined the impact of a cognitive apprenticeship-style learner-as-multimedia-designer environment on middle school students' cognitive skills development. The findings showed that engaging students as designers could increase their understanding of the importance of the cognitive skills involved. The skills mostly affected in this study included planning, presentation, collaboration, and testing. Following a design model used in the multimedia industry, the middle school students created multimedia projects for a real audience using state-of-art multimedia tools, and learned such design tasks as storyboarding, designing, and evaluating.

Theoretical framework

Promoting higher order thinking has been an issue of critical importance to educators. Research shows that appropriate uses of technology such as using computers as cognitive tools to extend human minds and help learners to construct their own knowledge can have potentials to enhance students' thinking skills (Jonassen, 1994). Engaging learners as designers is an instructional strategy that implements this constructivist idea.

In a learner-as-designer environment, learners, instead of merely receiving information from computers, become an intellectual partner with the technology and engage in a constructive learning process (Salomon, Perkins, & Globerson, 1989). The emphasis is on using multimedia tools to assist in processing information meaningfully and in integrating new knowledge with prior knowledge. As designers, learners are given the opportunity to be creative and pursue actively their own intended goals. According to Seymour Papert, "better learning will not come from finding better ways for the teacher to instruct but from giving the learner better opportunities to construct" (Papert, 1990, p.3). Because of its nonlinear and associative characteristics as well as its use of various media, interactive multimedia is considered to be capable of assisting information presentation, representation, and construction, and capable of facilitating this learner-as-designer process (Jonassen, 1994; Lehrer, 1993).

Designing interactive multimedia programs is a complicated and challenging task. This designer role calls for many critical thinking skills. Sixteen major thinking skills have been identified that form five categories: (1) project management, (2) research, (3) organization and representation, (4) presentation, and (5) reflection (Carver, Lehrer, Connell, & Erickson, 1992). Each skill in these categories has its own place in the entire development process, and is needed for producing a successful program. The development process, from the inception of an idea to the finished product, involves not only exercising the aforementioned thinking skills but also learning various multimedia tools, working with team members, working against a deadline and, more importantly, making a strong commitment. As the practice in the real world suggests, multimedia development relies heavily on various talents in a team (Liu, Jones, & Hemstreet, 1998). Whether a team member is a programmer, a graphic artist, a designer, or a manager, collaboration among team members is crucial. Although each member will have his/her distinctive role, the success of a multimedia program depends on constant communication and understanding between team members and their working together to reach the goal. Such collaboration and group interaction provides a concrete and meaningful context for enhancing cognitive development through social negotiation. It is the development of these cognitive skills (skills concerned with analysis, interpretation and decision making processes) that is the focus of this research. Specifically, we are interested in designing a learner-as-multimedia-designer environment to facilitate the development of such skills.

A number of studies have already documented the promising results of engaging students in the role of a designer. Some earlier studies were conducted using the Logo programming language. Harel (1991) engaged fourth-grade students as software designers in their Instructional Software Design Project (ISDP). Students used Logowriter to create instructional software on the topic of fractions for other students to use. As a result, students improved in their ability to work on fractions and learned more about Logo programming than the control groups. Qualitative data showed that students have developed problem-finding skills and increased their awareness of strategies to solve a problem. Kafai (1996) worked with students in designing games using the Logo programming language and discovered that students not only acquired design skills but also reached a high level of reflection beyond the traditional school thinking.

Spoehr's study (1993) showed that students developed more complex knowledge representations and various thinking skills through the design of hypermedia programs. Similar results were found in the study by Lehrer and his colleagues (Lehrer et al., 1994). In their study, ninth-grade students used a program called HyperAuthor to develop hypermedia presentations about a topic in American history for their peers as an educational tool. As a result, students significantly increased their time on-task behavior and internalized some design skills over the course of their design projects. Students' responses indicated their increased understanding in such areas as: (1) mental effort and involvement, (2) interest, (3) planning, (4) collaboration and (5) individualization.

Liu and Rutledge (1997) worked with a group of at-risk high school students as they designed multimedia projects for a children's museum. In their project, student learning was scaffolded in several ways: (1) explicit design instruction, (2) learning state-of-art multimedia tools, (3) coaching by the teacher, and the clients, and (4) interaction with various multimedia experts. The result showed that students have significantly increased their interest and involvement throughout the project. Students steadily increased their time spent on the project and became more motivated in learning than the control group. Moreover, their self-efficacy was enhanced and they obtained a more positive image about themselves. Many students have reset their goals for the future—to work in multimedia design profession rather than working in fast food restaurants. In terms of the production and design knowledge, students have recognized the importance of storyboarding and collaborating with team members.

Designing such a constructivist learning environment is not easy. It involves the learners, the tasks, the context, the process, the coaches/teachers and the outcome. While initial studies on this topic have given us a good picture of what is possible through engaging students as designers, more research is called for to understand how to construct such an environment effectively and study various factors contributing to a successful environment. While studying how elementary, middle and high school students were involved in creating multimedia programs, McGrath and her colleagues (1997) suggested that there may be an age difference in readiness for design---with the sense of responsibility absent at the elementary level, very mixed at the middle school level and very impressive at the high school level. They raised the hypothesis that novelty may be the factor for student motivation. Other research showed that while students were highly motivated in many respects and were on task, the critical design skills of planning, and time management were not easy for them to acquire (Liu & Rutledge, 1997).

Given the benefits of the learner-as-designer approach, it is obvious that to achieve the goal of enhancing cognitive skills, much depends on how such an environment is constructed and various factors (learner, tasks, the context, the process, the coaches/teachers and the outcome) interact with each other. This present study is designed to understand the impact of a cognitive apprenticeship-style learner-as-multimedia-designer environment on middle school students' cognitive skills development.

Research question

The purpose of the research is to examine in what way a learner-as-multimedia-designer environment affected middle school students' cognitive skills acquisition. The research question is:

Are the middle school students' cognitive skills affected by engaging in the role of being a multimedia designer? If so, to what extent?

Design of the study

Participants

The participants were students in an elective multimedia class (N=16) from a middle school in the southwestern part of the United States. Eighty percent of the student population was white and 20% was of a minority race. There were five female and eleven male students. To get into this multimedia class, students needed to have a GPA of B and above, recommendations from two teachers and an essay describing why they wanted to take this class. These seventh and eighth graders had fairly high computer skills. Many had used software such as Clarisworks, Hyperstudio, Photoshop, and internet. Four students were in the multimedia class for the second year. The class was co-taught by an art teacher and a multimedia teacher. Students spent roughly two-thirds of their time in using computers and one-third in learning art using a non-computer based art curriculum.

The Learner-as-Multimedia-Designer Environment

The study took place during the spring semester of 2000. The multimedia class met every day for forty-five minutes for a total of eighteen weeks. This school offers a multimedia class as an elective for its seventh and eighth graders (which is not common for most of the middle schools) and the curriculum is in existence for the second year. At the time of the study, the class had access to five Power Macintosh computers, 15 Dell computers, a color scanner, a digital camera and a video camera. Professional multimedia software were also available for use such as Adobe Photoshop, Adobe Premiere, and PowerPoint. However, not all computers were equipped with all the software and zip drives. Students needed to share the resources, and transfer files from one platform to another, or one computer to another (as some computer were more powerful than the others). The PC and the Mac labs were quite a distance away from each other. With a very tight schedule in the middle school, it was challenging for students to make full use of the 45 minutes while transferring files or waiting for their turn to get onto a computer with some specific software.

The organization of the class consisted of three phases. Phase I (approximately five weeks) was devoted to learning software and creating a small presentation file as practice. The goal for this phase was to learn the tools and be able to use state-of-art multimedia software. Phase II (approximately eight weeks) focused on working in groups and creating a large presentation program for use in the upcoming teacher job fair. Students followed a 4-phase development model used in the multimedia industry (Liu, Jones, & Hemstreet, 1998) and created a project for a real audience. Students assumed the role of a researcher, a graphic artist, a programmer, a project manager, and audio/video specialist, depending on his or her preference. Cognitive aids such as storyboard and flowchart samples were presented to students to provide guidance on their planning of the project. Students were also introduced to basic multimedia design principles such as consistency, simplicity, legibility, and contrast. They provided feedback to each other, and received feedback from their peers, teachers, researchers, and the client. During the course, students made a field trip to a local multimedia company and got first-hand experience of what it was like to be a multimedia designer.

In Phase III (approximately three weeks), students used the skills they acquired and worked on creating a web site template for their school. While students received direct instruction and much guidance during phases I & II, such instruction and guidance were gradually faded in Phase III. Students were very much on their own, applying the skills and making their own decisions. Guidance and assistance were provided as needed. While the goal for Phase II was to provide needed scaffolds for the middle school students and helped them acquire important design skills, the goal for Phase III was to see if the students could apply what they learned on their own in a new situation.

Data Sources & Analyses

Multiple data sources were used. The triangulation of the data was to provide a better picture of the process under study.

Project Design Questionnaire. A 20-item questionnaire based upon Lehrer and his colleagues' work was used to assess learners' various cognitive skills needed in producing multimedia projects (Lehrer, et al., 1994). Each item used a five-point Likert scale with one being "not true of me" and five being "very true of me." The 20 items addressed six categories: audience (3 items), presentation (2 items), planning (3 items), interest (5 items), mental effort (2 items), and collaboration (5 items). Sample statements included "I often ask myself about the best way to present an idea, like should I use a graphic or just write about it," "I think having other students look at my project is important," and "Doing projects sure beats listening in class." The KR 20 for the questionnaire was .82. Students completed the instrument at the beginning and the end of the project. Paired-tests were conducted.

Task Ranking. Students were given a list of ten tasks relevant to their project development, and were asked to rank the tasks according to their relative importance. Some of the tasks were "Making the graphics very colorful," "Have someone to try out the program," and "Plan and write down on your index card what your card will look like." This instrument has been used in a number of research studies on the same topic (Lehrer et al., 1994; Liu & Rutledge, 1997). Students were given this instrument at the end of the project. Descriptive analysis was conducted.

Concept Map. Students were asked to complete a pre-concept map and a post-concept map on the concept of “multimedia development.” Students were given the core node “creating a multimedia project” and were asked to create a concept map of any concepts they would link to the core node and label the importance of each link. At the beginning, a brief tutorial on creating a concept map was given and each concept map generation took about 15 minutes. The differences in the two concept maps were analyzed descriptively in terms of the depth and breadth of the nodes listed.

Reflection Logs and Interviews. Students were asked to reflect on their learning experiences after phase II as well as Phase III. For each reflection, students were given some questions. Sample questions included “Of all the things we have done this semester for this multimedia class, what activities do you like the most? Why?, “What activities do you like the least? Why?”

Interviews were conducted with the students on their design and thinking process at the end of the research. Following Miles and Huberman's guidelines (1994), the data were transcribed, chunked, and coded using themes emerged from the data. These qualitative data together were to provide richer and more detailed information, and were used to substantiate the results from the statistical analyses.

Results and Discussion

The paired-T tests showed that there were no statistically significant differences between the pre-test and post-test scores. However, the mean scores for the posttest were slightly higher than those of the pre-test for the categories of (1) audience, (2) presentation, (3) planning, and (4) collaboration (see Table 1).

Table 1. Means and Standard Deviations (in Parenthesis) for the Design Skills

	$Mean_{Pre\text{-}Test}$	$Mean_{Post\text{-}Test}$	T-value	
Audience	3.88 (1.04)	4.15 (.68)	-1.13	p=.27
Presentation	3.84 (.83)	4.0 (.67)	-.55	p=.59
Planning	3.25 (.56)	3.40 (.61)	-.85	p=.41
Interest	4.16 (.51)	3.90 (.67)	1.39	p=.19
Mental Effort	4.0 (.86)	3.6 (1.11)	1.35	p=.20

Collaboration	3.73 (.68)	3.81 (.74)	-.53	p=.60

Though not statistically significant, the T-test analyses showed the post scores were a bit lower than the pre-scores for the categories of (1) interest, and (2) mental effort. The interview and observation data also showed that these middle school students grew a bit bored of the same development process used for Phases II & III, and became less interested toward the end. Multimedia design skills such as brainstorming, storyboarding, designing and testing/evaluating were new skills for the students to acquire. It was intentional that Phases II & III followed the same 4-phase model so as to provide multiple opportunities for the students to acquire and practice these skills. During the each phase, a considerable amount of time was spent on the apparently "boring" tasks of planning, designing, and testing. The data showed that the students became aware of the importance of these tasks, but they may not like doing them as much as learning software programs (also see below). This finding seemed to be in line with other research showing novelty can play a role in middle school students' motivation (McGrath et al., 1997). The challenge for the teachers and researchers is to keep the students interested while engaging them in the more important, but less fun, tasks such as planning, designing and evaluating.

Students were given a list of ten design tasks to rank their relative importance. The more important tasks in the students' opinion included "Discuss with your group what info to include," and "Research and find relevant information," " Plan and create a storyboard of what your program will look like" (see Table 2). The less important tasks included "Making animation," and "Making sounds." It is interesting to notice that the important five tasks were all related to planning and designing. Four out of the five less important tasks were related to the mechanics of creating the media.

Table 2. Importance of the Design Tasks Ranked by the Students

Design Tasks	Average*
Discuss with your group what info to include	2.4
Research and find relevant information	2.5
Plan and create a storyboard of what your program will look like	2.9
Brainstorm/Think about the best way to present an idea	3.5
Make sure the buttons & colors are consistent from one screen to another	4.6
Scan in pictures	6.1
Make the graphics very colorful	6.9
Get someone to try out the program	7.1
Make sounds	7.4
Make animations	8.5

* The lower the mean, the higher the importance.

There is a significant difference in the number of concepts accurately listed by the students from their pre-concept map to the post-concept map: $t(1,14) = -3.14$, $p < .01$. Students listed significantly more relevant concepts in the post-map. In the pre-concept map, most of the nodes were about the production and only twelve nodes were about some aspects of planning, or designing. This number increased to 41 in the post-concept map. More importantly, the concepts of "storyboarding," "designing," or "testing/evaluating" were not mentioned at all in the pre-map while they were listed for 27 times in the post-map. The concepts listed in the pre-map were less concrete and to the point.

The interview and reflection data provided more information to show that students had acquired some understanding of the importance of planning and testing, and the need to work well in groups. One student said, "If we have another project, I'd suggest everybody have fun doing it and do it faster and have time to revise it. And plan ahead so that we have time in the end." Another commented on the process: "I think working in a group has its advantages as well as working on it by yourself. You can overcome obstacles together. Our group worked well together. If somebody in our group didn't participate and contribute as much, then we go and talk to the person and tell them: 'Look, we need your help and we need to finish this project on time, or we will get a bad grade. You should help or you should come after school and finish your part by yourself.' It usually worked."

Being a multimedia designer is often associated to a professional job. Middle school students do not usually get an opportunity to be in that role. The results of this study showed that engaging middle school students in being a multimedia designer can have positive impact on their cognitive skills acquisition. Though promoting higher order thinking is an educational goal, it is usually a challenge for twelve and thirteen year olds to realize their importance and to develop such skills consciously. The learner-as-multimedia-designer environment provides a structure and an opportunity for the development of such cognitive skills. In this environment, the students had a multimedia development model to follow, a concrete project to work on, a deadline to meet, and a client to be responsible for. All these provided necessary scaffolds to the middle school students. The findings showed that the middle school students began to acquire an understanding of the important design tasks such as storyboarding, designing, and testing, though they may not often like these activities.

Learning a piece of software and creating a program with it is a typical way of multimedia authoring in a classroom. Engaging students as multimedia designers, on the other hand, extends multimedia authoring by placing students in a designer position. Instead of merely learning the technical skills and creating a project, the designers need to consider other issues such as the needs of the audience, the distribution of work in a group, the management of time and resources, and the deadline. They need to implement steps such as planning, designing, evaluation, and discussion. The authenticity and complexity of the design tasks provide students a learning environment where they can develop cognitive skills and skills of high value to the work place. This study investigated the effect of being multimedia designers on middle school students' learning of design knowledge, and showed that such an environment can facilitate the development of cognitive skills for the middle school students.

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Student modeling for performance assessment using Bayesian network on web portfolios

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Abstract: Web based curriculum development allows students to develop their learning portfolio and interact with peers on a web learning system. This system contains web portfolios that record in detail students' learning activities, peer interaction, and knowledge progress. However, teachers can not easily diagnose students' learning processes and regulate effective strategies according to student activity performance without the model of activity performance on web learning systems. This investigation proposes a novel methodology that employs Bayesian network software to assist teachers in efficiently deriving and utilizing the student model of activity performance from web portfolios in an online manner. Teachers can assess and diagnose performances with the model of learning activity on web learning systems. The model of activity performance also allows teachers to manage various activity performances in web learning systems so that desired strategies can be achieved to promote learning effectiveness.

Introduction

Teachers normally assess and diagnose students' learning activities based on the student model developed from teachers' experiences. The student model includes all aspects of the student's behavior and knowledge that impact their performance and learning (Wenger et al. 1987). For instance, Burton et al. (Burton 1982) constructed a student model of learning procedural skill to diagnose students' misperception in the learning skills. Fletcher et al. (Fletcher 1975) also developed a student model in computer-based instruction to understand students' learning status in computer aid instruction. Similarly, teachers can understand the model of activity performance on web learning systems by analyzing web portfolios because these portfolios record in detail students' learning activities, peer interaction, and knowledge progress.

Related studies(Burton 1982, Chi 1982, Conati 1997, VanLehn & Martin 1997) have explored how students think and behave in order to diagnose and maximize the learning effect in intelligent tutoring systems. Teachers can know how individual students learn concepts or skills via the developed student models. The student models of intelligent tutoring systems focus on the states of knowledge and skill of individual students. However, a web learning system allows many students to learn and interact with peers on the Internet. Teachers may enforce group learning strategies such as collaborative learning (Johnson 1993) and peer support (Baker & Dillon 1999) to promote learning effect. In doing so, a teacher can intervene in the student learning process by closely observing their behavior in peer interaction. Therefore, in addition to domain knowledge of the learning concepts addressed in individual student models, teachers must know from the student model how students behave and perform in portfolio development processes and how they interact with peers on web learning systems to effectively interact with their students on the Web.

Teachers construct a student model by closely monitoring students' learning processes. For instance, Mitrovic et al. (Mitrovic 1996) proposed a methodology to develop a student model of problem solving by engaging students in explicit dialogues about problem-solving decisions. However, teachers can not develop the students' activity model via interactive observation in a web learning system. Although the web learning system can log many behavioral records in web portfolios, inducing the relationship structure among various activity records and how these records affect each other is extremely difficult. Such difficulty is owing to that these activity records contain a large amount of various types of complex data and interweave with each other. Consequently, teachers can not easily derive the model of learning activity on web learning systems that impact learning performance.

Student modeling from web portfolios

Deriving the student model of activity performance on web learning systems for diagnosis and strategy regulation involves collecting portfolios, discovering causality structure among activities, as well as inferring students' performance from the observable activities. While using web-based learning systems, teachers have difficulty in obtaining and using the student model for strategy regulation and diagnosis purposes. These difficulties are summarized in the following problems.

The first problem is the lack of support for analyzing the causality relationship among various learning activities and performances. Teachers can predict student learning performance and adapt proper strategies at an early stage by analyzing available learning factors. To derive a student model that impacts student learning performance, teachers must answer questions such as "What behavioral factors affect student learning outcomes with respect to various types of activities in a Web learning system?", and "How do various types of learning activities affect each other? Does a student who often answers others' questions tends to submit homework on time?". Therefore, a teacher requires convenient support for inducing the causality relationship and impact factors that can explain how various student learning behaviors and performances are related. This is commonly referred to as the *causality discovery* problem

The other problem teachers have is answering probability questions such as "If a student often answers others' questions, what is the probability of that student achieving a good learning outcome for a particular learning concept?" and "If students achieve a poor learning outcome for a particular concept, how will they behave in the discussion activity?" To answer these questions, the teacher must compare the learning records of web portfolios for current students with similar web portfolios of previous students. Teachers can also apply the student model developed from previous web portfolios to accurately predict the behavior and outcomes of current students. However, as the available records in web portfolios have a sophisticated causality structure, teachers have difficulty in inferring student performance, commonly referred to as the *performance inference* problem, because estimating a student's behavior or performance involves complicated computation of probability.

Purpose of study

This investigation presents a novel methodology to assist teachers in deriving and using a student model in a web base learning system. Bayesian network software (Pearl 1988), a data miming and machine learning technique, is employed herein to facilitate teachers not only in reasoning the causality relationship among various activity performances in web portfolios, but also representing the relationship in probabilities for estimating students' performance. Such probabilistic reasoning can analyze student performance because it provides a mathematically sound means of handling an uncertain situation in assessment. With this methodology, teachers can go online and efficiently use web portfolios to derive and apply the model of students' learning behavior in web learning systems. Teachers can assess and predict student learning performances with the model of students' learning behavior. Doing so allows them to diagnose learning processes and closely monitor strategies to enhance learning.

Web portfolio system of using Bayesian network

In the learning programs, teachers identified ten essential concepts in C programming language: input/output, data types, arithmetic operations, switch control, iteration, if-than-else alternations, functions, message passing, array, and recursions. Students must develop portfolios for each concept and discuss it with other students on the web learning system. Meanwhile, teachers utilize the web portfolios to diagnose students' learning activities and fulfill the peer support(Baker & Dillon 1999) strategy. The peer support strategy entails recommend experts to students proposing learning questions. The expert must be willing to answer other students' questions. Analysis of students' portfolios can help a teacher diagnose student activity performance and enforce the peer support strategy. Analysis involves the following portfolios:

- Portfolio development activities, including the behavior associated with submitting homework, notes, experiences, and self-reflection.
- Discussion activity and learning behavior in the web portfolio system, including frequency of using the learning system, reading behavior, posting and replying in the discussion activity.
- Portfolio content assessments, including teachers' assessment of students' learning outcomes of the ten learning concepts by examining the products developed by students and quizzing them to assert their self-reflection.

To efficiently diagnose students' learning activities and fulfill peer support, teachers must know how portfolio development behavior, discussion behaviors, and learning outcomes are related in various learning concepts. For instance, teachers must diagnose students' learning processes and recommend proper students to answer other students' questions by asking the following questions:

- Which student is willing to answer others' questions and excel in a certain concept? What are the behavioral characteristics of the student in observable learning activities such as developing homework, experience reports, and self-reflection?
- If students overestimate their learning outcomes during self-reflection, can they effectively grasp learning concepts?
- What are the behavioral symptoms when students fail to grasp a specific learning concept?
- How are the ten learning concepts related? That is, does any concept heavily influence the learning outcome of other concepts?

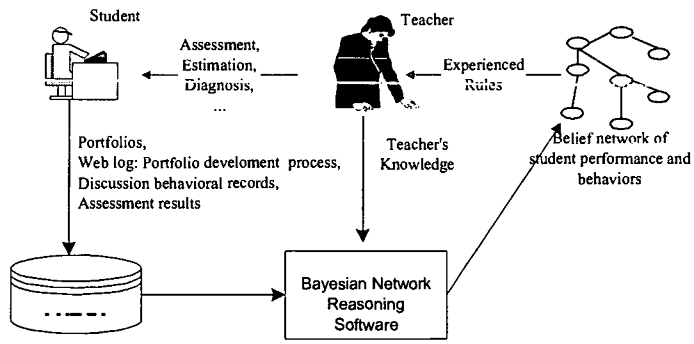

Figure 1. Student modeling of learning performance with Bayesian network software

Figure 1 illustrates how teachers analyze and use student model by using Bayesian network software from web portfolios. Students initially develop learning portfolios and discuss with peers in the web learning system. Meanwhile, the web learning system automatically records students' portfolios development processes and discussion behavior in the web log. After student portfolios, learning process and discussion records, as well as assessment results of students' portfolios are accumulated in a database, Bayesian network software enables teachers to induce the student model of activity performance in portfolios in a Bayesian belief network. The belief network clarifies the relationship among various activity performances in probabilistic rules. Hence, teachers can go online for utilizing the experienced rules to diagnose students' learning processes and regulate strategies.

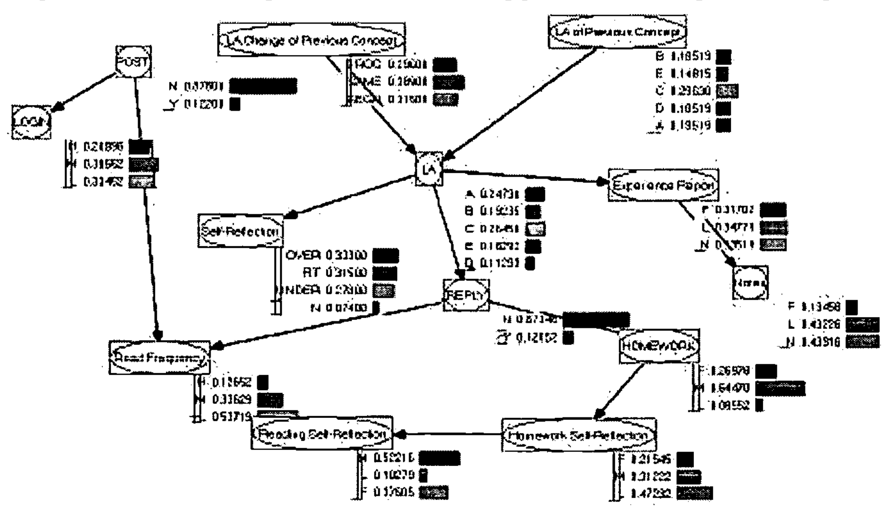

Figure 2. Belief network of student learning performances

Bayesian network technologies for performance modeling

Teachers can use the Bayesian network software to reason how various activity performances are related. For instance, VanLehn and Martin (VanLehn & Martin 1997) applied Bayesian network to discover the causality among 230 physics rules to diagnose students' learning status. Bayesian Knowledge Discoverer (BKD) is used herein to discover the causality relationship among performance of portfolio development activity, discussion activity, and learning achievement in various learning concepts. BKD() analyzes the students' portfolios and produces a belief network to explain the causality relationship among various activity performances, as illustrated in Fig. 2. The Bayesian network analysis includes the following activity performances:

- **Reply**: the performance of answering others' questions which is classified into Y (ever answered others' questions) and N (never answered others questions).
- **Post**: the performance of proposing new issues or questions which is classified into Y (ever posted issues or questions) and N (never posted issues or questions).
- **Read frequency**: The frequency that students read articles in discussion activity which is classified into classes H (high), M (middle), and L (low).
- **LA of previous concept**: the learning achievement in previously learned concepts which is classified into classes A, B, C, D, and E.
- **LA change of previous concept**: The change of learning achievement in previously learned concepts which is classified into classes porg (progressive), same(the same), and regr (regressive).
- **LA**: The learning achievement in the learning concept which is classified into classes A, B, C, D, and E.
- **Self-reflection**: The accuracy of students' self-evaluation of learning achievement on the learning concept which is classified into classes OVER (over estimate), FIT (fit estimate), UNDER (under estimate), and N (absent).
- **Experience report**: the time require for students to submit their experience reports which is classified into classes F (on time), L (delay), and N (absent).
- **Notes**: the time require for students to submit their notes which is classified into classes F (on time), L (delay), and N (absent).
- **Homework**: the time required for students to submit their homework which is classified into classes F (early), M (on time), and L (delay).
- **Homework Self-reflection**: the time required for students to submit their homework self-reflection which is classified into classes F (early), M (on time), and L (delay).
- **Reading Self-reflection**: the time required for students to submit their reading self-reflection which is classified into classes F (early), M (on time), and L (delay).
- **Login**: The frequency students login the learning system to develop portfolios which is classified into classes H (high), M (middle), and L (low).

The belief network illustrates how various activity performances in portfolios with respect to cause and effect. For instance, the learning achievement (**LA**) in previously learned concept (A, B, C, D, or E) and the learning achievement change in previously learned concept (Progressive, Regressive, or Keep in the same) dominate the learning achievement (**LA**) (A, B, C, D, or E) in the current learning concept. In addition, the learning achievement of the learning concept also dominates the students' replay behavior (Ever or Never) in discussion activity, student self-reflection accuracy (Over estimate, Under estimate, Fit estimate, or Absent), and the submission time of experience reports (on time, delay, or absent). The bar chart besides each node represents the probability of student performance without any prior condition. For instance, without any available observable phenomenon, a student has a probability 0.24730 to attain learning achievement (**LA**) *A*, 0.19235 learning achievement *B* etc. A student has a probability 0.87348 not to reply others' questions or issues and 0.12652 to reply others' questions or issues.

Bayesian network software discovers not only the causality relationship, but also the impact factors among various learning performances. The impact factors are represented as a conditional probability notation. Restated, under an observable activity performance, a student has a certain probability to achieve a specific activity performance. For instance, a student has a probability of 0.37 to attain learning achievement *B* in a learning concept, but has only a probability of 0.04 to attain learning achievement *A*, if the student has learning achievement *A* and has been regressive in a previous concept. Table 1 lists the impact factors of learning achievement of a previously learned concept on the learning achievement of a learning concept. Table 2 summarizes the impact factors on reply performance by conditional probability in the web learning system.

LA															
LA of previous Concept	A			B			C			D			E		
LA Change of previous Concept	-	=	+	-	=	+	-	=	+	-	=	+	-	=	+
A	....	....	..	....	....	.....	....	....	....	..	....	....	..	....	....
B	.....	....	..	.....	....	.....	....	....	....	..	....	.....	..	....	....
C	.....	....	..	.....	....	....	.....	.....	....	..	....	.....	..	....	....
~~D~~	....	....	..	.....	....	....	.....	.....	....	..	....	.....	..	....	....
E	.....	....	..	.....	....	....	....	....	....	..	....	....	..	....	....

- : Regressive, =: Keep in the Same, +: Progressive

Table 1: Impact factors on learning achievement by conditional probability

REPLY					
LA	A	B	C	D	E
Y	....	....	....	....	..
N	....	....	....	....	..

Table 2: Impact factors on reply performance by conditional probability

Using the discovered causality relationship and impact factors, Bayesian network software also facilitates teachers to estimate students' learning performance from observable conditions. For instance, Figure 3 estimates students' learning achievement (**LA**) from learning achievement in a previously learned concept. A student has a probability of 0.5 to attain learning achievement *A* or *B* if the student with learning achievement *B* has been progressive in a previously learned concept. Figure 7 estimates learning achievement from the performance of discussion activity. A student has a probability of 0.65087 to attain learning achievement *A* and a probability of 0.34913 to attain learning achievement *C*, if a student replied to others' questions. Therefore, use of Bayesian network software allows teachers to accurately predict students' activity performance and, hence, to diagnose learning processes or fulfill strategies from observable phenomenon.

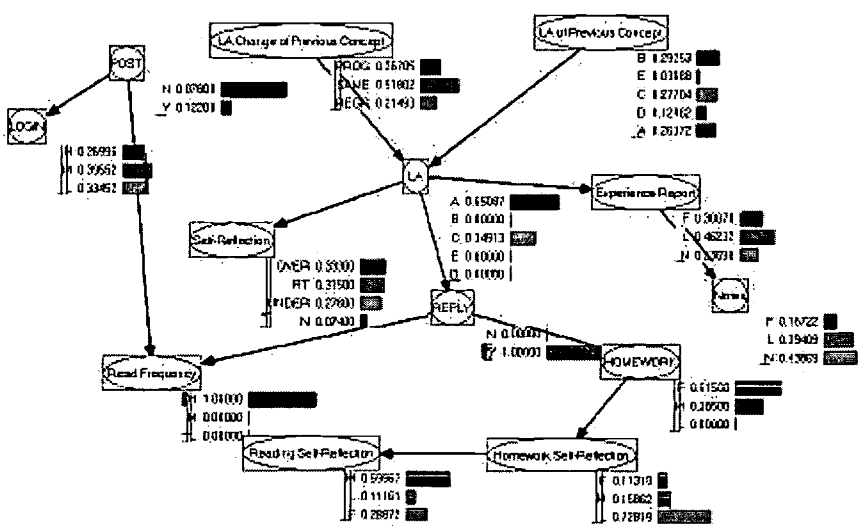

Figure 3. Estimation of students' learning achievement (LA) from performance of discussion activity with a discovered belief network

In sum, the web log and Bayesian network technology satisfy a teacher's requirement of effectively diagnosing student learning processes and managing teaching strategies because they overcome the difficulties in obtaining and utilizing the student model of learning performance in the web learning system online. First, the web log mechanism of web servers automatically records students' learning activities to help teachers obtain behavioral portfolios. Second, Bayesian network software facilitates teachers in inducing the belief network and impact factors among various learning performances. Third, teachers can utilize the belief network obtained from historical data to estimate various activity performances.

Conclusion

As students learn and develop learning portfolios on the World Wide Web, web portfolios completely record student learning processes, learning products, and interaction history. Although such web portfolios are collected in an electronic format, teachers lack computational support in deriving and utilizing student model of learning performance to utilize web portfolios. This investigation has described how teachers should effectively assess activity performance and fulfill pedagogical strategies by using portfolios. A web log methodology is proposed herein to accumulate the students' behavioral portfolios. This investigation also illustrates the experience of using Bayesian network technology to help teachers derive and utilize a student model of activity performance. Bayesian network technology can help teachers discover a belief network that not only impacts student performance from web portfolios, but also allows teachers to utilize the belief network to diagnose or intervene in students' learning processes at an early stage. Electronic web portfolios enable teachers to assess activity performance and analyze pedagogical strategies in an online and efficient manner. Therefore, teachers of a web-based learning system can also extend the use of web portfolios and Bayesian network technology for other pedagogical purposes with relative ease.

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Design and Evaluation of a Virtual Cartography Lab

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Abstract: Cartography is a discipline that focuses on the visualization of geographic data. In the cartographic classroom, students learn how to gather, measure, manipulate, and represent (using a map) data. Emphasis is often placed on different types of maps, specific methods of mapping, and map design guidelines. Nearly all cartography courses are taught in a traditional classroom setting and include both a lecture and a hands-on lab component. However, distance learning is permeating all disciplines, including geography. As a result, a research study was designed to evaluate the potential impact of a virtual, distance learning, cartography laboratory. This paper will present the research design, including the design of the virtual lab and accompanying course web page as well as the study results, including student and instructor impact.

Introduction

Cartography is a discipline that focuses on the visualization of geographic data. In the cartographic classroom, students learn how to gather, measure, manipulate, and represent (using a map) data. Emphasis is often placed on different types of maps, specific methods of mapping, and map design guidelines. Nearly all cartography courses are taught in a traditional classroom setting and include both a lecture and a hands-on lab component. However, distance learning is permeating all disciplines, including geography. Even courses that are taught on campus in a classroom have a distance-learning element, as many instructors create course web pages, which may include syllabi, announcements, lecture notes, study guides, and student grades. While course web pages serve as useful resources and even contain instruction-related material, they usually are not designed to serve as a substitute for classroom instruction. But, the demand for more course scheduling flexibility continues to push the envelope towards including more distance teaching/learning in many curriculums.

The reasons for the expansion of distance education are varied. Maybe the two most significant factors are the changing student population and the improving technology. As a national trend, student populations are getting older and are less interested in full-time, resident education. In fact, 40% of students claim to be part time and the percentage is only expected to increase (Chute, Hancock and Balthazar, 1991). As a result, students are demanding flexibility in time and geography; they want to take classes that adhere to their schedule and they want minimal (if any) travel. Technology is a driving force behind the boom in the number of distance education courses conducted. The correspondence course of the past had made way for technology-enhanced methods of instruction delivery (Moore 1986, Beller & Or 1998) including, television courses, teleconferencing, computer-conferencing, and most recently Internet delivery.

Distance education, in its purest sense, is not geographically constrained; the students and the instructor do not meet for instruction. In fact, students may not be located in the same town, the same state, or even the same country as the instructor. As a result, most distance education courses are designed to serve students who rarely or never visit the actual campus. However, on-campus students are also beginning to demand more scheduling options as a result of a national trend in increased student employment. The number of students who maintain full-time or part-time employment along with a full course load continues to rise. In 1996, over 40% of freshmen reported that they would work in come capacity to help pay for college, while only 34.7% of freshmen reported working in 1989 (Furr and Elling, 2000). The increase in college students' employment responsibilities results in less time available not only for studying but also for attending class. Colleges currently attempt to meet these students' needs by offering a variety of time options, but adopting a distance-learning component into a campus-based course may provide more flexibility, while maintaining high academic standards. How to incorporate distance-learning components into course has not become a standard procedure though. Presently, the design of these courses is very dependent on the technology available to the instructor and students (Wells 2000). But as technology pushes forward, opportunities become available for educators in all disciplines to explore and offer distance-learning courses in their fields.

The research presented in this paper focused on incorporating distance education into a classroom-based cartography class. The objectives were not to design and evaluate a pure distance education course; rather the goals were to determine how on-campus education may be enhanced in terms of instructional flexibility and educational effectiveness. Two primary research questions were addressed. How should a virtual cartography lab be designed? Can cartography, a graphics-geared discipline, which has traditionally included a very hands-on instruction format, be effectively taught with a virtual lab component?

Methods

The educational impact of utilizing a virtual cartography lab was tested using two Introduction to Cartography classes. One class (Class 1) met Mondays and Wednesdays, while the other (Class 2) met Tuesdays and Thursdays; both classes occupied the 2:00pm to 3:50pm time slot. Class 2 functioned as the control group and was taught using a traditional method, which comprises 2 hours of lecture and 2 hours of lab per week. A virtual lab was introduced to the curriculum of Class 1, whose students completed most labs through a distance education format. A two-sample difference of means test was conducted on both the exam scores and the lab scores from each class to determine whether a statistical difference existed between the two groups. The design of the virtual lab along with the curriculum differences is discussed below; results are presented and discussed in the following section.

Designing the Virtual Cartography lab

Computer mapping often requires specific software that is not commonly installed on most computers, including university computer labs that are accessed by students. As a result, availability of the specialized software needed for mapping exercises was a critical factor of this experiment. The software, ESRI's ArcView 3.2, was made accessible in two ways. First, the main university computer lab offers 24-hour admittance to all students with a current identification card. A university-wide license of ArcView was obtained and all PCs in the main university lab were equipped with the software, making it available to students 24-hours per day, 7-days per week. Second, a Microsoft Windows 2000 Terminal Server (an internet server) equipped with Citrix Metaframe software was installed in the geography department. This server allows the network administrator to make a selection of software running on the main department server accessible via the Internet to anyone with a valid username and password. Therefore, students are able to access the fully functioning version of software with the same interface as though it were running on their home computer, which in reality, functions merely as a host. Only two programs housed on the main department server were selected for Internet server accessibility. Both programs, ESRI ArcView and Macromedia Freehand, are utilized in the introductory cartography course.

In addition to making software available, the actual laboratory exercises needed 24-hour accessibility. A course web page was designed specifically for Class 1 (the virtual lab group). The page was created using the BlackBoard program, Internet course management software. This program allows instructors to create course web pages onto which students logon using an assigned user-id and password. The page maintains course documents, including the laboratory exercises in Microsoft Word format, student grades, and an announcement page primarily used to remind students of the due dates of the virtual laboratory assignments. Also, because communication is an important element of any distance education (Wells 2000), the course web page included a chat room in which students could post questions to the instructor or to other students. The chat room was designed so students could ask questions in text format or post a graphic (such as a map) accompanied with a question. The class was regularly encouraged to visit the web page to check for assignments and due dates.

The lab component of both classes included 11 assignments, most of which were map-making exercises. Class 2 completed all assignments during scheduled class time, while class 1 (the virtual group) completed 7 entire assignments and part of 3 others through the distance education format. One assignment required aerial photographs and was, therefore, completed in class (in the future, however, the photographs will be scanned and made available on the internet server). For three assignments, students needed to collect position readings using a Global Positioning System (GPS) and then complete mathematical calculations in two exercises and create a map in the other. The positions were collected during class and the remainder of the assignments was completed outside of class.

Students in both groups were given the same assignments and were allowed at least one week for completion. The traditional group (Class 2) received the assignment instructions in class on lab day and worked on the exercises in the lab with the instructor and a teaching assistant (usually present) available for help. The virtual group, however, was informed in class when the week's assignment had been posted to the course web page; they were encouraged to e-mail either the instructor or the teaching assistant with any questions regarding the lab, but, otherwise, completed the assignment independently.

Because the virtual lab group completed most assignments outside of class, more in-class time was available for review of lecture material. No additional material was introduced to this group that wasn't introduced to Class 2. In fact, all lectures were accompanied by PowerPoint presentations, which were identical for both groups. Instead, the extra time in Class 1 was devoted to more thorough discussion of the material presented. In addition, in-class worksheets that address famously troublesome topics such as locating positions using the Universal Transverse Mercator (UTM) coordinate system, calculating standard deviation, or determining distance and azimuth between UTM positions provided reinforcement of the subject as well as "self-checks" of student understanding. The same worksheets were made available to Class 2, but, because time did not permit completion in class, they were advised to work on them outside of class.

Results

Data were gathered in two areas. First, a log of time spent by both the instructor as well as the teaching assistant was kept to evaluate time spent outside of class with each group and second, student performance was assessed through exam grades and exercise grades.

Outside Class Help

All time spent helping students outside of scheduled class time with both lab assignments as well as lecture material related questions were logged. However, no distinction was made between time spent answering lab questions as opposed to lecture questions. Initial attempts to document time spent in each area failed as sometimes questions and answers permeated both areas of the course; therefore, a categorization of time proved impossible. Instead, the total amount of time spent with each student in each class was recorded and summed over the course of a week. Following meetings with students, a brief summary of questions addressed during the meeting was recorded.

From the total time spent per week, a mean number of hours per week was calculated for each class. The results reveal that 2.4 hours per week were spent helping the virtual lab group, while only .8 hours per week were spent with the traditional group. While time spent on lab questions was not distinguished, the summary of meeting questions revealed that most of the out of class time spent with the virtual lab class was devoted to answering exercise-related questions and most time spent with the traditional lab group was devoted to answering lecture-related questions. However, this analysis is qualitative and was made through reviewing the log; no statistical summary is available.

Student Performance Assessment

Two-Sample T-Tests were conducted to assess student performance in two areas, laboratory assignments and exams. For both analyses, a significance level of 0.05 and a critical value of 1.684 were established. The analyses were conducted using the SPSS software program. The null hypothesis developed for the laboratory assignments analysis stated that the two classes were the same (had similar assignment grades). The calculated value was 1.608; because this value was lower than the critical value, the null hypothesis could not be rejected. The null hypothesis for the exam grades was that the two classes maintained equivalent exam scores. The calculated value was 1.679, which was also lower than the critical value and again the null hypothesis could not be rejected. Overall, the analyses indicated that no statistical difference in either laboratory assignment grades or exam scores existed between the two classes. The inclusion of a virtual lab component in Class 1 could not be proven to be beneficial in the area of student grades.

Implications

One of the most significant limitations of the virtual lab was student uncertainty of lab expectations. More instructor time was spent outside of class answering lab exercise related questions for students in the Class 1 than in Class 2. The virtual lab students seemed less certain of expectations than did those students in the traditional group; a frequent questions were "am I doing this right" or "does this look right." Possibly the reason for the reservation on the part of the virtual group was due to the fact that most students worked independently, as opposed to the traditional group, who completed the assignments during class time, allowing for peer as well as instructor input. Although a method of virtual communication was provided (the chat room on the web-page) for Class 1, a map looks very different on a screen than it does printed; in fact very different design techniques are applied to virtual as opposed to printed maps. In addition, when reading a map and providing feedback, the reviewer often draws arrows indicating where to move objects, inserts text, or re-draws map symbols as suggested changes. Reviewing a map posted to a web page is more difficult for the reviewer (and therefore less likely to occur) and probably less informative for the map designer since suggested changes would be textual only.

One way to help alleviate the uncertainty could be to include high-quality examples of what the final map should look like for each assignment. However, peer or instructor input would still be absent and feedback is crucial in the map design process (Dent 1998), without it, the designer may feel uncertain about the effectiveness of the design or about the map's overall communication. Including a "feedback session" in class, in which students share their maps-in-progress, may provide an opportunity to include the critical feedback into the students design process, although the labs would then cease to be virtual.

Overall, the research presented revealed three significant implications of including a virtual lab component in an on-campus cartography lab. 1. Providing 24-access to the computer programs along with basic lab instructions is not sufficient; students are denied the input necessary during the map-making process. 2. The additional class time in the virtual lab class did not significantly improve student exam grades. 3. The virtual lab class required more instructor time spent outside class with students, trouble-shooting computer hardware/software/printer problems, and designing the necessary course web page.

In conclusion, distance education has been shown to be an effective teaching method in select cases. However, cartography is a field, which necessarily requires instructors to develop artistry and creativity in students. The cartographic "eye" is often developed through hands-on mapping exercises, which requires a significant amount of feedback and a virtual lab, by design, results in map-making in near isolation.

Distance education may be shown to be an effective educational delivery method in many disciplines. However, just because it is technologically possible to construct a distance-learning course doesn't mean that it will be effective. The results of the research presented here indicate that some types of courses, including the cartography lab and the map-making process, in general, may not be delivered as effectively as others through distance instruction.

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Give It A Go! - Using Interactive Digital Television To Help Passive Viewers Become Active Learners

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Abstract: Significant number of adults have problems with basic literacy, numeracy and communication skills. Interactive digital television is currently being developed to meet commercial and entertainment needs, but educationalists may be able to use it too, to deliver active learning opportunities directly to the home, workplace or place of viewing. The paper describes the use of DVD, satellite and cable systems to deliver interactive learning, citing experience drawn from the *Upgrade2000* project.

Introduction

Seventeen percent of European adults are unable to calculate the change they should expect to receive in a simple shopping purchase. Ten percent cannot pick out the time and venue of an event from a publicity poster. People with significant difficulties with basic numeracy, literacy or communications face a bleak future: in the UK they are five times more likely to be unemployed. If they do find employment it is twice as likely to be officially classified as lowly paid. Sixty percent of the prison population have basic skills problems. At any time only five percent of adults with basic skills problems will receive formal assistance (All figures from Moser, 1999). The UK government is co-ordinating attempts to address these issues through the Basic Skills Agency (BSA).

This paper outlines why television, and especially interactive digital television, is an effective medium for reaching people with basic skill learning needs. It describes the Upgrade2000 project, which developed a series of interactive television programmes for use in the home, workplace and training environments, together with a supportive learning surround. The development phase of the project is complete and programmes are scheduled for UK national broadcast in March 2001 under the series title "Give It A Go!" The paper particularly focuses on the pedagogic design framework for the interactive elements of the educational programmes and how these relate to the television technologies of digital versatile disk (DVD), satellite/aerial broadcast and cable narrowcast.

What is digital television?

Most television today uses analogue broadcasts, where the image and audio signals are transmitted more or less in proportion to the levels they are to be displayed/played on the consumers' TV sets. However, if consumers install additional hardware, usually Set Top Boxes (STBs), the signals can be sent in digital format. Digital transmission usually gives better picture quality, but perhaps more importantly each channel takes less spectrum space. This allows many more channels to be broadcast.

To reach all households, transmission companies currently have to output their signals in both analogue and digital formats. However, as soon as sufficient numbers of households have suitable Set Top Boxes, governments intend to raise huge revenues (billions of Euros) by selling off the analogue channel space for further digital tv channels, mobile phones and other wireless applications. Many European governments intend to end analogue broadcasts between 2006 and 2010. In the UK consumer access to satellite and terrestrial aerial digital reception was considerably aided when the main rival broadcasters, Open and ONdigital, started to distribute their STBs at zero-price rental.

An alternative to 'through-the-air' broadcasting is cable transmission. In some European countries, Germany for example, this is the dominant form of reception. Most existing analogue cables could already take digital signals, but cable companies must still invest in complex transmission equipment and replace the STBs in each home. The marketing opportunities offered by interactivity, though, mean that most cable companies will convert well before the dates given above.

To allow broadcasters to monitor the use of pay channels, the satellite and terrestrial technologies usually require the consumer to plug their STB into the home's existing telephone line. This is often referred to as a "back channel", but the wire is actually bi-directional and can be used to carry personalised interactive services such as home banking, home shopping, email and designed-for-TV-display information pages. Digital cable technology has a significant advantage: as well as making use of the cable itself as the back channel, it can use the cable's higher capacity for delivering to the viewer full web access and possibly video-on-demand services. The combination of video-on-demand and full web access is very attractive for educational programme providers and is discussed below.

Why use interactive digital television for education?

People with basic skills problems are notoriously hard to attract back to formal learning opportunities. Many perceive themselves as having "failed" at school and are highly dismissive of traditional adult education provision. Television, though, offers a different approach. This section of the population watches more hours of television than the average viewer, and their households have been amongst the early adopters of subscription-based multi-channel satellite and cable services (BSA).

Television can reach the masses: in the 1980's the BBC attracted weekly audiences of 100,000s for a basic skills tuition series "On the Move". It can also stimulate follow-up action: in 1999 the UK's open learning initiative Learning Direct took over 10,000 telephone enquiries after the Channel 4 soap "Brookside" series showed characters facing up to and overcoming basic skills problems.

From a logistics point of view, distributing learning materials through the television rather than via CD-ROMS or other media is relatively simple. There is no need to register to receive materials, and no need to follow complex instructions to install them on PCs (which can be a circular problem for basic skills learners). However, in a multi-channel world, bringing the programmes to the attention of the viewer and tracking their subsequent progress will still be a problem. We discuss this later.

The Upgrade2000 project

The Upgrade2000 project developed an integrated set of interactive television programmes, a web site and CD-ROM materials for further learner support, and instructor guides to enable non-specialist educators (mentors in small organisations, for example) to tailor the materials for individual situations. This paper concentrates on the television component of the project. The programmes were produced between January and June 2000, and the content was tested via DVDs. They are scheduled for broadcast via satellite in March 2001 as described below.

Interactive programmes for basic skills learners – design structures

People with basic skill needs are notably more receptive to learning if it has a clear link to their immediate occupational or leisure needs (BSA). With this in mind, we designed each programme to have a main theme section showing practical and applicable occupational, with in-context branches to the basic skills materials. Fig. 1 shows the structure of the programmes.

Many occupational tasks, such as wallpapering a room or planning exercises at a health clinic, can conveniently be explained though a naturally sequential development. The vocational skills section of each programme was designed to be watched in a linear / sequential route. However, viewers have different Basic Skills learning needs and interests. We use interactivity to allow the viewer to branch to "Learning Encounters", and then choose their own route though the basic skills content. Examples of Learning Encounters are how to estimate the area of paint needed, communicating with customers, and skills in scan-reading.

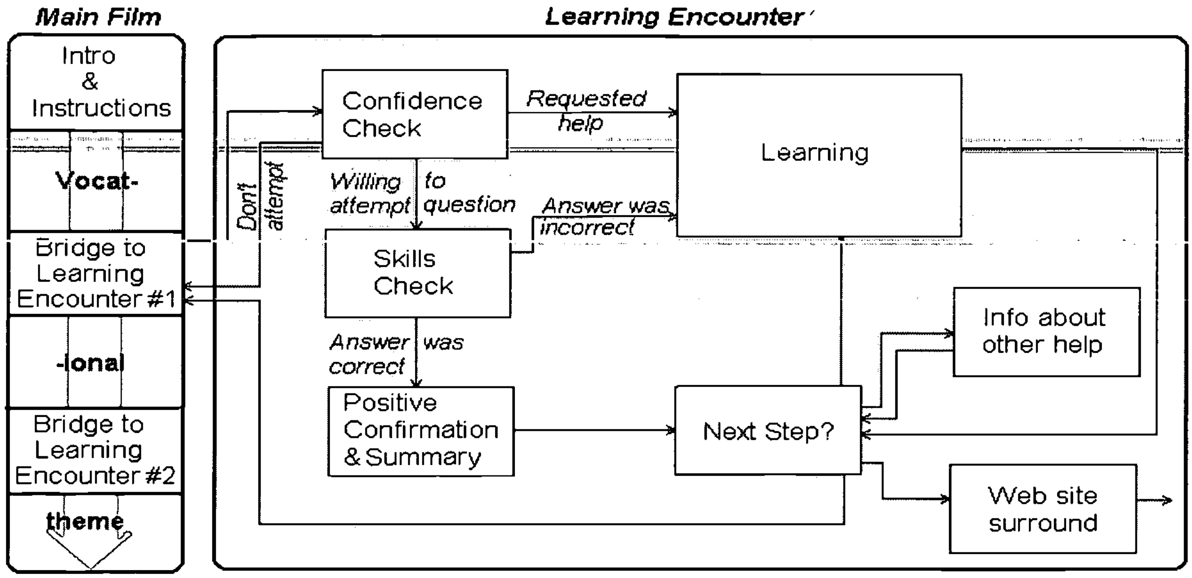

Figure 1: Structure of the main programme and learning encounters

The first item within the Learning Encounter is a bridge, which explains the link between the work skill and the underlying basic skills. It is motivational in tone.

Basic skills learners often have a very fragile confidence in their own abilities. It is important that we do not to place them in positions where they believe they will fail again. The confidence check outlines a problem and asks the viewer if they believe they could solve it. The viewers may opt to attempt to solve it, request help, or return directly to the occupational theme (the Learning Encounter may be too easy, too hard, or not in their area of interest).

The skills check builds on the confidence check and sets a problem encompassing all the learning points of the Encounter. The viewer may select an answer from a multiple choice menu using the colour or arrow keys, or the 0 9 keys for some mathematics problems, on the remote control. We chose not to use alphabetic keyboard input at this

some of our viewers.

If the skills check is answered correctly the programme gives positive confirmation and summarises our approach to - perhaps they had a lucky guess at the – or to go to the supporting web site (discussed below) for further practice, or to retur

after the correct confirmation they are led through the solution a little at a time. There can be further branching

scan reading, for example.

Learning Encounters also offer information about other sources of help, including the UK's government's on-learning provider *Learning Direct,* launched during year 2000. They also provide a selectable link to the Upgrade2000's learner web site especially designed for viewing on the domestic television set. Here the learner could have further practice, and take practice assessment with formative feedback. An advantage of the web over current television is that the web server can be programmed to keep detailed records of answers and interactive inputs made by the user, so it could – if authentication of identity could be resolved - be used for building portfolios of work leading to summative assessment. The technology for TV access of web sites (see Green, M 1999) was not

he project drew several conclusions about the style and suitability of the interaction as described above. A key point is that basic interactive television technology – as opposed to computer technology – cannot 'remember' upon events later. Interaction is largely restricted to actions based on the last input only. More advanced facilities do exist, but they vary between the different types of transmission technology, and if different platforms programme makers have to restrict their use of interactivity to the lowest common denominator. Branching based on user selection is the most common approach.

that Basic Skills learners are comfortable with using the remote control keys to answer questions. The introduction to each programme showed on screen how to use the remote control. To assist poor readers we also arranged that all menus had voice over instructions, with one of the on screen buttons replaying the audio on demand. Together these approaches were found to be sufficient instruction our learners did not need paper or human instruction to use the technology. Horsburgh (1999) reports similar fin equipment.

Digital television technologies

Digital Versatile Disk sometimes referred to as Digital Video Disk (**DVD**

DVDs look like CDs, but are capable of holding 1½ to 2 hours of television quality programmes, menus and instructions that control the interactivity. The disks can be viewed either through devices that plug into standard

players will leap in November 2000, when the games console Playstation II which also shows DVD Video on tv screens, is launched in Europe.

At the time of the Upgrade2000 project no commercial systems for interactive television were installed in the interim solution. However, we met a number of problems similar to those listed by Fritz (1999): the expense of authoring systems meant that production had to be outsourced (with its + Euros to press, meaning that we could not give them away for home trials by learners; we found notable differences in playback behaviour between

made second versions as necessary. We also surveyed learner and mentor reactions by interview and by questionnaire. However, we are reluctant to in the DVD equipment and interest in their progress may have an effect on learner perceptions. Our pedagogic

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consumer's Set Top Box picks out a selected channel and passes this to the television set for viewing.

Many consumers already have videocassette recorders. These can record the output of STBs, but because they are -in recording media are becoming

configured for use with the (satellite) system will be available from January 2001.

The main commercial motive for transmission companies to support recorder- revenue- . For example, a range of adverts could be 'downloaded' by nighttime broadcast to the STBs, and shown at prime time as appropriate. If linked with a device *who* is watching (FutureTV use a card for viewer identification) adverts can be targeted individual's past home shopping purchasing habits.

The technology for downloading programmes can also be used by educators. The components and "master controller" program of interactive programmes can be broadcast when off-peak schedules permit, to be available for later viewing. The viewer may then skip sections or rewatch sections as many times as they choose. This gives the equivalent experience of watching a DVD.

Through a partnership with Coleg Digidol (the Welsh Digital College), the Upgrade2000 programmes will be broadcast on the Open platform in interactive format in March 2001 on the S4C2 channel. The broadcasts will be receivable, free-to-view, throughout the UK and some parts of northern Europe. Open's channel-usage tracking systems will be able to provide accurate figures on household viewing levels (including use of recorded copies). Learning Direct should be able to track the number of viewers who proceed on to recognised courses.

Narrowcast

Narrowcasting is where each viewer signals, via the cable, to the transmission company which channel they wish to watch. This is then transmitted over the same cable back to the house. The technology, though more complex at the transmission end, allows video-on-demand services. If quick enough (not all current systems are) it can replicate the DVD experience by showing short sequences of video separated by menus to select the next component. A second, strong advantage that narrowcasting is also the way that web browsing works. A number of cable companies are now offering full web browser access to the tv screen, including video streaming at far better quality levels that is possible over standard telephone lines. This gives the possibility of "hooking" a viewer's interest through interactive television, then passing them on as "learners" to web sites that can track and fully adapt to the individual's progress, without the learners changing physical media.

Having already invested heavily in their technology, existing cable companies are likely to try to maximise their revenues by using the switch to digital communications to create the space for broadcasting extra channels whilst leaving just a small capacity for narrowcasting Web access. Television by narrowcasting may well come from a different source: Asynchronous Digital Subscriber Line (ADSL) is a technology that allows telephone companies to use existing telephone lines to carry television signals. The approach is not certain to work: each programme has to be highly compressed to meet ADSL's bandwidth and this may over-compromise picture quality. Also, ADSL can only be transmitted a few kilometers over copper wire (i.e. the type of cable telecoms companies use between the last exchange in the chain and the home). Many rural households are likely to be outside this range.

Conclusions

The possibility of using interactive television for education has been postulated for a number of years (eg Bascish, 1996; Bates, 1999). The Upgrade2000 project has identified a particular use to reach the basic skills audience. This group watches more television than average. They have also been amongst the earliest adopters of home-based digital audio-visual products. The cost of acquiring digital receiver equipment is, in any case, falling and for some systems is now free.

Bates notes that is the transmission companies that are financing the development of interactive digital television, and that their commercial interests are leading them to target the greatest revenue-generating markets of blockbuster film rental, shopping channels and advertisement-bearing information services. They are tailoring the hardware they distribute to suite: the Set Top Boxes are designed to support the above functions but do not yet have the built-in memory that could hold downloaded programme components to be watched interactively at a later time. Likewise, the current viewer tracking methods can record what programmes were watched, and can even recommend follow-ups in a similar genre, but the systems are orientated towards the needs of billing functions rather than offering learning material matched to learner progress.

Even though educational programmes must rely on systems developed for commercial markets the technology is moving in useful directions. The Upgrade2000 programmes are scheduled for satellite broadcast interactive programmes to disk-based STBs in March 2001. This paper has also shown how ADSL might provide a seamless environment for interactive television leading on to web pages with streamed video. Overall, the Upgrade2000 has developed and is testing a new pedagogic model that uses interactive television to 'hook' the viewer's attention and

-building practice, and then pass them to the web site for more detailed learning. We summarise this rase "moving passive viewers to active learners".

Accreditation of home-
identification cards into the STBs. It is a parent's responsibility if they let the child use the card to watch something

know who actually answered questions, and whether they were receiving help from others in the room. Perhaps the

different adverts in breaks between programmes depending upon the individual's profile as recorded by the tracking

slot but the whole family is watching. However, this may be more of an issue for health or personal relationship

The future of Educational Television, Invited talk at the launch of the Open University TV channel on Finnish Television., 17th January 1996

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Using an in-house developed e-Learning portal at Ngee Ann Polytechnic to deliver a online course in Calculus

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Abstract: This paper discusses how a web-based course in calculus is created using a Computer Algebra System and delivered to the students who are studying for their diploma course at the Polytechnic using an in-house developed e-Learning portal named e-CAMPUS system. The e-CAMPUS is an in-house developed portal for lecturers to deliver their course materials and other purposes. It has the necessary features to support an online course completely. The system was developed to support the campus wide mobile computing initiatives that see the Polytechnic helping students to own their personal notebook PC. The initiatives hope to cultivate a learning culture in both students and staff to fully exploit the new development of Information and Communication Technology for life-long learning. The paper will emphasize on showing how teaching and self-learning materials in calculus were written using a Computer Algebra System and placed on the web using the e-CAMPUS to support the students in learning anytime and anywhere. Students are able to carry out investigation, exploration and much more, with the online materials. The paper will also show the many features like online assessment, online discussion that are built within the e-CAMPUS to support virtual learning.

Introduction

The advancement in the information and communication technology has greatly affecting many aspects of our lives including the education. In an educational institution like Ngee Ann Polytechnic, it is believed that the technology can be used to improve the learning environment for both student and staff. Through many initiatives, the Polytechnic hopes to use the technology to cultivate and promote a life-long learning culture in all who comes into contact with the Polytechnic.

The polytechnic places great effort in creating an environment allowing both students and staff to learn anytime and anywhere. One of the initiatives is to help all students to own their notebook PC. The mobile computing initiatives hope to enable students to have easy access to the information provided whether they are on or out of the campus.

The initiatives also provide an opportunity for many courses of study to go online. In this paper we share the experience in creating a course in calculus taken by all first year students who are studying for the Diploma in Mechatronic Engineering. The teaching and material in mathematics has been created using a Computer Algebra System, Scientific NoteBook. An in-house developed portal, e-CAMPUS is used to deliver the course material.

e-CAMPUS

e-CAMPUS is an integrated virtual learning environment that allow students to learn at anytime and anywhere. It makes uses of the latest state-of-the-art Internet Technology for effective delivery of courses and management of learning experiences. The environment was developed based on modular approach and it can be customized or scaled up or down to meet the different needs and aspiration of different organization. Additional functionalities can be easily added as the learning infrastructure grows. It supports the ASP(Application Service Provider) service model for cost effective implementation.

Biometrics Technology that allows the use of thumb print to recognize individual learner can be incorporated into the system as an option to provide more accurate performance tracking and measurement capability. The use of Biometrics Technology also enabled course contents and sensitive information to be protected and restrict access to only authorized end-users.

The system provides web-enabled use interfaces to manage the environment and to participate in on-line learning activities. It manages the learning communities by providing access to only the contents and data for which they have privileges and permission. It provides multiple levels of security according to the role of the users. The use of biometrics solution as a middle tier between the web server and the database server and biometrics device at client-end will further enhance the authentication mechanism of the system.

Providing an online course in calculus

Learning of Mathematics is often associated with calculation, investigation, exploration and many other tasks. In providing an online course in mathematics, it is important for the users to have access to a Computer Algebra System (CAS) on their PC. The users can use the CAS to perform the tasks of calculation, investigation, etc, without any additional tools. The system can be used to carry out tedious tasks and laborious calculation that otherwise difficult or impossible. With careful planning and correct instructions, the system can also be used effectively to explain many concepts that would help understanding.

The materials of the online course in calculus were created using a Computer Algebra System called Scientific NoteBook (SN). SN has the functionality of a word processor that enables all instructions to be typed conveniently. It also has the functionality for the user to type mathematical expression that is alive. The Maple Engine enables the users to perform a series of mathematical function without the need to learn any syntax.

All students taking the course are given individual account to access to the course materials and other related information on the web. They are presumed to have their own NoteBook PC loaded with the correct version of the SN.

The materials divided into a list of independent sub-topics for easy updating and easy access by the students.

Besides the learning and instructional materials, other facilities supported by the e-CAMPUS can be made available to the students.

Conclusion

The facilities in the e-CAMPUS open up many new dimensions and possibilities to the learning community. It is hope that with this platform, the benefit to both students and staff who are involved in this calculus course can go beyond the learning of mathematics. It is hoped that they are able to see a new paradigm in borderless learning.

Developing Generic Skills through On-line Courses

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Abstract: Developing generic skills for students in higher education institutions has become a priority issue. Higher education institutions are experiencing continual pressure from government, industry, funding bodies and students, to place greater emphasis on developing generic skills that are currently delivered through the "hidden curriculum". This paper explores ways of developing students' generic skills in higher education through on-line delivery. By investigating the nature of generic skills and contemporary methods of teaching and learning, it proposes a framework for learning designs within higher education contexts to prepare students for the workplace by helping them develop generic skills as well as subject-specific knowledge.

Introduction

Over the past decade there has been a growing concern about the role of higher education institutions and how they are meeting the needs of employers. Increasingly, higher education institutions are being asked by industry, government and higher education funding bodies to produce graduates with versatile workplace skills, as well as subject-specific skills. This is causing a major reappraisal of higher education institutions purpose, learning outcomes and research activities. (Australian National Training Authority, 1998; Bennett, Dunne, & Carre, 1999; Candy, Crebert, & O'Leary, 1994; Dearing, 1997; Mayer, 1992).

As higher education institutions struggle to implement strategies and courses to promote the development of generic skills across different courses, they must firstly define what "generic skills" are. It currently has several synonyms including key, core, life, competencies, work, employment, transferable, personal and others. These terms usually refer to "skills that are common to more than one work site, more than one occupation or more than one field of knowledge" (National Board of Employment Education and Training, 1996, p. 17). The Finn Review (1991) and the Mayer Committee (1992) were both commissioned by the Australian government to identify key generic skills considered fundamental to performing tasks in a wide range of occupations and needed by graduates from higher education institutions. These reports considered being able to work in teams, communicating clearly, personal and interpersonal skills, problem solving, understanding technology and using mathematical concepts efficiently, all as important skills required by employers in the workplace. This is in consensus with the Australian Council for Educational Research (2000) which found that the most frequently mentioned and desired generic skills by employers include communication, problem solving, critical thinking, interpersonal skills, ethics, life long learning and information and technology literacy.

Strategies Used to Develop Generic Skills

As promoted by Biggs (1999), Candy, Crebert & O'Leary (1994), Gibbs (1992) and Ramsden (1992), an emphasis on process, rather than subject content is needed to develop generic skills. Learning environments with a focus on the learner activities, rather than creating "excellent" lecture notes are needed. This approach is in contrast to traditional didactic methods of teaching in higher education institutions, which emphasise subject specific content and the transfer of knowledge from lecturer to student, which must often be memorised for examination purposes. This is also supported by Oliver (1999) who proposes three elements are needed when designing learning environments: course content; learning strategies, which determine how the learners engage with course materials; and learning supports or scaffolding, which is needed to guide learners and provide feedback on their progress.

Through a broad review of the literature, it was found that the three elements of self-regulation, reflection and authentic context are the central tenets of instructional design needed to create learning that can develop students' generic skills. As shown (Fig. 1), these learning strategies provide a framework for developing suitable learning activities that in turn determine the required learning resources and supports needed for effective learning environment.

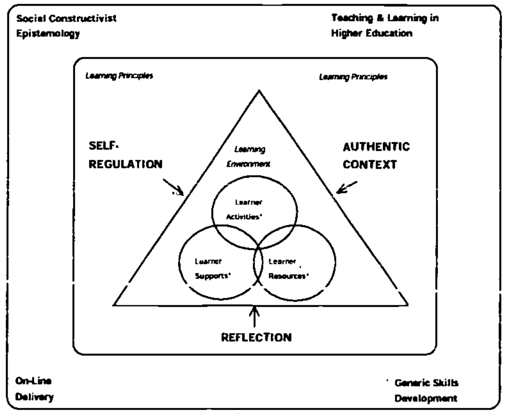

Figure 1: A framework for promoting generic skills

On the basis of the above framework, an on-line learning environment was developed for a final year project management unit (multimedia based) at Edith Cowan University. It incorporated a heavy group-work component, with a strong focus on peer-assessment (student contracts and weekly journals). Learning activities were developed using self-regulation, authenticity and reflection, activities with an emphasis on collaboration and self-directed learning. As part of a team, students were required to access necessary information needed to complete weekly tasks and then use self/peer assessment and journals to reflect about their progress, and that of their peers (Fig. 2).

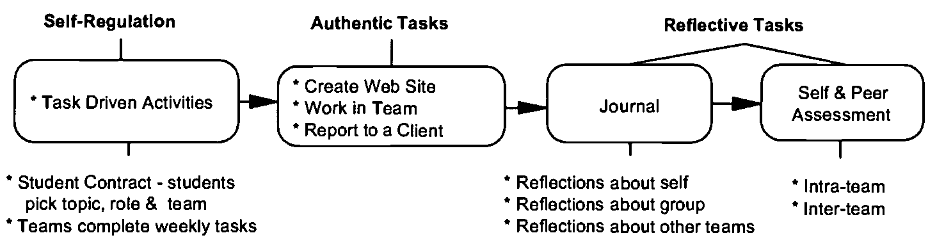

Figure 2: Learner activities associated with critical learning strategies

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Developing On-line E-Commerce Business Plans to Provide Students with Context and Job Opportunities

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Abstract: This action research presents a description of how an on-line E-commerce business-planning unit was developed. Initially, an intensive ten-day E-commerce course was developed in collaboration with government, industry and university sectors with a view of raising awareness and promoting electronic business planning issues. The course utilised a range of learning approaches, including peer teaching, in which participants were trained as team leaders to facilitate group learning. Based on the evaluation of this course, a full semester course for final year tertiary studentswas developed and evaluated. An overview of both case studies is given with recommendations for future developments.

The Need for E-commerce Training and Awareness

The rapid increase of Internet usage is demanding that businesses update their skills and re-engineer their organisations, products and services to meet new competitive demands both locally and globally. This is not only providing immense opportunity and threat for small, medium and large businesses at a micro-economic level, but is posing similar opportunities at a macro-economic level (Turban et al. 2000). Training is needed to support these changes that require equipping business operators with new skills and forms of information literacy. These demands raise some critical issues for educators, such as how to structure "rapid" training while at the same time keep pace with technology and business issues. How can large numbers of business operators be quickly trained in on-line technology? How can E-commerce strategies be quickly implemented by business to take advantage of this new revolution?

University courses spanning over three years duration will not provide the body of knowledge or skills needed by Australian business to compete in this rapidly changing marketplace. Training and development courses need to have ongoing collaboration and mentoring with industry to ensure the knowledge acquired is current and relevant (Mitchell, 2000).

Case Studies – Intensive and Semester Based Training Courses

In September 1999, a group of ninety, second year multimedia degree students from Edith Cowan University completed a two week intensive E-commerce business-planning course. They had no previous instruction in business planning and minimal understanding of E-commerce issues. Participants were required to develop an E-commerce business plan, which could be sustained economically by a business to sell products in an on-line environment. The course was subsidised by the Office of Information and Communications (OIC), which is part of the Department of Commerce of Trade, a Government department in Western Australia. Dow Digital (an E-commerce and on-line services consultancy and development company) developed the course and was subsidised to run it at Edith Cowan with a view of evaluating its effectiveness for university graduates in Australia, as well as how it could be implemented in third world countries.

In order to ensure relevant, authentic content, there was daily input by E-commerce experts and local business representatives that had established E-commerce as part of their business. "Just-in-time Learning" principles were used to deliver the course that focused on integrating students' knowledge base into real life contexts and engaging learners in collaborative project work (Erhaut, 1994; Ben-Jacob & Levin, 2000). This is supported by constructivist learning principles which emphasise social interaction, communication, exchange of views, collaboration and support for learners to take more responsibility for the learning process through learner-centred tasks (McLoughlin & Luca, 2000; McLoughlin & Oliver, 1998; Collis, 1998). Learning tasks required students to work collaboratively to create an E-commerce business plan and share the expertise of the group. Thus, collaborative learning, peer communication and negotiation were key elements of the learning approach. The course culminated in the students presenting their plans to a panel of E-commerce experts, members of local industry and their peers after the 10 days of intensive instruction.

A questionnaire was designed to elicit student and industry views on the value of the course. Results of the questionnaire were very positive, showing that students and industry representatives considered the course to be very worthwhile which was strongly reflected in point 8 of the questionnaire ("Overall, I though that the course was very worthwhile"), which rated 3.9 out of 4. From feedback gained, a number of conclusions were made: a two week intensive course is too short; the course is better suited to final year, final semester students; teams should be involved in developing more authentic business plans; team size should be no greater than four and students needed more help on creating budgets using spreadsheets.

On the basis of the two week intensive program, a full semester E-commerce business planning course was developed and implemented for final year, final semester multimedia students. A web site was set up for students to obtain the syllabus, chat on bulletin boards, download weekly notes/PowerPoint slides and contribute to an on-line "URL catcher". Students were given the opportunity to enter a business planning competition promoted by the Software Engineering Association of Western Australia (SEAWA) and sponsored by the Western Australian government. Successful teams were given four days of free training as well as notes and advice about how to build their business plans. All students were encouraged to use "real" business clients who wanted to move their businesses on-line. At the end of the semester, students presented their plans to peers, staff and industry representatives. (see http://www-scam.ecu.edu.au/projects/Business_Plans/BusinessPlans.htm).

Students were interviewed and questionnaires given to all participants in an attempt to evaluate the course. There was unanimous agreement that the course provided information and ideas that would help students gain employment, and also generate ideas for their own businesses. They also enjoyed the tutorial discussion sessions were contemporary E-commerce topics from newspapers, magazines and the textbook (Turban et al, 2000) were discussed by students and tutors. On the negative side, students felt the course did not integrate business-planning concepts with the weekly content well enough and would have preferred structured tutorial activities each week that would have contributed to the overall development of a business plan, with the E-commerce knowledge derived from the book tied into the business-planning structure.

Conclusion

The E-Commerce business-planning course was developed through a joint venture with business, government and Edith Cowan University. On the basis of a subsidised two-week course, a full semester-based course was developed for final year students. Overall, the course was well received by students and industry but was found to be deficient in structured business planning concepts.

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Fostering Higher Order Thinking through Online Tasks

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Abstract: Increasingly higher education institutions are being asked to be more pro-active in delivering instruction through on-line facilities, while at the same time being more effective in fostering higher order thinking skills for students. This action research case study considered the effects of tertiary students working in teams to collaboratively solve ill-defined problems in an on-line environment. The framework adopted for analysis of higher order thinking investigated types of talk that were indicative of reasoning processes. Results indicated that the students' capacity to display higher order thinking increased as a result of the students collaborating and communicating through the custom built on-line problem solving environment. The implications of the study are that on-line collaborative environments can facilitate the development of higher order thinking skills that are increasingly expected of graduates.

Introduction – Integrating higher order thinking and on-line technology

The ultimate educational goal for all educators that cannot be disputed must be enhancing students' ability to think and reason (Paul, 1993; McPeck, 1990). Research and interest at all levels of the educational system is promoting an increased emphasis on higher order cognition and lifelong learning (Australian Council for Educational Research, 2000; Candy, Crebert, & O'Leary, 1994; Brown, 1997). At the same time, students are increasingly being required to become familiar with using technology as a means of collecting information, and also as a means of communicating, collaborating and value-adding to their jobs.

Tinkler, Lepani & Mitchell (1996) propose that in a knowledge economy, where data and information are raw material, value-adding will require higher order thinking skills not only to convert information to knowledge, but also to convert knowledge into insight, foresight, and ultimately wisdom. This is supported by Candy, Crebert & O'Leary (1994) who also promote that access to and use of information technology is absolutely vital to lifelong learning and accordingly "no graduate – indeed no person – can be judged educated unless he or she is information literate" (p. xii). This view is supported by other reports which suggest that graduates must be technology literate in the new economy (Mayer, 1992; Finn, 1991; National Office of the Information Economy, 1998).

In Australia, as in many other countries around the world, this push toward technical literacy, generic skills and higher order thinking has resulted in formal testing being developed. The Department of Education, Training and Youth Affairs (DETYA) has funded the Australian Council for Educational Research (2000) to develop a "Graduate Skills" survey instrument and is being implemented in 2001 across all universities in Australia. This will enable universities to compare the variance in students' generic skills over the course of study, differences in student profiles between fields of study, and differences between universities. So the move to develop student generic, life long and higher order thinking skills must be taken seriously by all tertiary institutions. They can no longer just deliver content and ignore the importance of these skills.

However, the term "higher order thinking" is not clearly defined in the literature (Resnick, 1987). Talk of higher level cognitive processes evokes different views and perspectives from researchers, and this has been referred to as the great debate (Weinstein, 1993). Nevertheless, there is some consensus that when we speak of higher order thinking processes, we refer to thinking which is complex, multi-faceted and self-directed, and that the learner plays an active role (Resnick, 1987; Coles, 1995; Nastasi & Clements, 1992). In this study, we document the design and learning processes that took place in an on-line learning environment that aimed to promote the development of higher order thinking skills. Through the design of tasks that are authentic, collaborative and self-directed, students were engaged in solving ill-defined problems and self and peer assessment of others. Teamwork as facilitated by enabling students to give and receive feedback as well as comments on each others'work.

Context of study

Final year students enrolled in the Interactive Multimedia course at Edith Cowan University are required to develop skills and expertise in project managing the development of multimedia product, such as web sites. These skills are taught through the IMM3228/4228 "Project Management Methodology" unit where students practice developing web sites using project management models, performing needs analysis, developing design specifications, (storyboards, concept maps and rapid prototypes), conducting formative and summative evaluation.

The unit consists of thirteen, three-hour class sessions and runs over a full semester, or thirteen weeks. Each session consists of a one-hour lecture followed by a two-hour group-based activity. Team skills and collaboration are continually promoted and reinforced throughout the unit with teams of four students working together to build the web site. Learning outcomes include:

- communicating and collaborating in a team-based environment to effectively problem solve, resolve conflict and make appropriate decisions
- making a significant contribution to the development of a team-based web-based product
- developing a suitable project management model
- documenting and reporting on QA procedures, communication strategies, timesheet estimates, overall costs , proposal, legal, design etc which are representative of industry expectations
- evaluating the quality and effectiveness of the product

Students are required to complete three assignments that consist of a project proposal, design specification and final web site. Each assignment contains four assessment components. A team mark for the quality of documentation, final web product, and solving of the on-line problems. Individual marks are gained for reflective reports, which are designed to encourage students reflecting on their and others contributions. Peer assessment is encouraged and negotiated with the team at the end of each assignment (team members who are not performing lose points that are added to the score of other team members).

There were 73 students involved in the study, which was delivered through a web site in order to make the learning resources available to both internal and external students. The site include problem solving software, a Listserv, anonymous bulletin boards, time management tool, syllabus and assessment materials, lecture notes, legal/QA templates, relevant URL's, web sites developed by previous students and a student details database (see http://www-scam.cowan.edu.au/ and go to IMM3228).

Designing the learning environment

Group based project work (building a web site) and problem solving were chosen for their relevance and congruence to the learning outcomes that were sought. Project work and problem solving are advocated for their capacity to support the development of generic skills and professional expertise and are successful as instructional strategies in may contexts (Collis, 1998; Klemm & Snell, 1996; English & Yazdani, 1999). Learner activities were undertaken in teams, and the on-line problem-based learning activities involved a number of activities and tasks that appeared to provide strong support for the development of a number of key skills. The students were required to undertake the following activities each week:

- Problem solving - the tasks required students to seek information from appropriate sources in order to solve problems that reflected state-of-the-art knowledge about project management. The students are able to use the Web as an information source but had to select from the many resources available, those that were relevant to the task

- Peer evaluation - having solved the problem, student teams were then required to develop criteria to apply to others solutions. The students had to examine the information given by other students, consider the scope of their inquiry and decide on the parameters which they were going to assess with, and also give feedback on.
- Collaboration - each group consisted of four students and required them to organise themselves into productive teams and share the workload, undertake separate tasks and maintain tight deadlines and schedules each week. Such activities demanded that students consider the requirements of others, be adaptive, responsible and flexible.
- Personal reflection on task and process - each student created reflective notes in which personal views of self-progress was recorded. Students considered the skills and competencies they applied, noted the skills that needed to be developed and developed learning goals that carried over to the next task. This provided a strong framework for the development of personal and process knowledge.

The on-line problem solving process is illustrated below (Fig. 1). From the figure it can be seen that it allows for communication, peer assessment and finally individual reflection on how successful the whole process was. Students post their solutions and then view, assess and give comments to other teams solutions in an anonymous fashion. This enables students to view others solutions and perspective's and also pass comments within the 'safety' of the on-line environment. So students can comment on the overall process and see how the efforts of their team compared to that of others as suggested by both peers and tutor feedback. To help student teams develop an approach to the problem solving process, the "Stair-Step" problem solving process developed by Lynch, Wolcott & Huber [, 2000 #133] was explained and illustrated to the students.

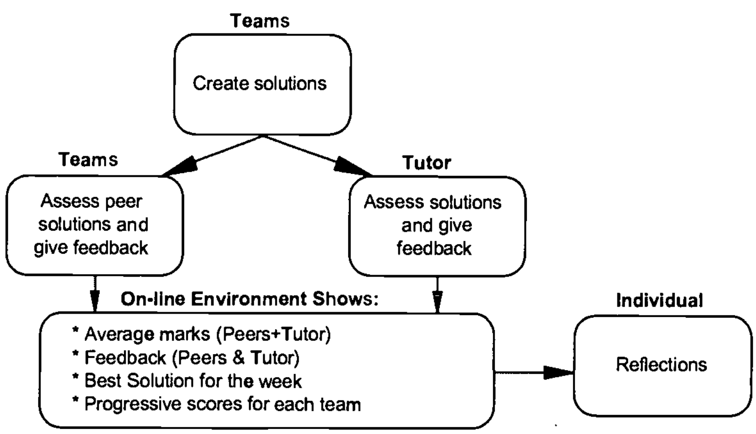

Figure 1: The on-line problem solving process

For the group project, students were required to complete three assignments that consisted of a project proposal, design specification and a web site. Each assignment contained four assessment components: a team mark for developing the project, a team mark for solving the on-line problems, an individual mark for personal reflections and intra-team self/peer assessment mark. Students were given three problems to solve as follows:

- *Assume that you are building a web site for a difficult client who thinks they know lots about multimedia design and development! Outline how you will scope the project, collect the content, develop acceptance criteria, control scope creep and cost the overall project. (Consider issues such as client objectives, feasibility, end users, hardware/software, use of sound/graphics/video, potential difficulties, evaluation (formative), implementation issues, maintenance issues and content collection issues).*
- *If the client asks for changes in design or content after you have commenced production, what should you do? How can the design specifications be tied into the legal contract? How will the prototype, formative evaluation process or storyboards help with this? What other considerations should you bear in mind?*
- *If you were the client, how would you ensure that the final product met the original objectives? If you were the developer how would ensure that you had satisfied the original objectives to the letter of the original contract?*

Working on-line gave students the opportunity to access multiple forms of peer support through shared tasks, teamwork, collaboration, feedback and peer review. It was hoped that this environment would create an effective climate of support in which students could practice developing generic and higher order thinking skills. To test the effective gain of this on-line environment in developing skills, an key-word indicators were used to monitor instances of higher order thinking, as explained in the following section.

Methodology

A discourse analysis approach was used to identify instances of higher order thinking in student responses developed by McLoughlin & Oliver (1998). This approach used a taxonomy of key-word indicators to signal instances of higher order thinking using the categories of cognitive accountability, critical enquiry, interpretation and reflection. This is based on a collection of words used in the English language which signal a statement is serving the function of reasoning or higher order thinking. For example, inference indicators such as "because" or "whereas" signal that what follows is a reason being given for the statement (Thomas, 1981). Key-word indicators for each of these are based on the following:

- Cognitive accountability, in which students explain or justify a concept, is evidenced when their language use includes "because" or "cos" to link a reason to a claim. Or, when they say "so", "then" or "therefore" to signal conclusion or inference drawn from preceding evidence
- Critical inquiry, in which students challenge, inquire, clarify, investigate or question a concept, and is evidenced through their language by questions such as "what if?", "why" or "you mean" in order to challenge or make deeper inquiry. Also, students can draw a hypothesis through the use of "if...then", "would", "maybe" or "perhaps" to link conditions to inferences
- Interpretation, in which students express opinion, suggest ideas, make rules, generalise, compare/contrast and give examples is evidenced when their language use includes "it means", "that means", "it says", "I think", "always", "never", "in comparison" or "for example/whereas" in order to express understanding or interpretation of text, activity or concept
- Reflection, in which students evaluate ideas when their language use includes "I think" or they make some form of metacognitive statement. Also, when their language includes some form of self evaluation or awareness of learning

Using these key-word indicators to find instances of higher order thinking provided an effective means of substantiating improvement in students' dialogue. By counting the number of key-word instances for each response in each problem solution demonstrated how student language changed over time, which illustrated whether the intervention had been successful in promoting higher order thinking. This type of analysis is supported by a number of studies (Thomas, 1981; Means & Voss, 1996; Tishman & Perkins) which also suggest that reasoning can be assessed by analysing how the discourse is structured.

The study used a computer based text analysis approach (NUD.IST, 1994) which enabled the researchers to search for instances of the on-line text that contained keywords which represented higher order thinking. The corpus of data used was based on feedback responses given by teams to peers' solutions ie student teams were required to assess and give comments (up to five hundred words) justifying the given mark to four other teams. As there were three problems to complete during the semester, we were able to collect three discrete compilations of responses in order to monitor changes.

Results

Because of the large amount of data generated for each problem, it was decided to investigate only a portion of the whole corpus. One of the four classes with twenty students was used over the full semester and their responses for each problem was coded. As shown (Fig. 2), a clear increase in the number keyword indicators used can be seen over the development of the three problems. A closer analysis in the second diagram shows that the main increases resulted from keyword indicators promoting critical inquiry. Keyword indicators for cognitive accountability, interpretation and reflection showed no significant increase.

The system of coding keyword indicators was useful is gaining an understanding of trends in the data. However, it was still necessary to examine the data manually and make decisions about how best to code some elements which didn't fall into any of the specified categories.

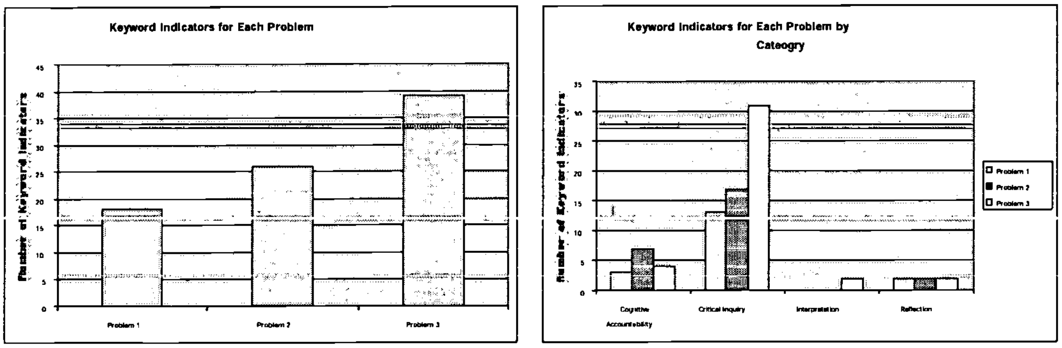

Figure 2: Higher order thinking keyword indicators for each problem

It was evident that as the semester progressed, and students became more confident in giving feedback, they became more direct and critical with their comments. Some examples of the comments made by students follow.

- "If you were the developer, how would you ensure that you satisfied the original objectives to the letter of the original contract"
- "It would be very interesting to see an expanded explanation from this group"
- "Who, what etc? What does this exactly mean? You should have expanded this more, it just doesn't make sense the way it is"
- "We feel that you have significantly missed the point of the question. The question asks how would you ensure that you HAD satisfied the original objectives not how you would ensure...."
- "We found your teams solution unclear and were not sure what you mean. You start talking about the developer then suddenly start talking about the client again. It would be better if you tried to stick with one idea before discussing the next one"

Summary and conclusions

The on-line problem solving application provided an infrastructure for the students to post solutions to ill-defined problems, and then view, assess and critique other solutions. Not only did this provide multiple perspectives on how to solve the problems, but it also encouraged students to reflect on solutions, challenge and question each other and revise their own ideas. Using a discourse analysis approach with keyword indicators to represent occurrences of higher order thinking, showed that there was a clear improvement over the duration of the semester. Our research indicates that online problem solving tasks have the capacity to foster inquiry skills, collaborative dialogue and critical thinking. Furthermore, the analytic approach of discourse analysis applied to online transcripts of tasks provided an indicator of the levels and types of thinking that occurred online. Our research will continue to refine the types of tasks that can be applied in online environments to support higher order thinking processes.

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An Educational Portal Oriented to the Development of Dynamic Learning Communities on the Internet in Brazil: The EduKBr Portal

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Abstract: The mutual plan/objective of this project is the construction of an Educational Portal--the EduKBr Portal--for a virtual Internet community that values education, quality of information and the process of knowledge-building.
The EduKBr Portal Project is a technical-educational product idealized, developed and implemented by EduWeb with the participation and partnership of Kidlink Project in Brazil's multidisciplinary team.
During 1998, Kidlink and Kidlink Project in Brazil were awarded and/or received governmental aid. Nowadays, the KBr Project coordinates the Kidlink in Brazil Project and is ahead of all activities and national socio-educational projects that support the development of the global Kidlink Portuguese Language Forum. The main goal of the new KBr Project and its Portal is to "spread the word" about the Internet mentality and support the Brazilian Educational System, with activities, cooperative projects, own educational web sites and communication/interaction in Portuguese to schools, youngsters and parents and professionals in Education.

The objective of the EduKBr Portal Project is to be an integrated, cooperative environment for learning and a space for coexistence and exchange of experiences, where knowledge can be shared among peers in the Brazilian cultural socio-historical context. It will be an open environment for learning and will be permanently under construction. All the interactive activities suggested by kids, youngsters and adults will be continually stimulated and necessary for the development of the community and of this environment.
The EduKBr Portal will be a collective workplace with the following objectives: (a) to apply the information technology, communication and cooperation found on the Internet in teaching-learning process in a consistent and innovative way—either pedagogically or technologically speaking, (b) to motivate the Cooperative Distant-Learning based on the Internet, applying inventive learning methodologies that serve different users, (c) to create a Brazilian multicultural community whose interest be directed to Internet in Education, (d) to disseminate the environment among various segments of society, aiming support of people interested in cooperating and participating in this virtual community, (e) to stimulate the mentality of collective and cooperative construction of learning among the participants of the environment, (f) to evaluate results obtained during the teaching-learning process.
EduKBr's greatest commitment is to create an online community involved and prepared to collaborate in a innovative way in order to make this educational environment useful and adequate to our reality, aiming to (a) democratize access to information, (b) disseminate the Internet as an object of common use and of wide-range application in Education, (c) develop the technological/scientific aspects of Computer in Education.
The EduKBr Portal idealized for this project is an specialized environment whose principal preoccupation is quality of information and it is structured to develop: (a) teaching-learning process, (b) implementation of human resources, (c) planning of distant-learning courses, (d) educational technology resources, and (e) Web-based Dynamic Communities for Learning.
The environment is divided in web sites that present projects, activities and services based on thematic content directed to: (a) the everyday life of youngsters and adults, (b) multicultural aspects and (c) disciplines or study areas prone to have or to suggest interesting topics and content associated to the Brazilian Web.
Because EduKBr is a thematic portal, consequently, considerations and pedagogical content are specific for each of the web sites of the environment. All the actions of the portal aim the formation and integration of citizen that are capable of exchanging experiences and realizing activities for personal and/or communitarian growth, within the new Information Society context.

Is this sense, the pedagogical content is directed to the assistance of some problem resolutions of our socio-economic-cultural reality and of our educational system (e.g. late school computarization, lack of motivation for participation in classes), that has been identified through ethnographic researches.
In a long term, the EduKBr Portal will be capable of (a) offering Brazilian schools a space with variety in possibilities and educational activities of quality, (b) simplifying the use of technological resources in order to facilitate interaction, integration and access to tools (eg. search engines, videoconference, GroupWare tools, production of images, sounds, etc.) within an only environment, (c) providing a democratic way of accessing documents and multimedia content, (d) facilitating query, inclusion and actualization of data/information in a distributed application activity, (e) combining curricular and extra-curricular items, meeting the interests of the users community, and (f) keeping an attracting, ludic, secure and stimulating place on the Brazilian Web.
Considering the opportunities and problems identified above, these objectives indicate the strategic relevance of the project and point to the social application and the economic potential for Education on the Internet.
The Educational Portal idealized for this project intends to be a "point of reference for the Brazilian Education" and an "Open and Virtual school on the Internet", according to the respective philosophical directives that characterize all of the works developed by EduWeb with collaboration of KBr Project.
Every website and project developed by the pedagogical team of KBr Project and graphically and technically implemented with partnership of EduWeb on the Brazilian Internet are serious products, result of educational field researches and of a qualitative evaluation process realized together with its users. Only after going through these stages the product will be available without any cost for the user.
In addition, security associated with quality were more than a criteria for being considered an important condition for those who intend to access selected information, far from the amount of random content presented on the Internet. Once in the portal, the user should not have any possibility of diversion.
When we think of security, we do not refer only to pornography or improper communication the Internet provides. There is, also, preoccupation regarding the quality of information presented, may it be produced by our pedagogical team or by suggested links.
It is important to point out that nor are we naive, or pretentious, but we know that not always we are going to reach our objectives—knowing the challenging characteristics of our users age (up-to-18-years youngsters). However, our obligation is to be at the head, offering places and indicating pages that offer relative security to schools. Surely our care does not invalidates the responsibility and attention teachers must have and pass to their students in classroom or in computer laboratories when they are using the Internet. This recommendation is valid to parents who do not watch the time their children spend online or what use their children make of the navigation on the Internet.
The differential, pioneering and another strategic relevance of the EduKBr Portal Project that guarantee and make its implementation technically possible are: (a) its interface verticality, (b) its commitment with Information Technologies applied to the creation of Dynamic Communities for Learning on the Web, and (c) the use of resources of Educational Technologies (e.g. Interactive Multimedia) for a quality Education/Distant-learning.
However, for the project to be successful, are still need we financial resources to: (a) guarantee the management autonomy of the environment, (b) pay the regular professionals and specialists that act in each of the thematic web sites, (c) study carefully the pedagogical content, (d) create an attracting graphical interface that is, at the same time, coherent with the new form of language and communication established on the Internet, and (d) offer a quality product committed with the formation of citizens that participate in the Information Society.
The proposition of this new education, supported by the use of mechanisms of science and of technology, should not cause the abandonment of human values. It should, instead, involve an specific knowledge directed to a social organization of the production and an opening of the specialized work market.
One of the roles of school is to form citizens apt to face the challenge of the society. The current model of society needs, unquestionably, of computer systems allied to a process of multieducation.
It is, therefore, vital that the use of the Internet in classrooms be clear. It is important to develop interest in, train and form teachers so that they participate in this development and be capable of transmitting their experiences and knowledge to their students. It is necessary to form a critical mass in debates on implications (specially those of social nature), methods and tools of computers applicable to Education in order to avoid the arising of a purely instrumental perspective of the use of computers in school.
It is for—and in—this scenario that the thematic web sites to the EduKBr Portal Project are structured.

QuS-Support of Digital Video Broadcast (DVB) in the Next-Generation-Internet

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This presentation provides an overview of possible protocol suites for encapsulating a high bandwidth demanding Digital Video Broadcast (DVB) stream in IP overlaying protocols, namely RTP, RTCP, RTSP and RSVP over fixed technology as physical transmission media. The presenters introduced a DVB Protocol Layers for transmitting DVB Service Information (DVB-SI). This layer-model will be extended and generalized for generic DVB stream transmissions by using a Multi-Protocol Architecture approach, that allows achieving inter-operability in multi-protocol architectures. This approach allows co-existence of different protocol architectures as a set of mixed protocol families, and seems to be quite suitable for transmitting DVB streams over IP by using different protocol types. Furthermore this presentation emphasizes quality-of-service, bandwidth requirements, resource-reservation and real-time boundaries for this very high demanding networking application.

Quiz collaboration — cheating or a learning opportunity?

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Abstract: In a statistics course for engineers, we have designed a system for assessment where web based quizzes is one of the key elements. The basic ambition has been to find a way to make students more active during the course, and to provide learning situations where discussion and collaboration are key elements. The need to achieve this in a cost-effective way has also been addressed. The new course design is a structure where students along the course have to answer sets of randomly selected questions that often are based on random data sets. The course design has made it possible to encourage student collaboration, both in other parts in the course and in quiz answering.

Introduction

The quality of learning is to a great extent dependent on reflection. However, even though a reflective behaviour usually is regarded as something desirable, it does not seem to be one of the most apparent characteristics of many students within higher education today. One underlying claim in this paper is that one of the most influential elements determining student behaviour is the assessment system, an element found in most higher education courses. The purpose is often to get a basis for the assignment of grades, but the process is seldom or never neutral: the assessment procedure is usually something students adapt to. The assessments are usually perceived as an integral part of the educational system and often also as legitimate, but there are several drawbacks with the most common assessment designs. Some of these that will be discussed in this context are the following:

- In many courses based on ordinary lectures, students tend to be rather passive during lectures even if teachers might regard activity as a way to get the opportunities to reflect upon.
- In a course with a final exam, students often tend to spend a great deal of their efforts rather late in the course preparing for this exam. When sorting out new concepts depend on time and reflection, which clearly is the case in our statistics course, it would be better if students were more active earlier in the course.
- The assessment procedures are often resource demanding, as well in construction, review, grading as in the administration of grades.

Furthermore, there often seems to be a heavy emphasis on getting the right answer rather on learning from mistakes which from a constructivist viewpoint seems more desirable (see Lundquist, 1999). This emphasis is an obvious effect from relying on exams and grading, because in such systems, it is the final answer that is counted and not the processes that have lead to this end. This emphasis is however presumably part of a more general culture, so this might appear just as clearly in systems based on other assessment approaches.

The new course design – background

In a statistics course for engineers, we have tried to find ways to cope with the drawbacks that were previously mentioned. It is one of our largest courses (6.0 ECTS credits), running four times a year with between three to six groups with about thirty-two students in each group. The grading system is based on two parts, the assignment part and an exam part. Both are compulsory, and depending on results in the exam part, students are assigned one of 4 grades: not satisfactory, 3, 4 or 5. After a gradual development drawing on experiences from changes in several courses, we have now got a course based on the following elements:

- Depending on teacher preferences, class sessions could be organized as either a) a mixture of lectures and problem solving, or b) no or very few lectures but where students work together in groups of about four with solving suggested problems, and where the teacher role is more of a facilitator (see Dunkels, 1996).
- Laboratory assignments where students work with statistical software to solve larger sets of problems. In the course there are now 4 such assignments, out of which 2 are subjected to a procedure of peer review: students review other student lab reports under the guidance of a teacher. No grades are assigned, but having completed these assignments is one of two compulsory elements in the course.
- During the course the students are required to answer a set of 4 web based quizzes.
- The final exam consists of two parts, the first with questions similar to the ones in the previous quizzes and a second where students submit full solutions. A student is assigned a grade of 3 when both the quizzes and the first part of the exam are completed. If a student wants to try for a higher grade (4 or 5) then the second part of the exam must be completed.

As a side effect, previous students who for some reason have not completed the final exam with satisfactory results have been allowed to go through this quiz system. Several of these have left their studies and are now working, even though they have had at least this actual course unfinished. For several individuals in this group, this design has made it possible to complete the exam part of the course without having to go to Luleå, something that has been perceived as favourable.

Overall effects

The course has been running with the present design for a year, and most important is that we have no indications that the new design has lead to any noticeable loss in student understanding. Instead we believe that it has been an overall improvement, mostly because of the following:

- Students are more active during the running course than they used to be.
- The quiz construction with random selection of questions and differences in questions in repeated attempts makes repetition meaningful: it leads to variation rather than rote learning.
- Many students collaborate, both in general and in quiz answering. They often seem to respond the way we want them to: rather than trying to find an efficient way of 'feeding the system', the quiz element is perceived as providing support in their learning.
- Students appreciate that the quiz structure (which is described further in a following section) provides immediate feedback.
- It has required some effort to construct quiz questions, but it has still not meant an overwhelming workload due to the fact that many questions have been constructed in previous courses that have been easy to import and, if needed, to rewrite. During the year 00/01, the quiz module has been kept relatively unchanged because of the need to see how it works in a steady state.

The quiz construction

The quizzes are part of the course web designed in WebCT. The course web contains other elements such as handouts, bulletin board, e-mail and management of student results. During the course, quizzes are set up in the following manner:

- Every quiz is made available during about a week with start and end dates following the course.
- In a given quiz, there are about 7 questions.
- A given quiz can be answered 5 times, and the best result is counted as the final one for that quiz.
- The questions are often selected randomly from a larger database, so in two repeated attempts or when two students enter at the same time, the questions are usually not the same.
- One of the different question types is called 'calculated' meaning that the system generates a set of numbers defining the particular question, and where students should enter a number as their answer. An example: in a question like "Given that a component's lifetime could be described by a normal distribution with mean 100 and standard deviation 20 (hours), what is the probability that the component will last longer than 120 hours?" the numbers 100 and 20 are selected from a database of randomly generated data sets.

Issues of concern

We have been concerned by the possibility to 'cheat' in this system. All students have to answer their own quizzes, but obviously we cannot definitely say who has answered a particular quiz. We have used different limits on the time a given quiz is available as a means to make cheating harder. There are those who cheat or at least depend heavily on others, even though they seem to be relatively few as far as we can understand from course evaluations. However, it seems as if the most important part in making cheating less likely is the construction with random selection of questions where several of these are based on randomly generated data sets. Since a particular answer set cannot be used directly in two quiz sessions, we have found that students are not so likely to 'help' each other by answering questions for someone else. Collaboration has instead of being a way to cheat become a positive element: two students working together get to see more questions than each of them would individually.

The entire design is also dependent on relatively low emphasis on assessment as a whole. The course elements are not graded separately as is common in higher education in many countries, but mostly simply compulsory. With grades assigned to quizzes, there would presumably be a greater urge to act rationally, i e make the most out of as little input as possible. This usually implies what teachers call 'cheating'.

Another important issue is whether the series of quizzes really can match the kind of final exam used before. There are obvious differences as to the level of detail that can be measured with the two instruments. Many students say they have learnt more than they would have with an ordinary final exam, both because they are required to complete the quizzes during the course and because of the collaborative element. Such opinions seem to have some validity, especially when expressed by elder students who only wanted to complete the exam part of the course, since they have previous course experiences to compare with. However, we cannot be certain that student results with the quiz system are on a level with the previous situation with the final exam. The issue is not easy to resolve, partly because of inherent difficulties to define what we really want to measure, i e understanding of the subject. This problem will hopefully be possible to tackle in future studies.

The issue of changes in workload is also not so easy to deal with. The amount of time spent on designing and review of final exams is naturally greatly diminished. Instead we have had to spend more time responding to students' e-mail, administration of the course web, sorting out technical questions and such. There has also been a change of when teacher resources have been spent. Instead of putting a lot of efforts in the later stages of the course with review of exams, there have now been more hours spent on for example design and maintenance of the course web. Our impression so far is that there has been a net gain in the sense that we have spent less time on the course as a whole, but there have been no really thorough measurements yet.

It has also been evident that this kind of structure itself can generate stress and frustration. All students are not so experienced with computers, so for some, the general idea of having to work with computers is frustrating. There has also been a tendency by some students to perhaps spend more time than they should have when answering quizzes. Instead of going back to the literature or simply think, some seem to perceive the quiz as some kind of computer game where they make repeated attempts without really trying to come to grips with a particular question. Furthermore, since the quiz system is machine based, the grading of answers is merciless. A simple typing error can make the entire answer graded as incorrect, whereas a written exam is reviewed by a human who is able to make balanced judgments. The overall impression is that most students have perceived the course design as positive. In course evaluations they have noted that there has been a supportive atmosphere both between themselves and with respect to the teachers. Many have also expressed great satisfaction with the quiz system, and then especially the prompt feedback. On the negative side is the frustration and stress experienced by some students. They are not so many, but on the other hand, they seem to be so troubled that their reactions cannot be simply ignored.

Conclusions

With a basically constructivist approach, our ambition has been to make it possible for students to collaborate, discuss and learn from own mistakes in order to make the course elements meaningful to themselves. The idea of using a course web is in itself something we primarily have perceived as a way to facilitate students' work, but we could mostly do without such support structures. The possibility to use self-correcting web based quizzes on the other hand has been a new element. Assessments usually have a significant influence on student behaviour, and this effect often seems either neglected or regarded as a problem. Our ambition has been to make use of this influence rather than trying to avoid it. The assessment system now consists of quizzes, administered sequentially during the course, and with a quiz design where repetition becomes variation and where collaboration is an advantage rather than the opposite. The experiences so far are positive. Our ambition was to improve our course by constructing an efficient structure that does not simply decrease teacher-student contact but instead makes use of new ways of interaction. The present use of quizzes has become such a way.

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Even though this paper has one single author, the entire course design has been the result of close collaboration within a group consisting of me and my colleagues Kerstin Vännman and Fredrik Johansson.

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Training, Support, Practices and Needs of the Distance Educator

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Abstract: Research has shown that faculty plays a key role in successful implementation of online instructional courses. Since faculty hold such an important role in the successful implementation of online courses the purpose of this study is to identify training, support given and needed, hours spent online, type of web course implemented and information that can be used to foster effective distance learning programs in the university setting.

From 1995 – 1998, higher education institutions offering distance education courses increased from 33 percent to 44 percent (Lewis, Snow, Farris & Levin, 1999). Many universities are purchasing online course delivery systems (such as Blackboard and Web CT) to use for their online courses. Faculty will have to be trained and given support, and more staff will be needed to maintain and improve distance education programs for the future. According to Williams (2000) the thirteen identifiable roles that are required to implement and manage distance education programs in higher education include: administrative manager, instructor/facilitator, instructional designer, technology expert, site facilitator/proctor, support staff, librarian, technician, evaluation specialist, graphic design, trainer, media publisher/editor, and leader/change agent.

Studies on online instructional courses in higher education institutions (Betts, 1998; Rockwell, Schauer, Fritz, & Marx, 1999; Willis, 1994; Wilson, 1998) indicate that it is the faculty who play the key role in its successful implementation. It is imperative to determine those factors that affect faculty in their adoption of online instruction such as support and training to improve an online program (McKenzie, Mims, Bennett, Waugh, 2000). In a study done concerning faculty education, assistance and support (Rockwell, Schauer, Gritz, & Marx, 2000) it was found that faculty needed further education about, assistance with, or support for developing interaction, developing instructional materials, and applying selected technologies. Other studies (Clay, 1999; Betts, 1998; Clark, 1993) support the need for training and support for distance educators.

The purpose of this study was to identify: a) training received on Blackboard (online course delivery system), b) tools used on Blackboard with courses, c) the number of hours spent interacting with students on-line each week through the use of Blackboard, d) other uses of Blackboard besides online classes, e) the number of hours students are spending per week using Blackboard for the course, f) if an adequate amount of support for Blackboard implementation was received, g) what kind of support was needed, h) the number of hours or classes that were used to orient students to Blackboard, i) other technology used in classes in past, and j) the type of web course (web-presence, web-enhanced, web-centric, or fully web based) that was offered using Blackboard.

The sample for this study included fifty-nine faculty members at the University of Louisiana at Lafayette who chose to include online technologies in their teaching and research. Respondents spanned seventeen different departments including faculty, staff, and administrators. A survey *Blackboard Usage and Technology Integration Questionnaire* was developed. The survey consisted of open-ended and closed-ended questions pertaining to information on Blackboard training, Blackboard support, tools utilized in classes, amount of time involved online with Blackboard, number of hours spent to orient students to Blackboard, other technology used with courses, and type of web course implemented on Blackboard. The study was conducted during the Fall 2000 semester.

Forty-one surveys were returned. Findings indicated one web presence course, twenty-two web-enhanced courses, five web-centric courses, and web based courses were offered. Blackboard was being used for the majority for placement of the syllabus. Additionally Blackboard was implemented for Internet assignments, External links, and Discussion Board. The majority of faculty had not gone through formal Blackboard training. The hours that faculty spent per week on Blackboard for one class ranged from one hour to ten hours. Faculty estimated that their students spend anywhere from fifteen minutes to eight to ten hours per week on Blackboard for one class. The majority of faculty felt like they had enough technical support for their implementation of Blackboard. Additional support that faculty felt was needed included technical assistance in setting up the courses on Blackboard. Most faculties had previously used PowerPoint notes and Internet assignments in their courses.

In conclusion, faculty is using new technology in their teaching. For faculty to be successful with technology integration, training and technological support is a must.

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Workload, Advantages, & Disadvantages of a Newly Developed Online Course

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The introduction of computer technology necessitates a change in the approach to education at the university level. Distance education is capable of offering new learning opportunities unrestricted by time, distance, or individual differences among students. The course Health and Sexuality was designed and piloted as a web-based class during the Spring 2000 Semester in the Department of Kinesiology at the University of Louisiana at Lafayette. The purpose of this study was to determine the workload hours pertaining to the design and teaching of an online course, and to ascertain advantages and disadvantages involved in taking and teaching an online course. Some advantages students expressed included the ability to work at their own pace, and not having to attend class. Disadvantages included computer problems, and procrastination. Grading workload and time on the computer increased tremendously for the professor. This information will be used to improve online teaching and learning.

Expanding e-learning effectiveness.
The shift from content orientation to knowledge management utilization.

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Abstract: The e-learning industry in recent years faced a tremendous development. The technological capabilities of modern tool-sets expand from off-line to on-line solutions covering a wide spread of learning needs (Close et al, 2000), (Ruttenber et al). Nevertheless the requirements of modern business units seem to diversify from training seminars to corporate learning portals implying a desired reinforcement of capacities for effective actions. Academic institutes such as universities have to adopt their traditional approaches in the modern setting. The e-learning initiative both in corporate and academic environment defines new ways of improving performance. The objective is to reveal the necessity to formulate dynamic learning environments capable to be customized according to value perceptions. The research effort is concentrated on the definition of variables that will enhance the value justification of such systems and will realize the modularity of a value creating e-learning environment through advanced knowledge management systems.

INTRODUCTION

The establishment of e-learning systems within business settings or academic institutions is something like fashion. Many models, many different types, many markets, many interest groups, different degrees of satisfaction and many users looking for customized solutions (Urdan & Weggen, 2000). Unfortunately the e-learning market is not as mature as we would prefer in terms of effective solutions, advanced functionalities and learning standards.

The analysis of the e-learning market in Europe as well as in USA is not only difficult but it has to be based on issues closer to effectiveness than to population increase. In most of cases the virtual universities, the e-learning systems base their functionality on a simple browsing mechanism accompanied with a section of web links and a few on-line quizzes. In other words which is the value of such a system when in most of cases the employment of the ICT's is limited on static learning scenarios. We could state that these systems secure the growth of the so-called distance-learning marketplace in Europe even though the learner satisfaction from such a system is very limited. A critical question is can we enhance the learner satisfaction on an e-learning system or his first impression will be negative. The mass of integrated e-learning platforms seems to be unable to support different degrees of value delivery. They seem to construct their powerfulness over common characteristics that in general simulate the traditional way of teaching. So a number of critical questions emerge:

Does e-learning differentiates from the traditional learning? Can we define concrete ways of content enrichment in virtual environments, which add value in traditional learning content and support dynamic learning settings? Can we justify theoretical foundations that prove the different value layers of learning efforts? Can we test the ability of learning environments to support different educational goals through the employment of different learning processes? Can we develop learning environments capable of supporting the intellectual capital exploitation both in academic and business environment? Finally but not least, can we formulate a framework that will support the Enterprise Application Integration in a manner that will take into account the learning needs of business units? In other words can we define an application layer within business Intranets that will establish knowledge management architecture?

Our experiences from various projects related to e-learning can be summarized in the figure 1. The *learning effectiveness*, a concept with various quality factors included, has a direct relation to the technological complexity of the e-learning environment. The distinction of five relevant learning paradigms is not only a theoretical value hierarchy that formulates a contextual setting for analysis. It rather gives an essential feeling for the inability of many e-learning initiatives to be effective for the trainers and the trainees.

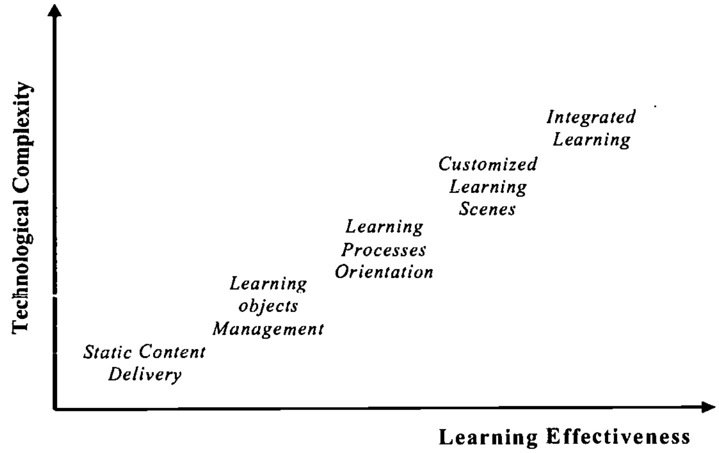


Figure 1: The e-learning paradigms evolution

The five learning paradigms that deliver different levels of value are:

STAGES OF E-LEARNING EVOLUTION	
1. Static Content Delivery	Content selection, Html Authoring
2. Learning Objects Management	Knowledge Base, Metadata, Value Components
3. Learning Processes Orientation	Learning Processes Specification, Pool of LP
4. Customized Learning Scenes	Learning Needs Recognition, Learners Profiling, Learning Styles, Learning Paths
5. Integrated Learning	Application Integration, Corporate Portals

Table 1:The technological characteristics of the five e-learning paradigms:

The majority of e-learning initiatives are limited on the application or the customization of learning platforms that facilitate the delivery of learning content on a predefined, static and sequential way. The flexibility of such implementations is rather inadequate to support the dynamic nature of learning, but as it is the easiest form of doing e-learning it is also the common one. The incorporation of knowledge management mechanisms in learning platforms such as learning objects databases supports the effective management of learning content in terms of reusability and utilization of knowledge bases. This functional enhancement of e-learning environments is not enough to utilize the learners' perception for e-learning usefulness.

The inability of the two first e-learning paradigms to provide dynamic features to the learners as well to the trainers set a "wall" that has to be penetrated in order to exploit further the effectiveness concept. This penetration has to be based on more sophisticated technological components that allow the establishment of dynamic e-learning strategies. The orientation of e-learning to the learning processes that define the learning paths for the trainers is very critical. The detailed analysis of different learning processes provides a pool of available learning scenarios. The reveal of learning paradigms that penetrate the "wall" require more advanced technological infrastructures. For example the dynamic combination of learning processes in e-learning environments have to take into account the full support of the embedded learning subtasks. In other words the engineering of such a system will need enormous effort for the well-justified distinction of learning subtasks and subsequent technological required components.

Another consideration for the enhancement of effectiveness should be the profiling capability of an e-learning platform to utilize its components on the direction of creating *one to one learning situations*. The recognition of learning needs, the diversification of learning styles, the categorization of learners according to their preferences in specific learning processes, their interest in specific learning objects that cover their knowledge deficit are namely parameters that differentiate the e-learning paradigm of customized learning scenes. The profiling procedure for the accomplishment of such a scope has to be based on advanced algorithms and of course extensive parameterization of the e-learning environment. The multifold flexibility seems to be a well-defined effective learning goal but in order to be tested and to be implemented it needs enormous research effort. Finally the need to develop effective knowledge management mechanisms in modern business units, sets a subsequent goal to integrate e-learning systems with other critical enterprise applications. The orientation of e-learning to business process knowledge management in modern e-businesses and enterprises of the digital economy formulate a context on which the learning content has to be discovered in all the spread of the daily business operation. The tacit and explicit knowledge that is hidden in people, business processes and services has to be captured and promoted in e-learning systems. The Enterprise Application Integration dimension of e-learning paradigms nowadays is the piece of the puzzle that has to be incorporated in e-learning paradigms. The critical issue from this perspective is to be able to develop a grid on which every business processes could be related with specific learning processes. A first implication of our intention to create a theoretical tool capable to map the relation of a business processes to a mix of different learning processes is a grid that helps the relation of any business process to specific learning processes according to their embodied value. A learning scenario is a combination of learning processes that formulate the educational space for the trainer and the executive trainee. A first approach is presented in figure 2.

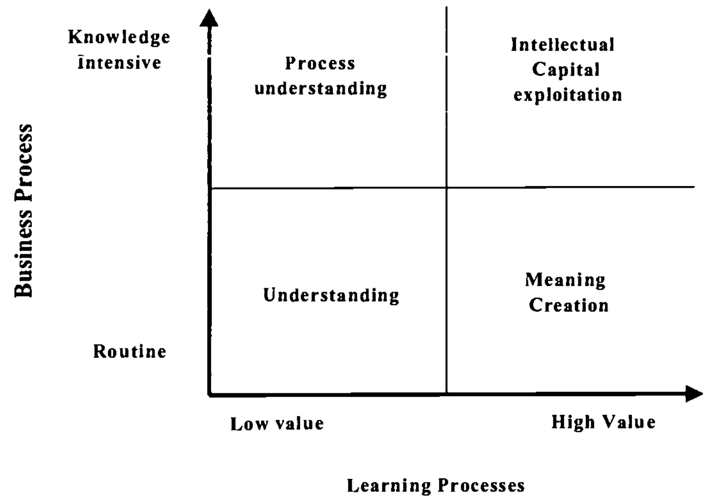


Figure 2. The business to learning process grid

The two dimensional grid defines four separate quadrants capable to describe four different learning situations. We distinguish four learning situations that are supported by different learning processes:

1. Understanding
2. Meaning creation
3. Process understanding
4. Intellectual Capital Exploitation

The conceptual model implies that every business process could be break down into separate business tasks that can be positioned somewhere on the learning grid. Consequently this approach could be analyzed further in order to specify in a more detailed way the parameters of each learning situation. The selection of specific learning processes changes the mode for the executives training. The selection of advanced learning processes with increased information transformation requirements enhances the quality of the achieved learning goals. The value delivery through the e-learning paradigm is organized through the employment of specific learning templates. So, the Author of such a system is going to be navigated through an advanced mechanism on which the main role is to choose the learning situation that best fits the trainee needs. Of course the value dimension of such a system is not implying a concrete measurement system of value satisfaction. The intention is to formulate a method on which the trainer would be responsible for the maintenance of all the content material capable of supporting different value levels of trainee exploitation. The difficulty of this ambitious aspiration is the development of a metadata content classification mechanism that will support the classification of the learning content on the e-learning system knowledge-content base.

CASE STUDIES

Our research unit (eLTRUN, www.heltrun.aueb.gr) in the past three years has participated in the design and development of e-learning systems both in European and International level. In parallel the realization of the need to utilize e-learning solutions gaining experiences from knowledge management theory formulate a two-fold approach: The analysis of e-learning from knowledge management perspective.For this scope we understand the necessity to research on the linkage between the efficiency of e-learning systems and the capacity of knowledge management mechanisms to provide a core component for e-learning. But even though the capacity of modern systems to manage the knowledge effectively in terms of data management mechanisms we concluded that something more was missing on the puzzle of effectiveness. The analysis, the specification and the formulation of a concrete e-learning pedagogy (Lytras 2000) in terms of learning processes, learning styles, learning modes and learning motivation parameter (Lytras 200). The previous work related with our research has to do with various e-learning projects implementation.

The **Teletraining Center of Athens University of Economics and Business** (www.teleduc.aueb.gr) was implemented in order to provide a pilot e-learning system capable to support the delivery of four seminars all over Greece, covering topics such as electronic commerce, statistics and marketing. The technological infrastructure includes servers, digital cameras and three of the most popular e-learning platforms such as WebCT, Lotus Learning Space and Blackboard. The first analysis of a survey conducted having as a sample the students of the e-commerce seminar provides useful recommendations: First of all it was more than clear evident the need to enhance the functionalities of the system with dynamic ways for the construction of learning content. The limitation of the e-learning platform to support students in different modes than sequential browsing of learning modules was a major disadvantage. More over the inability to provide mechanisms that would facilitate the exploration of knowledge according to specific learning needs was pointed out as a learning obstacle. From teacher's perspective there was a major difficulty at the reconstruction of learning material since there is a limitation in html pages linking. Additionally the content management constraints the creativity and doesn't support flexible learning scenarios [8].

The GEM consortium, **Global Master in Electronic Commerce)** (www.heltrun.aueb.gr/gem/new) is an international network of business schools sharing a common curriculum in e-commerce at the master's degree level. The global character of the program is ensured through the official cooperation of the best business schools and universities in Europe and North America, all experienced in research and education in e-commerce. The program has received the endorsement of the European Commission and G7's Information Technology group.

The development of an e-learning facility was considered from the members of the consortium as a vital process of the whole master program and for this reason there was an extensive research on the capabilities of the integrated platforms to support the whole approach.. The Athens University of Economics and Business undertake to develop the e-technology course for e-commerce master program..

The **MODEL IST (Multimedia for Open and Dynamic Executives Learning)** project is an innovative approach pursuing the development of a dynamic learning environment capable of managing effectively the knowledge in business units. The MODEL approach is trying to define a new market of knowledge management solutions and tools. We could describe it as a niche market that facilitates the development of competencies and the exploitation of the human capital. The core competencies in the modern organizations are constructed through vital business processes that in general provide a web of interconnections among people, knowledge resources, customers, tasks and evaluation standards. The major observed problem in the current situation is the absence of knowledge management systems that increase the re-usability of knowledge for training purposes. The executives training is mainly accomplished using executives' seminars and various workshops with reliance on not clearly defined quality standards. Moreover most of business units suffer from their inability to support new hired employees according to the specific characteristic of core business processes and business environment in general. The cost for training a new employee is superlative and increases if we take into account knowledge oriented and not routine business processes. In other words we have an exponential increase for the cost of training or learning when the subject of the training is more value creating.

In the Leonardo Da Vinchi project called e-LEARN we investigated the capability of WebCT to support English language courses for public sectors executives in collaboration with Linguaphone. Finally the project ESWL (Educational space without limits) set a postgraduate master course available to the students of three master programs in Greek Universities with the use of WebCT. All these projects and extensive research has reinforce our approach for e-learning. The major components of our approach for e-learning effectiveness and evaluation are presented in the following section.

DYNAMIC LEARNING CONCEPTS

The e-learning concept can be really treated as a technological advancement with advantages and disadvantages. The ability of the information and communication technologies to realize its various components formulate a wide range of applied informatics. On this continuum of available technologies we have to incorporate intelligence in order to enhance its performance and efficiency. The common practice to buy an e-learning platform, to adopt content or to buy content and to deliver on 24-hour basis the learning material to various learners has a justification: It provides an easy way to claim your presence on e-learning irrelevant the absence of mechanism that exploit the value diffusion for the learners and the trainers. Our approach is setting or is currently researching the ability of a three-dimensional model to expand the traditional considerations for e-learning importance. The Multidimensional Dynamic Learning (MDL) Model is based on three complementary dimensions:

- *The Knowledge Management dimension*
- *The e-Learning dimension*
- *The application integration dimension*

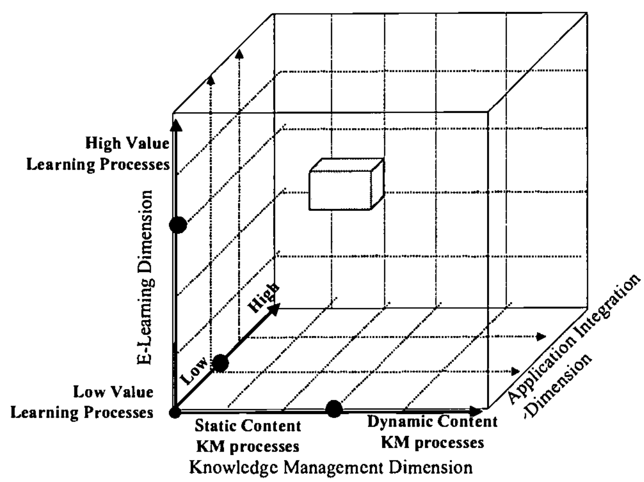


Figure 3: The MDL cube

Each of these describe in synopsis detailed considerations that confront the e-learning platforms such as knowledge management systems with embedded e-learning pedagogy and capacity of dynamic integration with other crucial business applications. To be more specific we will use three explanations for the three dimensions of MDL model.

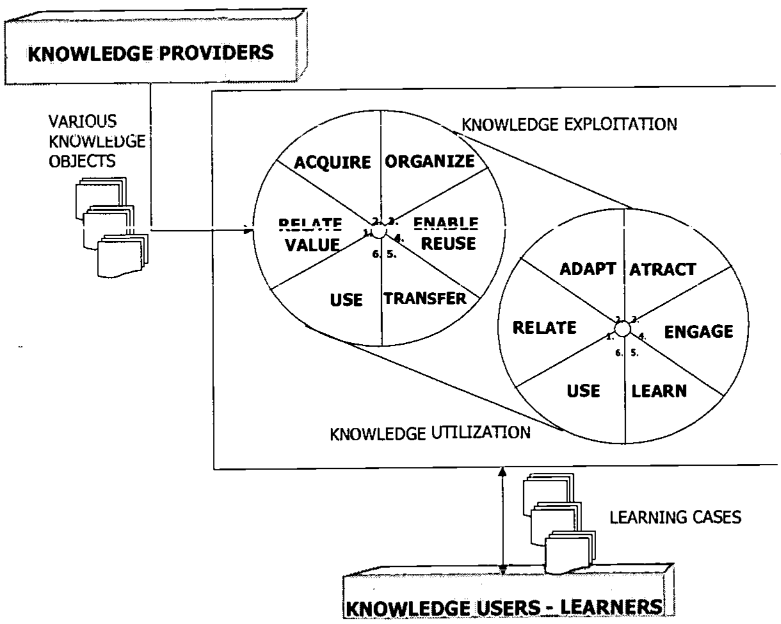
The **Knowledge Management Sophistication** summarizes the ability of the e-learning platform to manage learning content in various formats, to re-use learning modules and to support knowledge management processes such as knowledge creation, knowledge codification, knowledge transformation and knowledge diffusion.

The **ELearning Dimension** stands for the ability of an e-learning system to construct effective learning mechanisms and learning processes that support the achievement of different educational goals. With no doubt this dimension incorporates issues like learning styles, learning needs, learning templates as well as learning specification settings. The majority of e-learning platforms do not support mechanisms that would enhance the re-usability of learning content. The enormous efforts that have to be paid in order to redesign learning content or to adopt traditional content for e-learning purposes burdens the effectiveness of these tools. Our model, claims that the KM sophistication dimension is exploited enough when there are established knowledge processes that manipulate dynamic content. The re-usability of content and the support of high value learning processes presuppose the presence of an advanced KM subsystem capable to categorize, to enrich and to integrate various learning objects. Consequently the enrichment of learning content with various metadata is necessary for the application of dynamic learning. Very few learning platforms can nowadays provide metadata to the learning content and when this is applicable there is no a mechanism that allows the data mining of relevant learning objects from the learning warehouse system that manages the learning content.

The **Application Integration Dimension** summarizes for the e-learning platforms the capacity of collaboration with other business applications in order to obtain learning content from real business operations. This dimension seems to be the less detected on the common e-learning platforms and this causes a number of gaps for the effective implementation of e-learning systems. The critical issue of insufficient content in many situations is due to the inability of the organizations to establish a knowledge generation mechanism through the operation of information systems that support the most important business processes. Because in general, the e-learning systems in corporate environments can play the role of the most significant intellectual capital exploitation mechanism. (Stewart 1997).

The e-learning marketplace has been face a tremendous orientation to static approaches. Through the combination of the two life cycles, the knowledge management framework and the e-learning life cycle, the knowledge objects are transformed dynamically to learning products through specific consideration. The XML language increases the capability for the inclusion of semantics in knowledge objects and every knowledge stage as well as every stage of the transformation model enriches the initial knowledge objects with specific metadata. This approach has to be based in integrated approaches, which include ontologies (Staab and Maedche 2000), (Staab et al., 2000), knowledge management, semantics and annotations (Perez and Benjamins 1999).

The proposed model that is presented in figure 4 depicts the double loop knowledge management exploitation. With no doubt the full utilization of the proposed model requires further explanations and justification. For example in our approach the transformation framework intends to support a sophisticated e-learning system



where the educational scene is constructed dynamically through the deployment of well defined learning processes.

Figure 4. The integrated e-learning knowledge management framework

PAPER CONCLUSION

The MDL model approach sets a method for the evaluation of any e-learning platform. Of course the presentation of the method on this paper was limited due to the length limitation. The whole approach of MDL cube MODEL is supported by a number of accompanying frameworks and theoretical concepts, which in collaboration enhance the scientific justification.The development of a system that will realize the upper right layers of the cube is currently our research priority. Of course the required modules need extensive justification and creative work. We believe than in one's year time we will be able to launch international an integrated e-learning knowledge management system with the characteristics that we mentioned on this paper. The refinement of our approach is a continuing process and will be supported by a number of new projects that we are going to propose in Greek and European Commission programs.

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Analysing User Actions in a Smalltalk Programming Environment

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Abstract: AESOP (An Electronic Student Observatory Project) is a framework used for recording, and analysing user actions in a Smalltalk programming environment. One of its main aims is to provide an apparatus for identifying and analysing problems beginners have when learning to program. It is targeted on a distance learning course using an environment, LearningWorks, which has been modified to appeal to starting programmers. This paper describes the tools used to analyse the learning of programming concepts, for a large number of students.

Introduction

The AESOP project provides a way of recording students use of Smalltalk (Macgregor et al. 1999). The Smalltalk environment, LearningWorks (Woodman et al. 1999 & Goldberg et al. 1997), is used on the course *M206 Computing: An Object-oriented Approach* offered by the Open University (OU). AESOP aims to record student use of LearningWorks tools: HTML browsers, simulations, and programming applications. These tools appear in LearningBooks (Woodman et al 1999), and significant events occurring in them are recorded in a format which aims to make analysis of student learning straightforward.

Student use of LearningWorks

Students use the LearningWorks tools to write correct code by following highly structured sets of instructions and by developing novel solutions to set problems. The instructions and problems are introduced in LearningBooks, where each LearningBook has sections, each section has detachable pages, and each page has a tool. The first section always has a HTML-browser page containing instructions for practicals and discussions.
An "amphibian" microworld, using instances of classes `Frog`, `Toad` and `HoverFrog`, introduces the basic object concepts of message sending, state, behaviour, inheritance and polymorphism. This microworld, (Fig. 1), shows amphibians whose behaviour and state are affected by messages from action and menu buttons.

The AESOP software

The AESOP software has three main software components. The first component is a R*ecorder*, which records the student's use of LearningWorks. the second is a *Replayer* that can be used to replay what was recorded. Finally, various analyses are proposed, and analysis methods are added to the *Analyser* component. All three components have been developed incrementally from prototypes (Goldberg & Ross 1981).
The Recorder writes time-stamped strings representing "user events" to a text file. Each entry in a recording is a time-stamped event-signature, which represents a student action such as a page turn, button click, hyperlink selection or expression evaluation. The Recorder is launched automatically when a LearningBook is opened, that is, no student intervention is required.
The Replayer plays back a recording to show an investigator the important events that the student precipitated. The replay speed is chosen by the investigator, from "fast-forward" to "single-step". Replaying is useful to give the investigator an overview of a small selection of recordings, and suggest analyses that can be pursued.

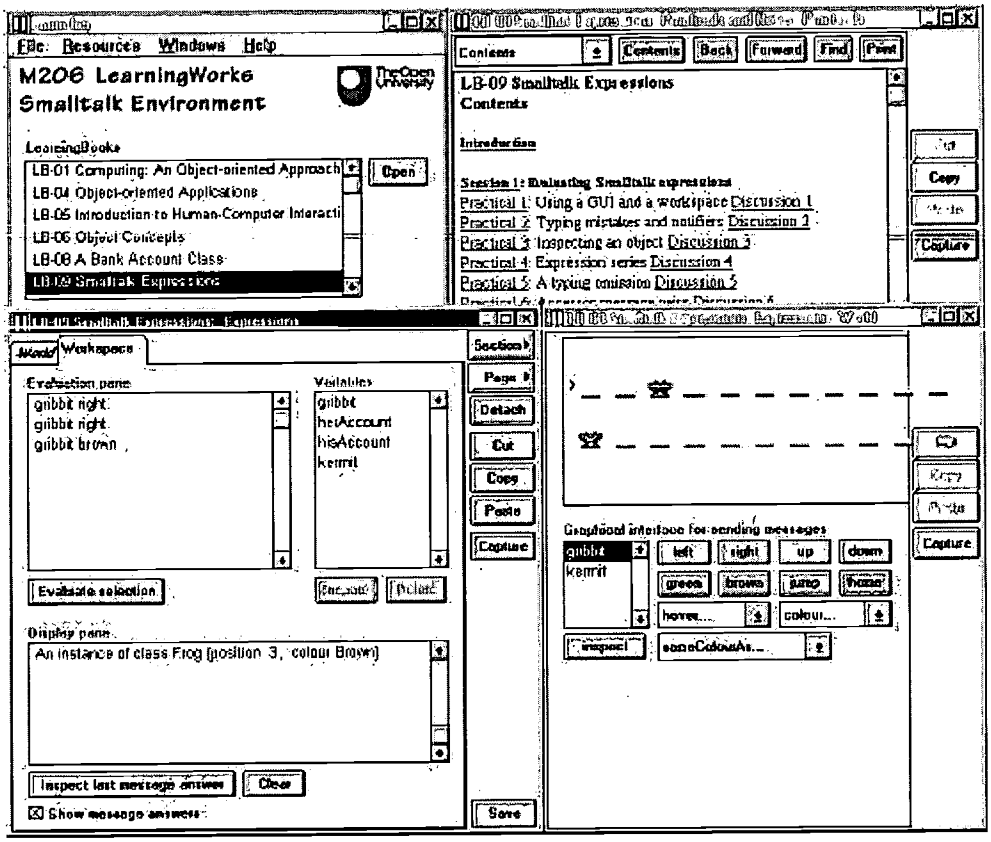

Figure 1: Practicals, amphibian microworld, workspace, and browser

The Analyser searches for patterns of behaviour across sets of recordings. A wide variety of possible analyses have been identified, and several implemented (Thomas & Paine 2000a). For instance, a *Time Tool* attempts to distinguish the time that a student spends doing various activities (Thomas & Paine 2000b) and a *Required Messages* tool outputs a trace of significant events.

Analysing the recordings

Around 400 students volunteered to use the recorder software during the 2000 presentation of the M206 course. The students e-mailed their recordings to the AESOP team who replayed a selection of the files and then pursued a variety analyses (Thomas & Paine 2000b). For example, by simply observing a student recording on fast forward, it was found that students were having problems making an object of class `HoverFrog` hover and change colour at the same time. This occurred when students attempted the practical exercise shown in Figure 2.

```
    Practical 10: Making a HoverFrog object hover
To make hoverFrog3 hover, two arguments have to be supplied -- Up or Down, followed by a
number chosen from the integers 1 to 6. So the following is typed to represent in
textual form a message asking hoverFrog3 to move up two 'steps'
    hoverFrog3 hover: Up by: 2
Send this message to hoverFrog3. Then, try sending several versions of the same message
with other arguments.
```

Figure 2: A practical exercise

One student's response to this practical is shown in Table 1. The *Required Messages Tool* produced this extract from a complete recording. It shows that the student evaluated the expression series contained in lines 2 to 6 of the extract.

	Event-signature	Timestamp	Comment
1	selectAnchor:c06s4p10.htm	02/19/2000 8:15:16.000	Hyperlink jump
2	*hoverFrog3 Down 4	02/19/2000 8:15:40.000	User input
3	*hoverFrog3 hover: 3	02/19/2000 8:15:56.000	User input
4	*hoverFrog3 hover: Up by: 1	02/19/2000 8:16:37.000	User input
5	*hoverFrog3 hover: Down by: 1	02/19/2000 8:16:51.000	User input
6	*hoverFrog3 hover: Up by: 1 colour: Red	02/19/2000 8:17:13.000	User input
7	DIALOG:hover:by:colour: is a new message	02/19/2000 8:17:18.000	Error message
	...		
8	*hoverFrog3 colour: Red hover: Up by: 3	02/19/2000 8:19:40.000	User input
	...		
9	selectAnchor:c06s4d10.htm	02/19/2000 8:20:34.000	Hyperlink jump

Table 1: An extract from a recording produced by the Required Messages analysis tool.

The extract shows, in line 6, that the student tried to send two messages, `hover:by:` and `colour:`, to the object named `hoverFrog3` at the same time. At this stage of the course, the student has not been shown how to use parentheses, as in:

```
(hoverFrog3 hover: Up by: 1) colour: Red.
```

and so received the error message (in a dialog box) shown in line 7 of Table 1. The student's response to the error message is shown in line 8 where they simply tried a rearrangement of the two messages. The result, not unnaturally, was another dialog error message. The result of not being able to solve the problem frustrated the student, who simply stopped trying to resolve the difficulty and jumped to another part of the practical via a hyperlink (step 9).

This behaviour raises a number of questions. For example, do other students have similar problems with this practical? Do students ever complete the practical correctly? To answer such questions a more powerful analysis than *Required Messages* is needed. This is the *Required Tasks* tool, which searches a recording for the sequence of messages that define a specific task. To do this, another tool, known as the *Task Describer* was built that is used to define a task. Figure 5 shows the description of the "hover, by" task with *Task Describer*.

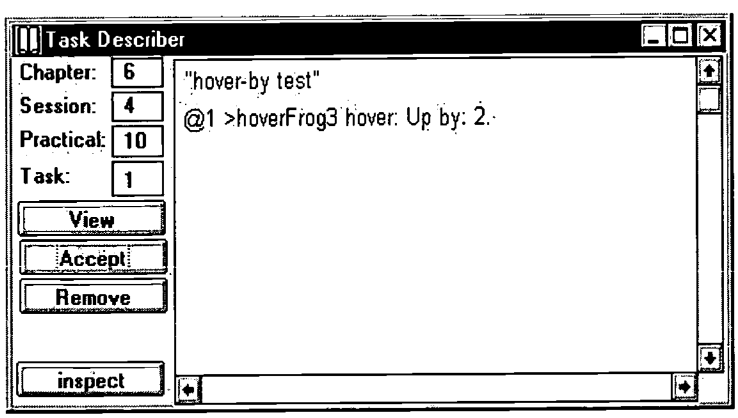

Figure 3: The Task Describer tool.

In this example, the task is defined as being complete if the student evaluates

```
hoverFrog3 hover: Up by: 2.
```

The precise test for completion of this practical is much stronger than this, but this will suffice for sake of illustration. The input fields on the left-hand side of the window shown in Figure 3 specify the chapter, session and practical in which the task appears, and assign an identifying number (1) to the task. The text area on the right-hand side of the window is used to define the task. The symbol @ denotes the start of the line, 1 is the score for completing the task, and > means it is an evaluation expression (there is a variety of types of task that a student can be asked to carry out).

Clearly, if a student recording includes the task defined in this way we can be confident that the student (eventually) succeeded in the task and the Required Tasks tool enables us to locate the relevant part of the recording for further investigation. However, we are also interested in those situations where students have tried to accomplish the task but have failed. In such cases, the correct outcome, as defined in the task describer in Figure 3, would not be observed in the recording. Therefore, the specification of tasks in the *Task Describer* has been extended in a variety of ways.

First, there could be a number of equally valid solutions to a particular task. The *Task Describer* tool deals with this by allowing its user to specify the different solutions as separate lines. It also allows the use of wild cards to indicate that certain parts of a task description are not significant. This is illustrated in Figure 4.

However, the main focus of attention is the search for incorrect attempts at tasks. To do this, the user must enter descriptions of tasks that are incomplete or which describe partial matches with the expected solution.

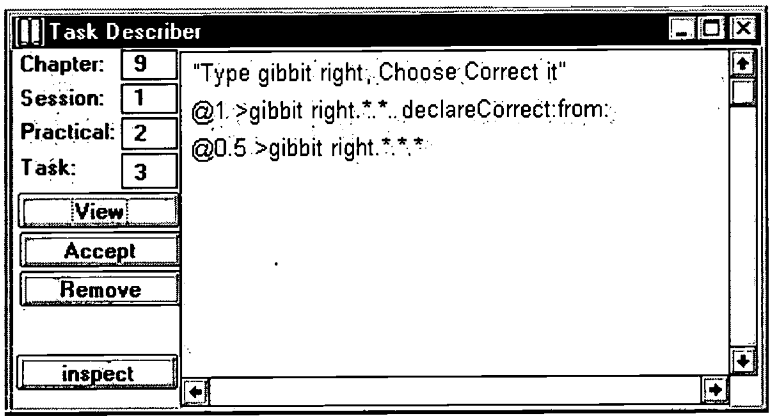

Figure 4: The Task Describer tool with multiple task descriptions and wild cards

The *Task Describer* tool has a further embellishment. It allows the user to associate a value (in the range 0 to 1) with each task description. This value represents a score that indicates how well, in the investigator's opinion, a description matches a correct solution. This enables us to score each student's attempt at a task and, by looking at all students' recordings, give a score to each task indicating how easy or difficult the students found that task. This latter activity is accomplished by using the *Analyse Tasks* tool.

Implementation architecture

The main AESOP classes are:

`ObservatoryRecorder` – records user events.
`ObservatoryReplayer` – replays recorded user events.
`ObservatoryAnalyse` – launches analyses.

A previous publication (Macgregor et al. 1999) described the recording instrumentation in detail. The present paper concentrates on the analysis instrumentation.

An instance of class `ObservatoryAnalyse` has an interface for starting each analysis. Selecting the appropriate item in the Analyse menu launches an analysis. One of the aims in developing the analysis tool was to make it straightforward for new members of the research team to develop new analysis methods for themselves. The first stage in developing a new analysis method is to think up a name for it and add it to the menu. The class `ObservatoryAnalyse` was designed so that all that this would involve would be to add a line to the class method `analysisActionsMenu`. For instance, to add the menu item *required event signatures* simply involved adding the line

```
mb add:'required event signatures' -> #requiredEventSignatures.
```

Where mb is the menu builder object, `'required messages'` is the string shown in the menu item, and `requiredEventSignatures` is the name of the method called when *required event signatures* is selected.

The required event signatures analysis enables the user to extract designated recorded event-signatures.. For example, to look at the event-signatures reflecting that the student has (i) opened a LearningBook and (ii) has selected an anchor, an appropriate line is added to the start of the method:

```
requiredEventSignatures
   requiredEventSignatures:=#'openUserVersion*''selectAnchor*').
   self analyseForRequiredEventSignatures.
```

Note that the second line of the method body continues the analysis.

The file to be analysed is loaded into the Analyser in the same way that a file is loaded into a word processor. This causes the class variable, `ObsStream` to reference the stream of characters contained in the file. Each analysis proceeds by going through the file line by line and applying an appropriate sub-analysis to each line. For instance, to analyse all lines in a file to check if it contains a required event-signature, the following code is used.

```
analyseForRequiredEventSignatures
 [ObsStream atEnd] whileFalse:[
      self analyseExpressionForRequiredEventSignatures].
```

Each line in the recording contains an AESOP expression consisting of the event-signature and its timestamp. Therefore, the method `analyseExpressionForRequiredEventSignatures` simply adds any required expression to a variable, then at the end of the analysis the variable shows the found expressions in the analysis tool window, for example:

```
openUserVersion:true 02/19/2000 7:43:29.000
selectAnchor:c06s2.htm 02/19/2000 7:44:16.000
selectAnchor:c06s2p4.htm 02/19/2000 7:45:56.000
```

A user-initiated action can precipitate several messages within the environment, but only one event-signature is recorded to represent the action. On analysis, the event-signature (with its timestamp) provides the information needed about the original user-initiated action.

Future work: analysing masses of data

The construction of a tool to compare the tasks that a student has been asked to do with what they actually did has been described. But it is important to remember that students are encouraged to do additional work or simply experiment. We need to build analysis tools that can analyse experimental approaches taken by the student. The idea of comparing an actual recording with an "ideal" recording is being pursued. In the ideal recording we flag methods and code evaluations that require students to use their initiative. These will provide the basis for task descriptions in the *Task Description Tool.*

We wish to examine data from a succession of LearningBooks to see how a given concept is used as time progresses. If, for example, a concept is introduced in one LearningBook, it should be possible to see that concept being used in later LearningBooks. If that concept is used incorrectly we should observe errors – and perhaps be able to deduce that the error was made because a concept was not picked up at an earlier stage.

If we see patterns of behaviour that are common to many students, it will be possible to say something useful: possibly that the teaching of that concept is flawed and should be changed. Whilst this may be useful information to the course team, it is not answering the central question of how students learn. It could be much more informative to examine what the student does immediately after being confronted by an error message. At present the only way to detect student's understanding of concepts is to look at practicals where they have had to think out answers for themselves, rather than just following a "monkey-see monkey-do" process. We are actively considering whether to include more structured self-tests in the LearningBooks.

LearningBooks assume that students will read the accompanying printed texts but the recordings do not show what the student does or how long the student spends doing it. It may be the case that students continually refer to the accompanying texts in order to clarify concepts whilst tackling the practical. It may be worthwhile, therefore, supplying electronic copies of printed texts so that, when performing the practical, the student can refer to the computer-based text. We could then record when a student accesses particular information and begin to address the

issue of whether a substantial gap between recorded events represents time when the student is interacting with other materials or taking a break.
The notion that all course materials would be available electronically coupled with the fact that a recording can give valuable information about errors that a student makes, has encouraged us to investigate the idea of an-on-line coach. That is, a piece of software that uses data about student behaviour in the face of errors to provide (i) help in the form of hints as to solve well-known problems and (ii) access to the relevant course materials for an explanation of the concepts related to the error. At the time of writing, a proof of concept implementation has been built (Thomas et al 2000).

Conclusion

Current work is pursuing research questions about learning and the refinement of unobtrusive instrumentation and analysis software. The project involves automatic recording, replaying and analysis of data from student-programmers using the OU LearningWorks programming environment. This approach allows researchers to investigate concept acquisition and change, factors affecting performance, and the identification of areas of misconception and difficulty.
The questions we are trying to specify and answer concerning how neophytes learn object concepts have been outlined here. The implementation of a selection of the AESOP tools has been described, especially those pertaining to analysis. The recording software is now fairly stable, forming a good basis for further development of replaying and analysis software. Many technical problems remain, but we believe that we have identified the main ones, and that progress will continue to be made.
During 2000 we are concentrating on determining appropriate analyses to be made of the mass of data we have collected. Beyond 2000 we shall extend the instrumentation to analyse the entire course of 5000 students. By then it is hoped that an on-line coach will be providing useful support to all our students.

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Electronic Collaboration Tools –Diffusion of an Innovation

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Abstract: In the last few years several types of electronic collaboration software tools (ECST) have come onto the scene. However, organizations have not fully accepted the wide spread use and features of these tools. Therefore, their full potential and opportunity envisioned has not been realized. The purpose of this study is to understand how ECST can be viewed as an innovation and how, as an innovation, ECST can be diffused throughout and accepted by an organization. Applying diffusion of an innovation theory, an empirical study will assess how well a proposed model describes a user's satisfaction with a tool and their subsequent willingness to adopt it. Moreover, this study will focus on several tools and evaluate the users satisfaction and subsequent willingness to willingly adopt a particular ECST tool.

ECST Adoption Model

(Rogers 83) identified five different attributes of innovations (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. Subsequently, these five variables may have a direct influence on an individual's satisfaction with a particular ECST tool. In turn, an individual's satisfaction will influence their decision to willing adopt a particular tool. The relationship of these variables is illustrated in (Fig 1).

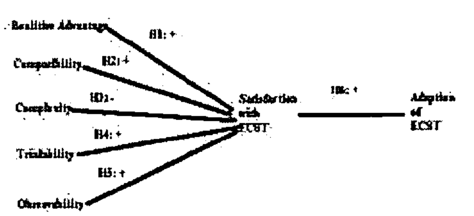

Figure 1: ECST Adoption Model

Relative advantage is "the degree to which an innovation is perceived as better than the idea it supersedes" (Rogers, 83). Relative advantage has been generally related positively to adoption (Rogers 83)(Tornatsky & Klein 82). In the context of ECST tools, and individual may find that a particular tool overcomes many of the limitations associated with same-time/same-place meetings. Therefore,

H1: *An individual's perceived relative advantage of an ECST tool will be positively related to the individual's satisfaction with that tool.*

Compatibility is "the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters" (Rogers 83). Subsequently, an individual's satisfaction with an ECST will be influenced by their perception of how well the tool fits or is compatible with the task at hand. It follows, then, that the compatibility of ECST should be positively related to the individual's satisfaction.

H2: *An individual's perceived compatibility of an ECST tool to the task at hand will be positively related to the individual's satisfaction with that tool.*

Complexity, on the other hand, is "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers 83). Studies have found complexity to be negatively associated with adoption (Rogers 83)(Tornatzky & Klein 82). Consequently, the perceived complexity of an ECST tool should be negatively related to the individual's satisfaction with that tool

H3: *An individual's perceived complexity of an ECST tool will be negatively related to the individual's satisfaction with that tool.*

Trialability is "the degree to which an innovation may be experimented with on a limited basis" (Rogers 83). In short, trialability provides a chance to learn and evaluate an innovation so that an individual can eventually make a decision whether to adopt it. Therefore, trialability should be positively associated with an individual's satisfaction with a particular ECST tool.

H4: *An individual's perceived degree of trialability with an ECST tool will be positively related to the individual's satisfaction with that tool.*

Observability is "the degree to which the results of an innovation are visible to others" (Rogers, 1983, p. 240). Therefore, an individual will have a higher degree of satisfaction with a particular ECST tool when they can observe how the tool may provide meaningful benefits by using the tool.

H5: *An individual's perceived degree of observability with respect to the benefits associated with an ECST tool will be positively related to the individual's satisfaction with that tool.*

In addition, an individual's degree of satisfaction will ultimately influence their decision to willingly adopt an innovation.

H6: *An individual's perceived satisfaction with an ECST tool will be positively related to the individual's willingness to adopt that tool.*

Research Design

This study will survey over 80 students at a large midwestern university who will use a particular ECST tool or toolset as part of their course work. The students will be assigned into small groups of three or four members. Each group will be required to research and write a paper on a selected topic and then present their topic to the class using a presentation software package. As a major part of this assignment, the groups will be required to meet for a minimum of three hours each week online over a period of five weeks. To start the study the students will be introduced to several different types of ECST tools. This will include: remote meeting; file sharing; desktop sharing; text/voice chat; messaging; other miscellaneous ECST tool types;

As part of the assignment, each group will be required to use and evaluate two different collaboration tool sets that will include all of the above ECST types. Each group will have one week to work with the tools and setup a collaboration schedule that will be used for the remaining four weeks of their assignment.

Data for this research project will be collected using online surveys and an online diary. Each student will be asked to complete a survey each week that will focus on the variables identified in the ECST Adoption Model. The results of these surveys will be used to test the model and to determine whether their perceptions changed over the course of the assignment. Each student will also document their experiences with the tools on a Web site set up specifically for this research project. This online diary will provide valuable qualitative data that can be used to supplement the survey data. The results of this study will be available and presented at the conference.

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Deconstruction of Socio-technical Information Systems with Virtual Exploration Environments as a Method of Teaching Informatics

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Abstract: The working group Didactics of Informatics at the University of Paderborn develops and evaluates a multimedia exploration platform for information systems (MEPIS) to the needs of teaching and learning informatics at secondary schools. The paper describes the basic ideas within a system-oriented approach of didactics of informatics and two of its most relevant ideas: the perception of a socio-technical information system and the concept of deconstruction. The pedagogical and technical requirements of developing multimedia tools and integrating them into teaching and learning processes in informatics will be outlined, and the demands on a multimedia-based exploration environment for the process of deconstruction will be described. Finally, a concept of evaluation of teaching and learning processes in informatics under the perspective of a system-oriented didactical approach and the practical use of an exploration platform at secondary schools will be presented.

Socio-technical information systems in a didactical perspective

By socio-technical information systems (IS) we understand the unity of software including the graphical user interface (GUI), the hardware, embedded systems for control and regulation of peripherally technical processes and for communication with other IS and, last but not least, the associated social action system of persons, who are interacting with the IS and with other people. The technical part of an information system is exceedingly connected with its social part, by human computer interaction (HCl) and further direct or indirect technical functionalities of the information system, affecting the interactions of humans with the system and the interaction between persons. The social interaction in the context of the information system extends this to a socio-technical information system. As an example, for instance, an aeroplane can be mentioned. Information systems, e.g. embedded systems, are closely linked with the surrounding technique of the airplane to a local network of hard and software. The crew acting with this information system via the GUI of the board computer and the software implemented there extend this system to a socio-technical information system. Safety of the plane and the passengers do not only depend on the correctness of the soft- and hardware but also on the ability of the crew to interact capably with this system. The term of the socio-technical information system, in which an action system formed by interacting persons is merged is a subsystem, has its science-theoretical roots not only in computer science but also in the sociology of technique (viz. e.g. Ropohl 1999).
The software of socio-information systems represent fundamental ideas and methods of informatics and also the concept of workflow and patterns of social action within the system. Social action, social roles of people and the workflow in the system's context will be influenced, e.g. by human computer interaction (HCI) with the technical parts of the system moderated by the graphical user interface (GUI). In the process of software development a model of the future system's functionality and its integration into the working and social context has to be generated. Modelling and developing software under this perspective is a highly communicative and interactive activity and needs close cooperation between developers and customers. Therefore, we need cooperative and evolutionary concepts for software development with stepwise refinement of its functionality. The technical implementation of a computer science system can therefore be used to prove the consequences of decisions in the context of the modelling process and co-operative action between developers and customers.

Objectives of a system oriented didactical approach

An important lesson for teaching informatics is that programming - in the sense of coding - is only one part of the construction process of an IS, and that it can no longer stand alone as the centre of a curricular concept.

Techniques of system modelling and of evaluation of existing information systems as well as theoretical aspects of informatics should also be a relevant subject of informatics work in the classroom. Scaffolding curricular concepts of teaching informatics at secondary schools which focus on the modelling aspects of software development and the social dimensions of IS are important issues.

Instruction using a system oriented didactical approach in informatics should include these essential objectives:

- Teaching fundamental concepts of informatics (like algorithms, methods of software technique..)
- Learning about (computer-based) modelling techniques.
- Recognising software development and the construction of IS as a communicative and co-operative process, i.e. construction decisions and group interests should be balanced.
- Learning, that the social impact of an implemented IS has its roots in the phases of requirement definition, specification and design of software
- Creating technical systems and IS is not only a technical but also an important social process with large influence on society

Realising this approach fosters not only the knowledge of fundamental concepts of computer science but also important comprehension and orientation in an engineered world and thus substantial aspects of general education are obtained in informatics at school.

Fostering modelling abilities of students by deconstruction of IS

Beyond algorithms, small software development, or the construction of a tiny IS classroom project, informatics also needs computer-based tools for modelling and for the exploration of existing IS. In complement to the method of constructing software, the method of deconstruction of software is a methodical alternative in informatics lessons. In addition, it also gives students the opportunity for discovering styles of learning and focuses in a special way on the modelling and design process as well as on the social implications of information systems.

The term "deconstruction" comes originally from the methodical concept of philosophy and science of literature (viz. e.g. Derrida 1997). It aims to analyse the structure and content of text and to interpret the author's opinion. Also it intends to find out about things, which have not been said by the author, but nevertheless were very important for the author's message. Deconstructivism can also be found in the fields of architecture and arts, where we may discover traditional and new concepts of design, logic, formal and informal structures, implicit messages, and so on. Why not transfer this concept in the area of teaching software techniques?

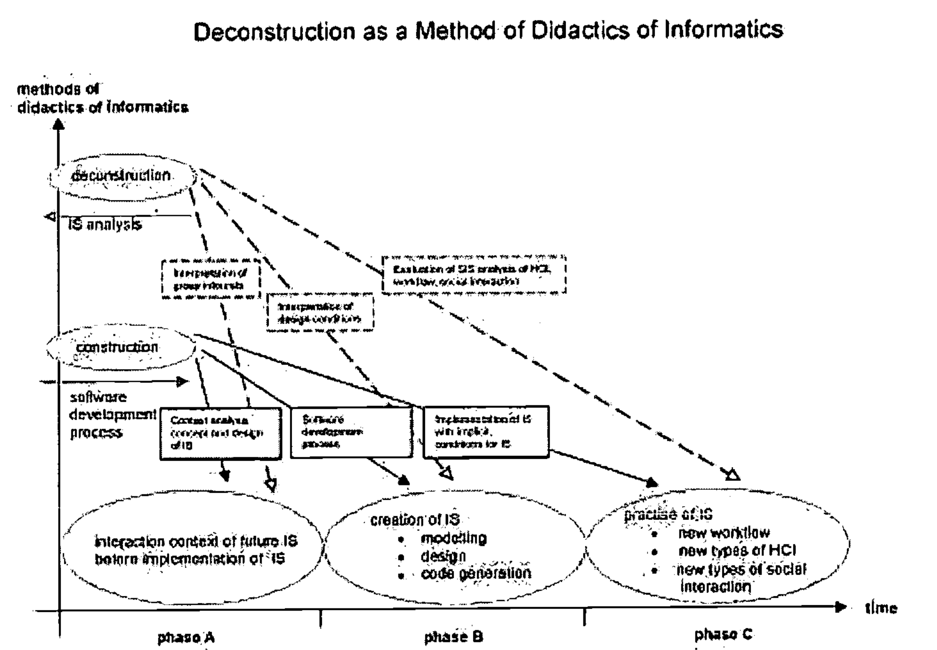

Figure 1: Deconstruction as a method of Didactics of Informatics

Software has different forms of appearance and allows different views to discover it: We could look at the source code and see classes, methods, algorithms, programming language structures or even informatics concepts such as e.g. the problem solving method 'divide and conquer'. We might look at the GUI and learn about software ergonomics as well as about the functionality of the software. We might learn about the organisation of work within the IS and the abilities people must have to handle this product. UML diagrams (unified modelling language) and documents that have been generated during the phase of design-decision complete the arrangement. It's like a puzzle and pupils might look for the pieces and put them to the whole. The complexity of a multimedia-based exploration environment should be scalable so that it might be adapted to the level of different learning groups. When constructing software by themselves, pupils have to obey the chronology of the process and then, due to the lack of time, the software to be developed cannot be very complex. Deconstruction allows a kind of time travelling and offers a simultaneous look at different stages of the software development process, i.e. the preliminary interaction contexts of an IS before its development, the phases of software development, and the implementation and change of social context of the IS. Software design decisions may become a subject of discussions and alternative concepts of specification could be conceptualised. In addition, supplementing modules of the software could be constructed and systems' functionality could be changed. Thus, the fundamental informatics concept of re-engineering could be realised in the classroom. The main objective of this endeavour in an exploration environment is to strengthen the pupils' sensibility towards the decision-making character of modelling processes and to let them learn about the methods of modelling and software techniques. Thus informatics at school will be able to realise some essential objectives of general education: contribution to the school student's problem solving competencies, fostering social competencies e.g. (ability to work in a team, communication abilities), ability to use cognitive tools not only in informatics but also in other areas, and last but not least the ability to value the social impact of changes in technology, especially in information technology.

Virtual exploration environment MEPIS

To realise this didactical concept it is necessary to develop didactical software with open access to the source code and a multimedia-based exploration environment, which offers the different tools and types of documents such as: Java development kit, object browsing system, examples of CRC-modelling, description of use cases, description of social context of IS (patterns of interaction, types of workflow), video sequences of social action representing the use cases, interviews with future users, interviews with developers and applicants, documents concerning with the history of ST and IS, parts of documentation of the concrete IS, fragments of source code, elements of the GUI of the software, description of methods to develop, modules of software to develop, UML class

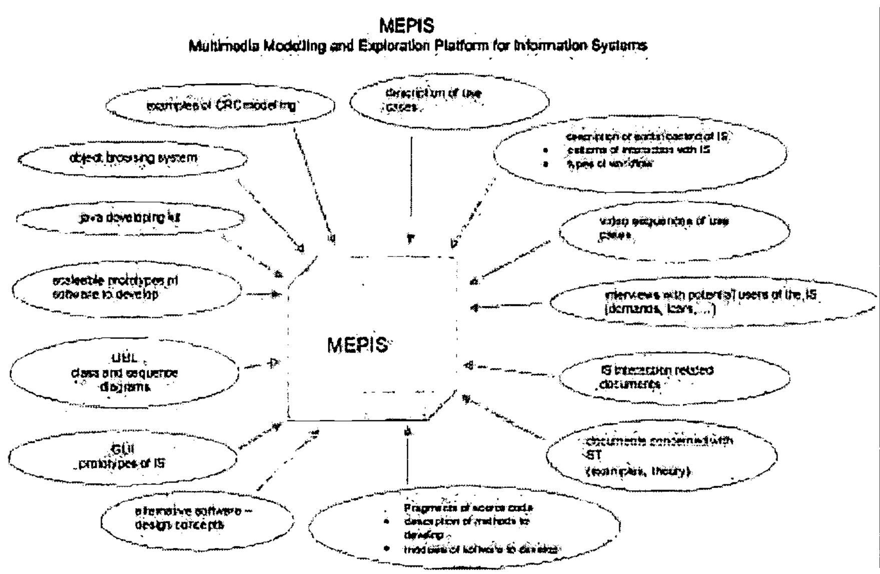

Figure 2: Components of MEPIS

and sequence diagrams, GUI prototypes, alternative software design concepts, software development strategies, scalable prototypes of software to develop and so on.
The scalable exploration environment should be used for different learning scenarios in informatics at school. It should also be integrated into the teaching and learning process of the class. In an informatics project, which e.g. is to construct a small piece of software, pupils may use the exploration environment to answer questions that arise during their classroom work. The software represented in the system could be extended by creating new modules. MEPIS also represents the concept of learning by example. Informatics-related problem solving, constructing software, learning about informatics and deconstruction of an IS with MEPIS should be an integrated part of classroom work.

Questions of evaluation in a system oriented didactical approach

Learning and teaching processes are very closely linked and represent different views on the same matter. Therefore, the main subjects of empirical classroom research should be the teacher (teaching process), the students (learning process), to include the classroom interaction between students and the teacher and among the students themselves. Also, the human computer interaction (HCI) of the students with different computer-based tools and with the multimedia exploration environment (MEPIS) should be empirically evaluated.
There are some very interesting empirical studies dealing with different subjects of learning at schools. The international TIMMS-study about teaching-styles and students' conditions of learning mathematics produced especially remarkable results. But there is a lack of such empirical studies in regard with informatics at schools, and there are none regarding the special research interests of a system oriented didactical approach of teaching informatics at secondary school. Due to the perception that it is an important task of computer science to model and create information systems that have a tremendous impact on the associated social interaction system and even on the whole society, modelling and creating a small information system has always been an important classroom activity in informatics. With a system-oriented approach, a small IS, represented in a multimedia exploration environment, could be analysed and deconstructed, its socio-technical elements then bared for further learning and discussion. Empirical analysis of informatics at school under the perspective of an system oriented didactical approach pose some of the following questions:
Does the method of deconstruction and the use of MEPIS foster the students' abilities of modelling a small IS and do they acknowledge the fact that the functionality of IS depends on design decisions that could be influenced by the interests of applicants, developers, users or given economic circumstances? Does the use of deconstruction and of MEPIS change the objectives and the practice of informatics in school from a programming language course into a course in which fundamental informatics concepts are submitted? Does the method of deconstruction and the use of MEPIS open the pupils' view for the social impact of information systems and help them realise that an IS implicates an associated system of social action? Does deconstruction in terms of general education not only foster formal problem-solving abilities but also social competencies like teamwork and communicative competencies? Will deconstruction contribute to technical and general education by fostering the comprehension of the possibilities of forming a socio-technical information system in different ways? What is the contribution of a multimedia exploration environment of IS to informatics at school? Can it increase the effectiveness of computer-based modelling techniques und create a constructivistic learning environment? These are some of the essential questions of the didactical research project.
The observed contradictions between issues and results in educational practice motivates a new strategy for application of didactics of informatics. Therefore, recommendations, materials and multimedia tools have to be designed and tested. The MEPIS-project supports a new kind of relation between research, training and educational innovation. At first, future curriculum of informatics education has to be defined and a desired learning-process to be described. Thus, a number of hypotheses need an empirical evaluation in the context of the research. The courses can be videotaped at different periods to analyse case studies. Analysis focus could be the structure of the lessons, the methods used in problem solving, and the students' skills of thinking. The research group has to decide which parameter of the concept has to be changed to the next step to improve the solution. During a longer period, each step of evaluation can be manifested in a multimedia database. The possibility of storage and retrieval of large quantities of empirical data has a long tradition in didactics. What is new is the access to multimedia data and the ability to use it to analyse and compare complex learning-scenarios. Therefore, the empirical research concept must be acknowledged as a long term study.

Evaluation strategies of teaching and learning processes in informatics

Empirical data can be collected by using and combining qualitative and quantitative empirical research strategies and instruments like interviews, questionnaires, observing and videotaping lessons, assessment of course materials, or group discussions about observed teaching-practice. To obtain more empirically founded information about teaching and learning informatics it will be useful to examine the classroom interaction between pupils and teacher and among the pupils themselves. Further objects of empirical analysis of classroom practice could also be teaching-styles, organisation of classroom work by the teacher, course materials, writings on the blackboard, curriculum concepts of the lessons, source code and documentation of the software developed by the pupils, keystroke-recording of human-computer interaction situations in the classroom, results of running tests of the pupils' designed software, media support and the technical equipment in the classroom, pupil records in their exercise books, opinions of teacher and students about informatics and the objectives, the content and the practice of the attended lessons. An important source of data with didactical relevance will also be the evaluation of navigation patterns with MEPIS. Qualitative data covering the whole classroom interaction process may mainly be collected in a sample of some classes at few schools. Quantitative data will also be collected in control groups to value the influence of teaching-methods, didactical concepts of informatics and the role of multimedia-based exploration environments. For evaluation purposes and recognition of the results of empirical classroom research, it will be useful to compose clusters of students which are homogenous with respect to relevant research variables like cognitive and methodical precognition, abilities and learning types or the influence of gender.
The implicit theoretical concepts of didactics of informatics will also be empirically examined in discussions with heads of faculties or schools and the teachers by interviewing students and by the analysis of video-recording of lessons (Magenheim 1999).

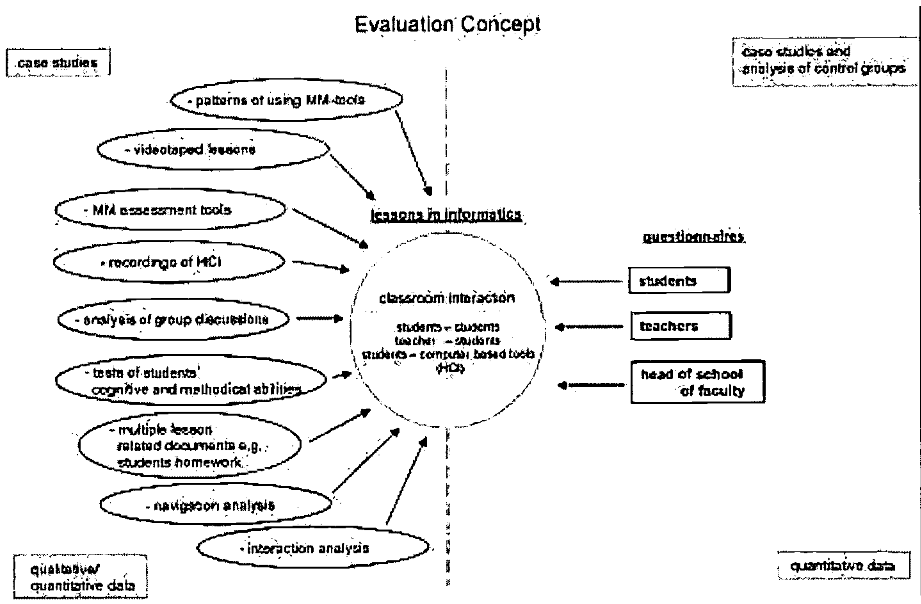

Figure 3: Evaluation Concept

To collect case-study data for empirical evaluation of classroom scenarios it is necessary to record a lot of classroom interactions. Therefore, classroom practice has to be observed and videotaped by two cameras, one for the teacher's and one for the students' perspective. Sometimes, it even might be necessary to use not only fixed but also portable cameras. The operator is allowed to walk around in the classroom to record discussions within groups or to visualise pupils' interaction with the computer. But videotaping classroom interaction for evaluation purposes has to be handled very considerately, trying not to disturb the sensitive communication context between teacher and pupils and to minimise interference from outside.
Special attention must be given to the analysis of MEPIS. We want to find out patterns of use and navigation with MEPIS. What kind of knowledge and methodological competence do the students gain by using the exploration environment and how will they transfer their competences to solve informatics-related problems at school? This

may answer some questions concerning the integration of constructivistic virtual exploration platforms into a concept of traditional methods of teaching in classrooms. We will use well-known empirical instruments of human computer interaction and software ergonomics and combine them with methods of classroom research to find answers.

Conclusions

Evaluating learning- and teaching-processes is an important subject of didactics of informatics at university and has to be integrated in informatics teacher-training at university. Evaluating classroom practice and the use of multimedia exploration platforms in informatics serves different purposes.

Methodology and the tools of research, also the results of the empirical study, have to be connected with the practice of teacher education in informatics. It is very important for teacher students to learn about the educational practice of informatics at school. They will come to know about differences between theoretical concepts and practice of informatics lessons. Evaluating learning informatics is necessary not only to produce new findings or get information about current results from other research projects but also to understand empirical research methods. In a process of lifelong-learning future teachers should be able to enlarge their knowledge about teaching by studying further research results on classroom practice in informatics. Founded on a critical judgement of these research results and due to their own experience future teachers may improve their teaching-practice.

Finally, to foster these skills it is important to offer teacher students in seminars at university the opportunity to gain their own experience with classroom situations, discussing and evaluating their own behaviour in the classroom and to strengthen their faculties for self-assessment. Thus, teacher training at university will make a substantial contribution to improve teacher students' abilities for lifelong-learning and, as a result of this, in long term to increase the quality of informatics at school.

We hope that integrating multimedia tools into the their own teaching practices will not only enlarge the teacher students' methodical abilities but will also contribute to the understanding of the concept of modelling and to the pupils' comprehension that socio-information systems are formable in different ways.

As another spin-off of the MEPIS-project, the video-tapes and the variety of lesson-oriented materials may be used to establish a "best practice" data base of lessons in informatics, which may also be used to improve quality of teacher training and thus finally, the quality of informatics at school.

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TIMMS, e.g.: http://nces.ed.gov/timss/TIMSS-R/more.asp

CD-ROM of Teaching Greek, Irish and Finnish History of Arts in Secondary Education

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Abstract: A new CD-ROM of Teaching History of Arts is presented in this interactive session. The content of the CD-ROM is Architecture, Painting and Music in Greece, Ireland and Finland. Every country has chosen "a golden period" of history in each art and presents it using multimedia material. There is also possibility to update the information in hard disk through Internet.

1. General Description

The CD-ROM takes the user to three countries in three ways. The first one is a "data mining" which is an interactive engine that helps the user to access information by art, time period, picture, name and context. By exploring the material of CD-ROM the user collects the necessary information of three arts of three countries. The second engine is a slideshow creation and customisation tool for teachers. Thus he/she is able to create appropriate teaching material according to the needs of a certain lesson. The third one is an interactive game engine that has evaluation purpose.

All "software engines" retrieve and process information from common "pools of knowledge" (databases) that are placed on the CD-ROM or exist in the Internet or local discs or servers.

During the presentation the audience will find out versatile use of this CD-ROM and they will have ideas for creating similar products. After the presentation the session participants are able to test the CD-ROM in order to have a personal experience of this learning tool.

2. Key Objectives

This CD-ROM is an on-line educational software that allows end-users to retrieve, discover, set-up and exchange information about the arts and their history in each of the three European countries. It presents new teaching and learning processes that emerge from the on-line use of open-ended educational software, by testing it in everyday school life.

2. The Scenario

The main menu is the starting point of all educational activities available in the CD-ROM. The mentioned software engines include several groups of activities such as: Art presentation, Teachers' desktop, and Game. The host explains these activities to the user and prompts him to choose one of them. By choosing an Art the user proceeds to the "data mining" section of the application. Teachers may choose the slideshow, in case they use the CD-ROM in the Classroom, or Teachers' desktop if they want to set-up a slideshow or change the application parameters. At last everyone can choose to enter into the gaming section to entertain him/herself and to evaluate his/her knowledge on History of Arts.

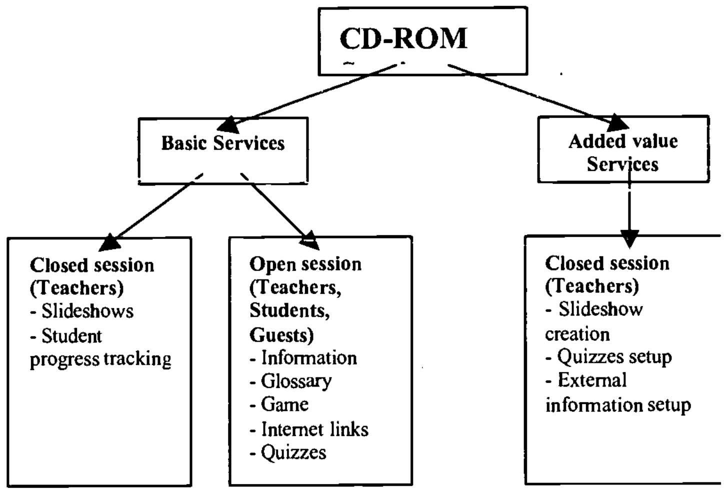

Figure 1: Services offered by the final product

Selecting an Art, while being in the main menu, the user proceeds to next stage, where objects of special interest are placed on the screen by chronological order (multiple scrollable timeline graphic screen). In this stage there are available brief descriptions of the socio-economic environment for each period for every art, in the form of text and narration.

After choosing an object the user reaches the main screen that presents essential information by using pictures, text, videos, narration and hyperlinks. Further information can be reached by clicking on each one of the five predefined buttons (Location, History, General Description, Tell me more, Frequently Asked Questions). This information is attached to a series of overlapping windows, so that the user can track the depth of it.

Teachers' desktop or teachers' laboratory provides an interface with wizards that help them to adapt the application to their needs without changing its structure. Thus, the presentation of information becomes more flexible. The pool of contents supplies the slideshow with all available media relevant to the theme, which exist in the CD-Rom, in local discs, or the Internet. We propose to develop at least six slideshows (two for each Art) as examples in order to ease the job for other people.

The presentation of any information is supported by a number of external utilities. These utilities help the user to exploit this information with the CD-Rom software package as well as with other packages. They are Help, Glossary and Notes.

Finally, by choosing the Game, the user enters into the evaluation section of the application, which also is an entertaining one. In this section a series of educational games drive the user through predefined trails to his/her final qualification. The game is scaled up with a set of rounds that lead to different certificates or diplomas. Partial games-quizzes of different types and forms are drawn in random order from a game pool.

Interdisciplinary learning process with ISDN-videoconference: "The production of Wine"

Jukka Maki, The Ziridis Schools, Greece

In this paper I explain thoroughly one example of an innovative project using ISDN-based videoconferencing in teaching of elementary students.

Is It Possible To Teach Music In a Classroom From Distance of 1000 km? Learning Environment of Music Education Using ISDN-Videoconferencing

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Abstract: ISDN-technology has solved many educational problems in rural areas in Lapland, Northern Finland. This paper presents the results of research conducted in Utsjoki School about music education in classrooms. The instruction has been given using ISDN-videoconferencing from a distance of 1000 km. Also the model for teaching music in VC-environment is presented.

1. ICT in Teacher Training

The University of Oulu (Finland) has a ten-year-experience in distance learning. Located in Northern Finland, Oulu, is a center for small distant villages and towns in Lapland. Distance learning has become an everyday way of instruction and communication. The Department of Educational Sciences and Teacher Education of the University of Oulu is a leading educational institution in the field of DL. The use if ICT in DL (and generally in teaching) is a part of the compulsory studies for students. Students are also able to take optional courses of ICT.

Students complete their practicum studies at the University Experimental School and in village schools. Many schools in scattered areas do not have teachers with different focus areas of instruction. ISDN-videoconferencing has given opportunities for teacher trainees to practice their teaching skills with ICT and pupils in remote schools have had the opportunity to receive instruction in every subject of the school program.

2. The University of Oulu/Music Education

The Department of Educational Sciences and Teacher Education of the University of Oulu has Kindergarten, Elementary Teacher, Music Teacher and Subject Teacher departments. The University of Oulu is one of the three universities in Finland providing subject teacher education in music teachers for comprehensive and secondary schools. The goal of the music education program is to provide the student with skills, information and attitudes required in widely and autonomously taking care of tasks in music education as well as developing the work and scientific aspects. The student is familiarized with the goals, contents and protocols of music education as well as with the application and observation of pedagogic music research. [musicedu.oulu.fi].

Essential points of emphasis in studies are amongst others music and communication technology. All students take part in learning of distance education –methods, lesson planning, using videoconferencing and creating www-material for music lessons.

The Music Department has taken a leading role in developing and integrating the music education in Northern Finland. Cooperation has been done between schools, institutes of music and the Department. Some projects have been done by the members of the staff but mostly in cooperation with the students. Thus all the partners - professors, students, distance teachers and students in institutes and schools - have had important and unique experiences in music education by distance.

During the practical period of the studies at the Music Teacher Department the students taught music to the school of Utsjoki located 800 km from Oulu. The attempt to create a learning environment similar to a normal classroom with face-to-face teaching.

3. Models For Teaching In ISDN-Videoconference Environment

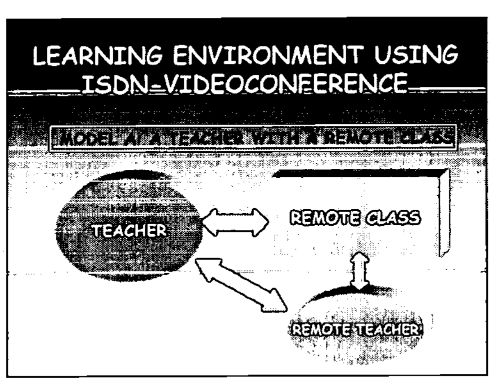

Figure 1: A teacher with a remote class.

In the first model a local teacher is alone conducting the lesson with the remote class. There might also be a teacher, but in many cases in scarced villages there are no special teachers for all the subjects of the school curriculum. Even the pupils take care of the of the facilities and the classroom discipline. More often there is however a teacher as a technical tutor, but he may not have any knowledge of the teaching subject. The local teacher has the main responsibility of teaching.

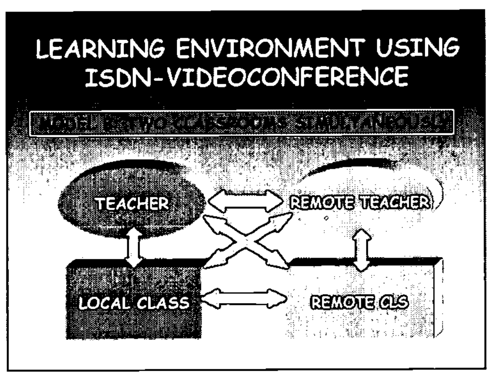

Figure 2: Two classrooms simultaneously.

In the second model a teacher is conducting the lesson with the local class and the remote class together. There may also be a remote teacher or a tutor. If the remote teacher is familiar with the teaching subject, the responsibility of teaching can be divided between the two teachers. The interaction and communication goes on between all the partners. [musicedu.oulu.fi/koti/jmaki.htm].

4. Utsjoki-Project

Utsjoki is a good example of activities that has been done using videoconference in teaching and as part of the practicum of teacher trainees.

Utsjoki is a village with 1500 inhabitants and it is situated in the very North of Finland on the Norwegian border [www.utsjoki.fi]. The municipality has three villages which are located tens of kilometers from each other. Each of them has a school of own but only with few pupils. Without VC-technology the pupils could not receive all the lessons of the comprehensive school program. The main school in Utsjoki has also upper secondary school. Many students of Lower and Upper Secondary School of Utsjoki are brought with taxi from a distance of 50 kilometers or more and some pupils remain every school week in Utsjoki returning home only for the weekends.

4.1. Background to the Project

In the early 90's there were first experiments of distance learning using Tele-X-satellite and later ISDN-lines. There also existed need for distance medical services and so there was interest in different level of municipality. Other villages in Lapland, technological institutions, universities, state and province became partners in the project, too. Because of the long distances from cultural centers and scarce teacher resources, videoconferencing has given new aspects for education.

The Utsjoki-project started in 1995 as preliminary preparation. Experimenting, research and establishing period was implemented in 1996-1999. It had financial support from the Finnish state, European Social Fund and European regional development Fund-project. Because of the excellent results, the Project-application with videoconference was continued until July 2000. [www.utsjoki.fi/~utspoli].

Most of the activities have taken place in the lower and upper secondary school. The main goal of the Utsjoki-project is to create and develop learning methods and networks that increase educational equality and utilize the decreasing resources of the schools. The networking of schools both inside the Utsjoki municipality and with other municipalities in the Lapland region makes it possible to combine the scarce resources of education providing the schools with further possibilities to exist.

4.2. Teaching music from distance

The Utsjoki School had a music teacher last time 15 years ago and so the pupils had no possibility to have music lessons. The use of ISDN brought a music teacher in the classroom and the pupils were enthusiastic with the instruction. The lessons were instructed from the University of Oulu, the University of Helsinki [www.helsinki.fi], Music University Sibelius Academy in Helsinki [www.siba.fi] and the Institute of Orivesi [www.kvs.fi]. The learning environment was developed to create a similar as a normal classroom face-to-face teaching.

The lessons consisted of teaching

- history of music
- theory of music
- singing
- rhythm instruments
- rock band instruments
- ensemble playing
- pupil presentations

The experiences were very positive. The Utsjoki School last had a music teacher 15 years ago and the pupils had not been exposed to music lessons. Use of ISDN brought a music teacher into the classroom and the pupils were satisfied with instruction. Teaching with two-way videoconferencing has major problems with the limited possibilities of sound and picture as they are of vital importance in teaching music. The University of Oulu has developed this learning environment and tried to minimize these particular problems.

Teaching with two-way videoconferencing has major problems with the limited possibilities of sound and picture which are more emphatically in teaching music. The main role is the quality of sound and picture. Using one ISDN-line (128 kpbs) a delay of 0.5 seconds occurs. It doesn't sound very much and in normal communication (speaking) it doesn't bother us at all. But that delay is very big when making music with remote class – it's even impossible to sing and play simultaneously. When there are in use two ISDN-lines (256 kpbs) or three (384 kpbs) and the lip synchronization is adjusted, the delay is so minimized that human mind doesn't even notice it.

There are no differences when teaching theory or history of music from a distance or face-to-face. The teacher is able to use all the written and acoustic material plus the internet and application sharing. Also pupils are able to work in groups, present their exercises and teamwork with the same way as in normal classroom situations. Distance lessons give more possibilities for collaborative and self-directed learning and pupils come more responsible for their own learning, because they must be active participants in the learning process.

Learning to play instruments and ensemble playing meet some problems in teaching. When a pupil is learning guitar, the teacher cannot go next to him and show where to put his fingers. He must explain verbally but he can zoom his camera close to his own hands. This is even better than a classroom situation where a pupil tries to see from the distance of several meters the finger placement. So there comes a question: is distance teaching actually "close-teaching"?

The teacher can always show the rhythms with his own guitar. The same happens with teaching the drums: he shows how to play and pupil imitates. In face-to-face situation the teacher is able to take the hands of a pupil and play together with him. This cannot happen in distance lesson. But again one advantage: quite seldom there are two drum-sets in one classroom – during distance lesson the teacher can play together with pupil and the teaching is more practical.

Because music lesson has always quite high amount of decibels, the teacher and the learning group must agree some practical rules: when and how to start and finish, in which way the teacher interrupts the playing etc. Because the sound is delivered with microphone, the distant teacher might not hear all the details. That's why it's good to use more than one microphone and place and direct them in a proper way.

The modern videoconferencing technology also gives the teacher also the possibility to zoom the remote camera. So he is able to follow closely the performance. Furthermore he is able to play MIDI-instruments together with the remote group. If the teacher also has a classroom with him, they become really versatile jam-sessions between the local and remote pupils. The distance has no borders: one group in Finland and the other group in Australia – making music together!

The critical point in teaching music with ISDN-videoconference is the excellence of planning of the lesson. The teacher must prepare everything very well: the lesson plan, all the music to be listened, to written examples of partitures, transparencies, instruments, VC-equipment – everything must be physically close to him. And he must always be flexible to change his good lesson plan in case of technical problems. A remote music teacher must be a "super-teacher". A good music teacher also uses other means like the internet and email which supplements real-time teaching. Often fax, post and even telephones are useful and necessary ways of communication.

The evaluation of the learning is sometimes quite complicated in music lessons. The teacher doesn't always see or hear all the pupils and that's why the participation during lessons is not always well recognized e.g. when they're singing together there might be problems to separate the voices. If there is a tutor or remote teacher, the evaluation is possible to do together. Often the atmosphere during the lessons is not conveyed via ISDN. After every lesson it's good to have a feedback discussion between teachers and also pupils can tell their thoughts. In the case of the Utsjoki-project it was even more essential, because part of the lessons were instructed by the remote tutor (teacher of physics). Those lessons were however planned by the music teacher and the pupils in turn reported about the lessons to him.

Links in www

[edtech.oulu.fi] Research Unit for Educational Technology. Department of Educational Sciences and Teacher Training. University of Oulu, Finland.
[musicedu.oulu.fi] Music Education. Department of Educational Sciences and Teacher Training. University of Oulu, Finland.
[musicedu.oulu.fi/koti/jmaki.htm] Home page of senior researcher Jukka Mäki. Music Education. Department of Educational Sciences and Teacher Training. University of Oulu, Finland.
[norssi.oulu.fi] Teacher Training School. Department of Educational Sciences and Teacher Training. University of Oulu, Finland.
[www.chydenius.fi] Research and Education Institute of Chydenius, University of Jyväskylä, Finland.
[www.helsinki.fi] University of Helsinki, Finland.
[www.kvs.fi/kvs/orivesi.html] Institute of Orivesi, Finland.
[www.minedu.fi] Ministry of Education, Finland.
[www.oph.fi] National Board of Education, Finland.
[www.ouka.fi] City of Oulu, Finland.
[www.oulu.fi] University of Oulu, Finland.
[www.siba.fi] Sibelius Academy. Helsinki, Finland.
[www.ziridis.gr] The Ziridis Schools. Athens, Greece.
[www.utsjoki.fi] Municipality of Utsjoki, Finland.
[www.utsjoki.fi/~utspoli] Telematic distance learning -project in Utsjoki, Finland.

Comparing the Impact of Two Types of Knowledge Organizers on Learning Complex Conceptual Material in a Second Year Course on German Thought and Culture

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Abstract: The purpose of this study is to provide students in a culture course with a study method that allows them to better conceptualize abstract and complex material. The study will be undertaken through a series of steps. First, students will receive ungraded training sessions in constructing knowledge maps and matrices ("frames and slots"). The instructor is also using knowledge maps and matrices as teaching aids and models. Students will be required to construct their own maps or matrices for two assignments. In these assignments, students will incrementally acquire competence in making knowledge maps and matrices, providing them with the expertise needed to complete the next step: constructing a knowledge map or matrix that acts as a proposal for a research paper. Finally, as part of the final exam, students will complete a concise knowledge map or matrix based on recall of information from the short assignments.

The Study

In this study, two types of strategic learning practices—knowledge maps and matrices—are compared for their impact on learning complex conceptual content. Knowledge maps are visual organizers of key concepts, typically hierarchically arranged and with labeled links between them, designed to represent understanding of the presented material at a given stage in the learning process. Matrices are frequently described as "frames and slots," where categories or themes of content are set out in frames or columns, and more detailed information pertaining to them is arranged in rows or slots to produce a table. Much research has been done documenting the usefulness of knowledge maps at both the K-12 and college level, particularly in the field of the natural sciences (see, for example, Novak, Gowin, & Johansen 1983: Briscoe & LaMaster 1991; Ruiz-Primo & Shavelson 1996; Regis & Albertazzi 1996; Markow & Lonning 1998). Relatively little research, however, seems to have been undertaken on knowledge mapping at the level of higher education outside the scientific field (one exception is Leahy 1989). Matrices are frequently presented (along with other visual organizers) as useful aids for organizing information during the educational process (see, for example, West, Farmer, & Wolff 1991; Jonassen, Beissner & Yacci 1993). These aids, too, are often seen as being most helpful in connection with such traditional "difficult" disciplines as the sciences, but have also found wider application in the humanities (Garrec 1978; Kleg 1988), as well as in non-academic applications for students (Dees et al. 1991; this study involves knowledge maps as well, but applies both these strategies to personal management, i.e., time and stress management). To date we have found no studies that focus on comparing the effectiveness of these two strategies, knowledge maps and matrices, on learning in any discipline. This study takes a first step toward addressing these apparent gaps in the literature.

The tendency to apply these strategies to the scientific fields may reflect the perceived centrality to the sciences of conceptual knowledge based on certain "core concepts" of a discipline (see Romance & Vitale 1974). Non-scientific disciplines, however, are often equally dependent on such conceptual knowledge; the focus of this study is a course in German intellectual history which demands of the students not only the learning of a broad historical overview involving a great deal of basic information, but a degree of understanding and expertise in certain overarching important philosophical, aesthetic and cultural concepts.

The purpose of this study, currently underway and to be completed in February 2001, is twofold: first, to assess the impact of using knowledge maps compared to matrices as aids to student learning in the context of an undergraduate class on German thought and culture; and second, to instruct students in the value of using these strategies for organizing their knowledge. The strategies act as externalizations of students' understanding of difficult conceptual material they will encounter in the course—a process that will enable them to assess the completeness and accuracy of their work against models provided by the instructor. Knowledge maps have the advantage of providing links between concepts and related information, but they also have a relative disadvantage: namely, the fact that they are cognitively more challenging to learn and to execute. An advantage of matrices, on the other hand, is that they foster the organization and categorization of information and descriptors in a straightforward manner, and are accordingly much easier to construct (perhaps explaining their greater use in the supposedly conceptually simpler non-scientific disciplines); unlike knowledge maps, however, they do not make the links between concepts and descriptors explicit. Consequently, it is not clear which will be more effective for student learning.

Students in the map treatment will use the IHMC Concept Map Software (available for download at http://wwwcmap.coginst.uwf.edu/), created at the Institute for Human Machine Cognition at the University of West Florida, for map design—easy to use freeware that is downloadable at no cost (although the size of the file virtually requires a cable modem or network connection). All students will be able to access the software either by using their own computer equipment or through on-campus computer labs, or both should they prefer. Students in the matrix treatment will use Microsoft Word (or any other word processor or program capable of making tables) to design the matrix tables as needed for each required assignment. Both groups will use freehand drawing for the final exam. In both cases, the software involved has a relatively short learning curve for basic proficiency but is capable of producing visually appealing and easily legible results. In addition to obtaining feedback from the students regarding the efficacy of the two learning strategies, the questionnaire will also collect data about their perceptions of the adequacy and usability of these tools.

Our research hypotheses are as follows:

(1) For each student outcome, the two treatment groups are equal. Outcomes are:

a. Two short assignments
b. Term paper proposal
c. One map or matrix question on the final exam based on recall of information from the two short assignments
d. Final exam score
e. Course grade

(2) There is a relationship between students' performance and their perception of the usefulness of knowledge maps or matrices as learning aids, as indicated by their responses to a brief questionnaire.

We also expect, although we will not attempt to prove, that relative to previous years' classes that did not use such visual organizers, the use of knowledge maps and matrices as learning aids will enhance students' comprehension and retention of structural historical/cultural knowledge in the three areas represented by the short assignments and term paper proposal. This assumption is grounded in the expectation that the use of knowledge maps and matrices as a feedback tool will facilitate meaningful learning; that is, learning which allows students to capitalize on what they have already learned by placing it more immediately in a structural relationship with new information (Ausubel & Novak 1978; Novak 1998).

The first phase of this study will be undertaken through a series of steps over the progression of the course term. First, students will receive training sessions in planning and constructing knowledge maps and matrices. Further, the instructor will use both matrices and knowledge maps as teaching aids and as models for the students. Students will be required to construct their own maps and matrices for two short assignments. In these assignments, based on the work of (Regis & Albertazzi 1996), students will incrementally acquire competence in making knowledge maps and matrices in the following sequence before working independently of instructor support. These are:

Assignment 1: (Arian Controversy) ***Known terms*** – a fixed number of concepts are assigned and each student constructs the map or matrix using only the terms given. The knowledge map students choose the linking relationships and the concept structure she/he considers most suitable.

Assignment 2: (Humanism) ***Concept stimulus term*** – only one concept label is assigned; each student structures and elaborates her/his own map or matrix using the given label.
Assignment 3: (Term Paper Proposal) ***Open*** – no concept label is assigned; the number of labels the students can add is open; each student structures and elaborates her/his own map or matrix on the topic of their choice using the given label.
Final exam question: (Choice of either assignment 1 or 2) ***Guided choice terms*** – students are given a number of terms greater than required to construct the map or matrix, not all of which apply to the question. They are instructed to use only the appropriate concepts to construct their own maps or matrices.

These are developmental steps in map and matrix making designed to guide the student toward greater ability to construct them independently of instructional support. For the two short assignments, each step is designed to provide them with the experience needed to complete the next step in the sequence. These steps are preliminary to constructing on their own the map or matrix proposal for the major research paper. Finally, along with short answer and essay questions on the final exam, students will be required to complete a concise knowledge map or matrix question requiring recall of information learned in the two short assignments.

Maps and matrices will be scored for completeness of conceptual structure and accuracy of related information for both treatments and, for the former, accuracy of links between concepts for the knowledge map. Presentation (visual clarity and coherence, as well as spelling and, where applicable, grammar) will also be evaluated. The knowledge map and matrix response question in the final exam is similarly scored but will not be returned to the students. Data analysis will take place after students have completed the course.

In the second phase, this study will be repeated in the Winter 2001 term, and the data merged for final analysis.

Implications of the Study and Preliminary Results

If it makes no difference to learning outcomes whether concepts maps or matrices are used, then the potential conclusion is that the "simpler" and more straightforward matrix strategy is equally effective to the knowledge mapping strategy in the production of meaningful learning, understanding and retention.

Preliminary results for the data analysis undertaken thus far indicate that the strategies contribute equally to learning outcomes when students' averaged grades on assignment 1 and the term paper proposal are taken into account. Table 1 illustrates that for each of these outcomes, the knowledge map and matrix groups' scores were the same. The map and matrix final exam question responses, however, show an advantage for those using knowledge maps.

	Maps	*Matrices*
Assignment 1	13	13
Term Paper Proposal	13	13
Final Exam Question*	14	9

Table 1: Averaged grades on assignment 1, term paper proposal, and exam question. *Students were given a choice of using either maps or matrices for this task.

While at this point in the analysis no substantial claims can be made about the relationship between the strategy chosen and learning outcomes, students did exhibit clear preferences across the A and B grade ranges. The total number of map/matrix choices for the students is 44. Overall, they chose maps 53% of the time and matrices 43% of the time. A more informative picture of the potential importance of using maps instead of matrices to enhance learning outcomes is presented in Table 2.

Grade Range	*Maps*	*Matrices*	*Total Choices*
A	14 (70%)	6 (30%)	20
B	4 (33%)	8 (67%)	12
C	6 (50%)	6 (50%)	12

Table 2: Grade range and preferences for using maps or matrices across four tasks.

Those students achieving in the A range preferred using knowledge maps 70% of the time, while those in the B range preferred matrices in almost the same proportion (67%). The C range achievers chose either matrices or maps in equal proportions.

An even clearer picture emerges when comparing map and matrix users responses in assignment 1 and the term paper proposal as presented in table 3. To date, these have been coded for identification of the following key information pertaining to the requirements of the assignments: (1) issues identified; (2) supporters and facts about them; (3) related historical actions and events; and (4) overall conclusions generated as a result of the students' research.

In each case the average assignment grades remain the same.

	Issues	*Supporters/facts*	*Actions/facts*	*Conclusions*	*Total*	*Grade*
Assignment 1:						
Maps	63	104	79	9	255(39%)	13/15
Matrices	81	167	152	7	407(61%)	13/15
Total:					**662**	
Term Paper Proposal:						
Maps	36	28	49	14	127(41%)	13/15
Matrices	92	20	55	17	184(59%)	13/15
Total:					**311**	

Table 3: Map and matrix user responses for assignment 1 and the term paper proposal.

Although the average grade is the same for the map and matrix groups, the matrix group generated substantially more information, 60% more, to achieve at the same level than did the knowledge map group. (Note that for assignment one the key concepts were provided by the instructor prior to students completing the assignment. In the Term Paper Proposal, students were given no prior information.) This finding becomes even more marked in the analysis of just one coding category, in this case, "issues," in assignment 1. The knowledge map group recorded 36 items and the matrix group recorded 92 items – 28% and 72% respectively from a total of 128 items of information. In this case, the matrix group generated just over two and one-half times the amount of information than did the knowledge map group – again, noting that the average assignment grade for both groups was the same.

We noted that if using either knowledge maps or matrices appears to have the same effect on student learning outcomes, then it is simpler to use matrices. We can conclude that using either one or the other appears to be just as effective when looking at the averaged grades for the work presented above. This is deceptive, however, because while there are no differences in the averaged grades, we found that the amount of work, as recorded by coding information items, was significantly discrepant between the groups. While knowledge maps and matrices are both very useful visual organizers for most students, the knowledge maps appear to provide more than that.

Our data suggests that using knowledge maps assists students to represent and recall their knowledge in a highly condensed manner, thus making the learning effort more salient and much more effective and efficient for these students than it is for those using matrices.

How did the students like using the software? A short 12-item questionnaire distributed at the end of the course shows that all students rated them highly as study aids, as conceptual organizers, and as useful teaching tools that are easy for instructors to learn and apply. Most felt confident in their ability to make maps or matrices and thought they would use them in other courses. Interestingly, most didn't want to discuss their maps or matrices with the instructor, nor did they want them used as evaluation tools.

Finally, the relatively low learning curve and high ease of use of both software programs, particularly for matrices, leads us to the conclusion that, given modern technology, extremely sophisticated pedagogical strategies with successful outcomes are more than adequately supported by quite simple and readily available technologies.

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CoBrowser: Surfing the Web Using A Standard Browser

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Abstract: Co-browsing is a synchronous class of collaborative application, which allows a group of users to "surf" the web together. Such an application can be deployed in an education environment in several ways. For example, courses that are project oriented might require students to collectively research or explore information on the Web. In this paper, we describe CoBrowser, a prototype co-browsing system that supports multiple groups, CoPointer, and Chat sessions. In past, co-browsing architecture have been based on either a proxy server or required a specialized plug-in for the web browser. The proxy server based approach is complex and is not scalable. The proposed CoBrowser addresses both these limitations and works on any platform that supports a graphical Web browser with Java capability.

1 INTRODUCTION

Co-browsing is a synchronous class of collaborative application, which allows a group of users to "surf" the web together. Such an application can be deployed in an education environment in several ways. Few examples are: (a) Courses that are project oriented might require students to collectively research or explore information on the Web. A group of students may be working together to write a report on the subject of computer security. For this, students may decide to research the material together to identify papers, which they can use for writing the report. (b) Instructor holds a recitation session with a group of students to explain or elaborate on some concepts discussed earlier in the class. (c) An instructor may find it useful to use different media, such as animation and video available in a digital library, to explain a breadth-first search algorithm.

Recently, many collaborative web applications have been developed (Maly et al. 1997, Mshow 2001, Centra 2001, Helpmeeting 2001, Davis et al. 1998). Most of these approaches either require modification of the browser, are based on the X Window System protocol. However, these approaches do not lend themselves easily to a group of users working on multiple platforms (such as Unix, Windows NT, MacOS, and Windows2000) concurrently and spontaneously. Clearly, it is no technical problem to write a distributed software system that runs on all participants' machines and has the desired functionality of synchronizing their browsing. However, in today's world, people are constantly on the move working from different machines and are unwilling to go through a complex install process to join a group session spontaneously. One should add that it is a technical problem to write such a system to work on all platforms. The second approach is based on the use of proxy server that is responsible for coordinating and delivering content to all the participant browsers. This requires only minor modifications in a user's browser but the approach has turned out to be fraught with great technical difficulties that nobody we are aware of has completely solved. In (Davis et al. 1998), we describe these and our own initial proxy approach.

This paper describes an approach that works on any platform that supports a graphical Web browser with Java and JavaScript capability and is easy to implement. Most new Web browsers, such as the Netscape and Microsoft Internet Explorer, have this capability. Also, in this approach it is not necessary for every user in the group to be on the same platform. It is feasible for some users in the group to use a browser on a Unix machine, while others use a browser on Microsoft Windows. In past, co-browsing architecture have been based on either a proxy server or required a specialized plug-in for the web browser. The proxy server based approach is complex and is not scalable. The proposed CoBrowser addresses both these limitations and works on any platform that supports a graphical Web browser with Java capability. Another advantage of this approach is that it does not modify the browser. Coordinated browsing can be integrated with audio to enable users to speak while browsing. However, this paper will only discuss the coordinated browsing architecture and its implementation.

The rest of the paper is organized as follows: Section 2 gives an overview of the architecture of the CoBrowser, Section 3 discusses the basic operation, and in Sections 4 and 5 discuss additional features. Conclusions and future work are detailed in Section 6.

2 COBROWSER ARCHITECTURAL OVERVIEW

CoBrowser is a multi-group co-browsing system. That means it allows several co-browsing groups existing simultaneously without interfering with each other. A typical co-browsing group consists of several participants who can surf the web together. CoBrowser provides the following functionality for a co-browsing group:

- When a user in the group loads a document from a site in a co-browsing session, the same documents gets loaded on all the other users' Web browsers.
- When a user resizes his browser window or drag the scroll bars in his browser window, all other users in the same group will get the same changes in their browser windows.
- If one user loads a local file into his browser (either drag and drop a file icon or use file open), all the other users in the same group will see that file in their window as well.
- When a user points to somewhere in his web page, any of other users in the same group can see that pointer
- When a user wants to talk with other users in the group, he can enter the group's chat room.

The key idea of CoBrowser is to monitor a user's activity such as opening a new URL, resizing his browser, scrolling the browser window, and etc., and then communicate this information to other users' browsers in the group. The other users' browsers on receiving this information perform the same activity such as download the same document or resize it's own window or drag the scroll bars. We use Java and JavaScript technology to implement our system. As seen in Figure 1 the CoBrowse system consists of software for a Central Service (CS), a collocated Webserver (WS) and a Co-browsing Server (COS). At the client side we have users that have JAVA enabled browsers and that form mutual exclusive (this is only a limitation of the current implementation) groups of surfers that share the same experience.

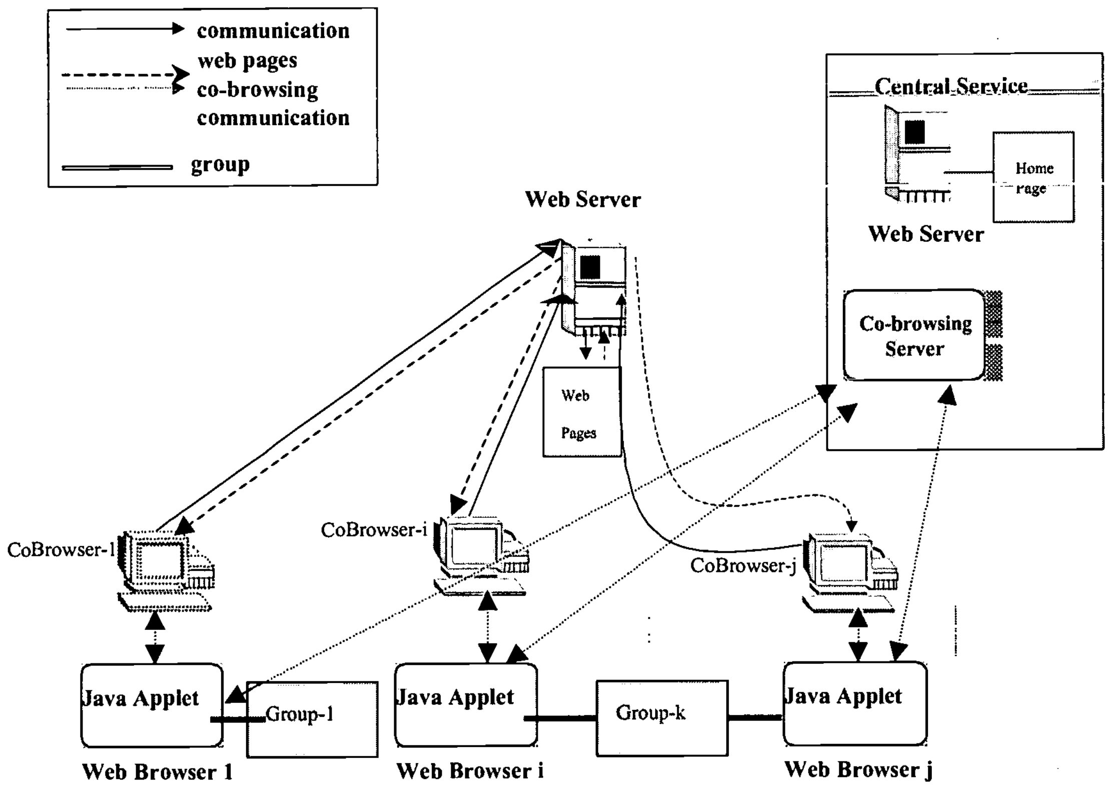

Figure 1: Multi-group architecture for co-browsing system.

3 COBROWSER BASIC OPERATION

To illustrate the working of the co-browsing architecture, we consider the following scenario where a new user joins an ongoing co-browsing session of two users. In the ensuing explanation we shall use always one group of users. Our system has been implemented to handle a number of simultaneous groups. The code to handle multiple groups is extensive and actual is the main cause of tricky bugs because we need to keep separate data structures for each group's information. However, there is no fundamental architectural design feature that is needed to go from one to two or more groups.

Registration Process. The new user downloads a registration document served by the CS-WS, see Figure 1, when the user starts cobrowsing by clicking the appropriate link on the CoBrowser home page. This document has a Java applet embedded in it that has the information about all the existing groups and all the users in each group. The browser downloads a signed applet that requires certain privileges on the user machines and runs it.

The applet registers itself with the Co-browsing server. The applet registration process involves informing the CS that it is active and the port number at which it will be listening. Upon receiving this information, the CS updates its table of active Web browsers in the session. Note, due to security restriction of Java applets, the Co-browsing server (CS) and the Web server (WS) have to be on the same host. The Java applet security environment does not allow applets to communicate to any host other than the host from where it is was downloaded.

Joining a Session. A new user, user-3 joins the existing group: cobrowsing-architecture. A new window, CoBrowser Window, is opened. The Java applet gets the URL of the current document being viewed by the group and sends it to the CoBrowser window. User-3 can start co-browse in the CoBrowser window. The Java applet remains active until the user leaves the co-browsing session. Since all new documents are loaded into the new CoBrowser window, the embedded applet remains active in the old window.

Co-Browsing in a Session. User-3 clicks on a link that points to the URL http://www.some.site/doc1.html or he resizes or scrolls in the new window. User-3's applet sends the request to the co-browsing server , which broadcasts the new URL or resize, scroll event to applets running on User-1 and User-2's Web browsers. The applets, upon receiving the URL information, issue a request to their respective browsers to load the new document in the new window or resize it or scroll the bars.

4 COPOINTER SUPPORT

When a group of users use CoBrowser system, one user may want to point to a specific position of the CoBrowser window to draw the attention of other group members. To satisfy this requirement, we implemented a special feature -- CoPointer. When one user moves his CoPointer to one specific position of a Co-Browsing page, all group members' CoPointers move to the same position. The CoPointer has the following features:

- The CoPointer always floats over CoBrowser Window.
- The CoPointer can be set and released.
- The group member who sets the CoPointer is the owner. Only the owner can lead the moving of the pointer and release it.
- The CoPointer will show the owner's name.
- There is only one CoPointer in a group, so a member in a group can only set the CoPointer after an existing CoPointer is released.
- The CoPointer points to the same position of the Co-Browsing page of a group when it first appears.
- The CoPointer keeps pointing to the same position of the group members' CoBrowser windows when the owner moves it.

This is actually quite difficult to achieve within our architecture. We could not without greatly increasing the complexity make the pointer be the typical pointer shape expected in distributed collaboration system. However, by using the browser window methods and properties provided in JavaScript, we implemented the CoPointer through a browser window. To create a CoPointer, we create new browser window that is a a page with the owner's name and a e which gives the appearance of CoPointer. "Pointer" is the name of the window title. To make browser window look like a pointer,we open the browser window as small as possible. We do so by opening the CoPointer at 100* 25 at (10, 10) of the screen, which is just big enough to hold the pointer image and owner's name. This browser window has no menubar, toolbar, locationbar, personalbar, and scrollbar, and not resizable. A snapshot of a cobrowsing session along with the CoPointer is shown in Figure 2.

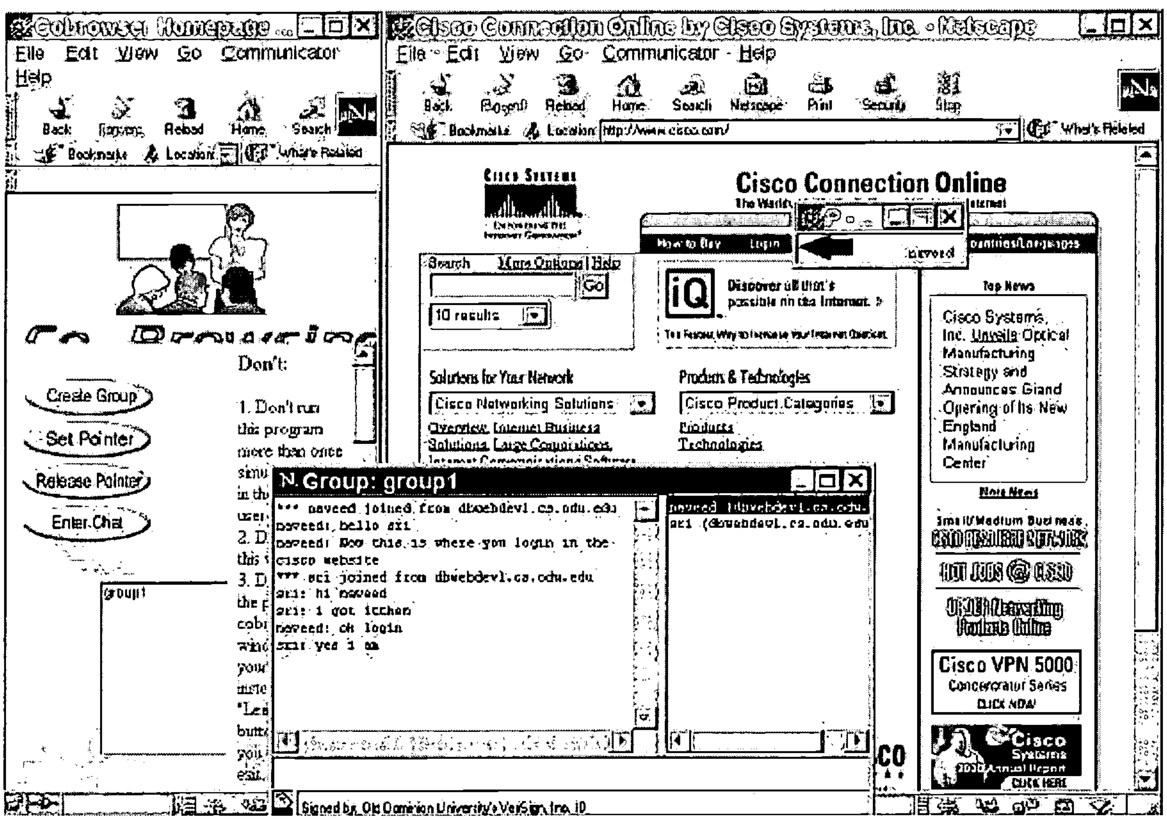

Figure 2. User 1 and User 2 in a chat session.

Because the CoPointer need to be coordinated with the instances at other users, the relative position of CoPointer to the CoBrowser window instead of the absolution position of the monitor is recorded and compared. When a CoPointer is set, a timer is turned on to check the relative position of the owner's pointer periodically. Once the relative position is changed, the new position is sent to CoBrowser server. Then CoBrowser server broadcasts the information to other group members whose pointers will be moved to the new position accordingly.

When a user joins or leaves a group, we need additional checking for CoPointer system. The group pointer status records whether a CoPointer of this group has been set, and the group pointer position records the current position of the group's CoPointer. When a CoPointer owner leaves a group, the pointer status is checked. If the CoPointer is still set, an alert pops up to warn the user to release the pointer before leaving the group. When a user joins the group, the group pointer status and position are checked. If a CoPointer has been set, a pointer window is shown on the position of the CoBrowser window indicated by the group pointer position.

5 CHAT SUPPORT

To alleviate the problem of not having audio yet available in our system we added as a short term solution a chat facility. We simply took on of the many free-ware JAVA chatbox classes and integrated it into our CoBrowser. The session management issues for Chat are similar to the CoPointer issues. A snapshot of a chat session along with a cobrowsing session is shown in Figure 2.

6 CONCLUSION

This paper describes a co-browsing architecture that allows a group of users to "surf" the web together. The architecture works with any graphical Web browser that supports Java applets. The users may potentially be geographically separated and working on different platforms. The system has been extensively tested for single and multiple groups and is available for demonstration from a server we run here at Old Dominion University:
http://www.cs.odu.edu/cobrowser/. Source code licenses are available from the University (one company is using the software for a 'helpdesk' system) and we will make code available also for non-commercial, academic research teams. We are in the process to test the scalability of our architecture. Support for page annotations will also be included for the pages placed in a tour where a group of users can follow a prescribed tour. Providing a means for such asynchronous use will facilitate the creation of reusable courseware materials. It also allows greater flexibility for large groups of students working together whose respective time constraints (work, parenting, etc.) would otherwise prohibit traditional collaborative methods. Once the complete Java Media APIs are available, audio will also be supported with the co-browsing architecture. This feature will enable co-browsing participants to have simultaneous audio and web browsing explorations.

Acknowledgment. We would like to acknowledge W. Haiyan for implementing the CoPointer support.

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Design and Implementation of Java and Flash Programs for Teaching and Learning Elementary Number Theory

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Abstract: Mathematics is widely perceived as an abstract subject to learn. However, information technology can be used as a tool for enhancing the students' understanding of the abstract concepts behind and also arousing their interest in learning a variety of topics of mathematics. This paper reports the design and implementation of Java and Flash programs for teaching and learning elementary number theory in the Hong Kong Institute of Education. Illustrative examples with screen dumps for topics such as Greatest Common Divisors, Eratosthenes Sieve, Prime Number Distributions and the Chinese Remainder Theorem will be provided.

Introduction

Mathematics is widely perceived as an abstract subject to learn. However, information technology can be used as a tool for enhancing the students' understanding of the abstract concepts behind and also arousing their interest in learning a variety of topics of mathematics. This paper reports the design and implementation of Java and Flash programs for teaching and learning elementary number theory in the Hong Kong Institute of Education. The programs are aimed at providing an interactive, flexible and user-friendly environment where instructors and pre-service student teachers can use it for teaching and self-learning purposes. Illustrative examples with screen dumps for topics such as Greatest Common Divisors, Eratosthenes Sieve, Prime Number Distributions and the Chinese Remainder Theorem will be provided. We hope our experience could be shared with those who are interested in developing interactive courseware in their own institute.

Design and implementation of our programs

Our attempt to integrate information technology elements into the number theory module is in fact part of a Teaching Development Grants Project being funded by HKIEd. The end product will be a comprehensive mathematics website hyper-linking all useful module materials, resources and self-design programs for easy browsing and use by students and instructors for teaching, self-learning or revision purposes. To cope with these ends, we have chosen Java and Flash as our basic programming tools in consideration of their portability, flexibility and versatility in web design. As a mathematics educator, we do believe that merely drills and practices derived from a text-based format should be prevented (Kennedy and McNaught, 1997). We do not favor a computer program or software, which is simply an electronic book. In our design, we have incorporated some basic features in our computer programs, which reflects well our teaching philosophy and pedagogy of the subject concerned. For instance, we designed an interactive Flash program to illustrate how the Eratosthenes Sieve can be used to find out primes out of the first 100 natural numbers step by step (see Fig. 1). This feature is what we call "dynamic teaching", which means to exploit the computer's ability to help explain abstract ideas or concepts which instructors may otherwise find it difficult to elaborate using transparencies, or chalks and blackboard only.

A criterion for effective teaching and learning is whether we are able to make material to be taught both interesting and stimulating. Another feature of our programs is to incorporate interesting animations to let students realize that the idea of certain important theorems could be originated from our daily life. The famous Sunzi Theorem (also known as the Chinese Remainder Theorem) is in fact a good illustrative and motivating example on this aspect. We designed an animated version of the Sunzi problems by Flash (see Fig. 2) and motivated students to formulate a general method of solution before a formal introduction of the theorem using the modern mathematics symbols.

One of the major uses of computer in education is to perform simulations. For the topic on the Distribution of Primes, we implemented the interesting spiral distribution of primes as discovered by Prof. Ulam in 1963 (see Fig. 3). Students can use the program for exploration purpose by changing the initial value of the spiral and observe the distribution pattern of primes. Another feature incorporated in our design reflects our belief that learning by doing is an important process in learning mathematics. For instance, we implemented a Java program to stimulate the scenario of computing the greatest common divisors of two integers using the Euclidean Algorithm, which would otherwise be done by pencil and paper in the traditional learning mode (Man et al, 1999). A screen dump of such as design is show in Fig. 4.

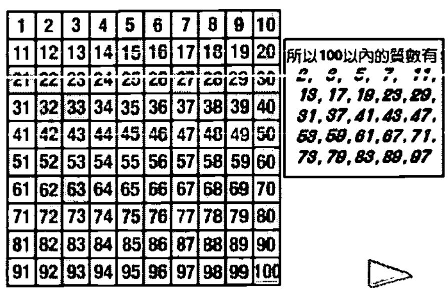

Fig. 1: Eratosthenes Sieve

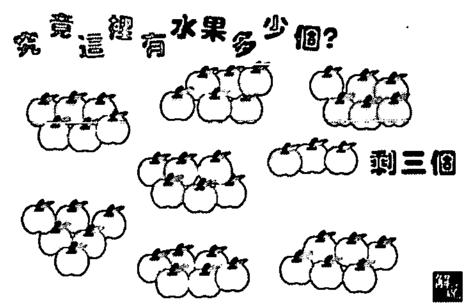

Fig. 2: An animated version of the Sunzi Problem

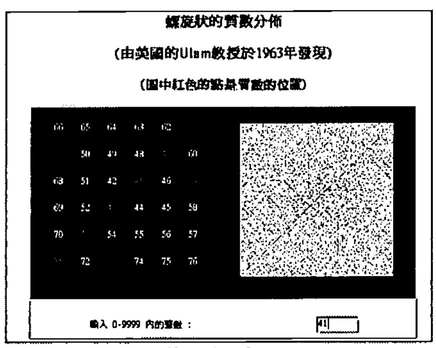

Fig. 3: Ulam' s Spiral of Primes

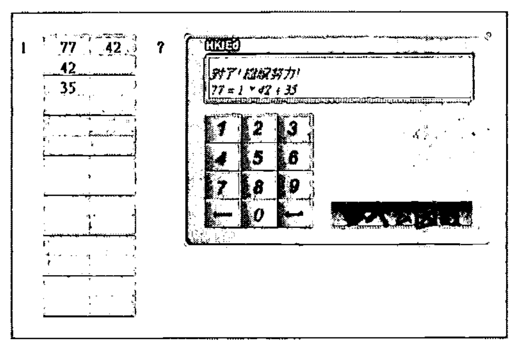

Fig. 4: An interactive program for computing GCD

Concluding remarks

We believe that the computer technology and the world wide web have a major role in the support of teaching and learning nowadays. Traditional delivery of certain subjects, such as number theory, can be enlivened more by suitable incorporation of computer simulations, animations and interactive computer activities. We hope our discussions in this paper could arouse those who are interested in developing interactive courseware in their own institute and would share their valuable experience with us in the near future.

Acknowledgments

The author would like to thank the Teaching Development Grants Committee for financial support of this project.

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Infusing Information Technology into pre-service teacher education. No computer lab, no budget for software, no time at the University. No problem!

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Abstract: Pre-service teacher education must preparc the students to effectively integrate technology into their teaching. But how to do that without the aid of teaching method disciplines, with no computer lab and no budget for software? Those challenges are faced in a project for the initiation of computer use in education that is developed in a Science teacher education program. Adopting a project-based learning strategy, students build products as webpage collections and multimedia tutorial, in a cooperative work and using creative ways. A "virtual computer lab" was structured with students' computers, in their home. Different shareware and freeware are used to develop the products. The tasks are developed in agreement with a schedule that doesn't coincide with the classes. The teacher plays a role of to challenge and top provide pedagogical and technological support to the students. The results of the experience are significant and stimulate the following of the project.

The computers are being used in Brazilian elementary and high schools. By other side, our pre-service teacher education programs still behave as if that resource yet didn't there be while pedagogical. Our colleges and universities, in their majority, do not use computers in teacher education – we have what we call a techno-absence in the teacher education. Our teacher education programs lack a learning technologically rich environment necessary to allow future teachers to develop a critical evaluation about educational applications of information technology (IT) and to discover how to use computer in the schools.

When we decided to incorporate IT - and not to teach computer – into our Science Teacher Education Program we found a first challenge: the teaching methods disciplines couldn't do the job. The difficulties to infuse IT are of several orders, but certainly the fact that the teacher education faculty still don't feel prepared to effectively use IT in their classrooms is the main one. (Bosch, Cardinale, 1993; U.S. Congress, OTA, 1995; Marinho, 1998).

To face that challenge, since we could have the contribution of teaching methods disciplines, we created PIPeTI (the acronym for Information Technology Pedagogical Initiation Project). The Project is being developed, since 1999, into the Cytology course that integrates the specific subject curriculum and is offered to the students in their first semester at the University. The students would be initiated into educational use of IT through projects developed as tasks performed by teams.

But it was not easy to start the Project. We have no time to the tasks, since the discipline has a lot of themes to be developed. That time problem had been overcome when the Project became an outclass activity. Another problem: we lack a computer set to be used by the students. So, students used their own computers - we created what we called the "Project's virtual lab" to overcome that hardware lack. Another problem: we have no budget to software. So we used shareware, freeware or evaluation versions of software, with special attention to intellectual property rights.

The Cytology's professor has the role of providing the pedagogical and technological support for the students.

The cell is the Project's main theme. Some students developed web pages to be used by children; others were challenged to build multimedia tutorials to be used in Biology classes with high school students or at the higher education programs. This way, our students could use try several software: Microsoft FrontPage, HotDog, HotMetal Pro, VisualClass (a Brazilian software for multimedia developing), Neobook for Windows and others.

Our evaluation pointed that the Project shows a feasible and relatively simple option to incorporate IT into pre-service teacher education. Our students, both in interviews and in comments made in class, stated that they felt that they were doing the work of a real teacher, creating with IT something they would be able to use later in their own classrooms. The Project is a valid experimentation of educational use of computer, leading the students to test the potential of that technology as a teaching resource. And, in a very interesting way, our Project used the space of a so-called specific content discipline to carry students to think pedagogical strategies for using computer, associating content and technological procedures into teaching-learning.

The project continues also as a possibility of demonstrating that the pedagogical qualification doesn't need to be restricted to teaching method disciplines.

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NetPro: methodologies and tools for Project Based Learning in Internet

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Abstract: The mission of the NetPro European project is to develop project-based learning through Internet. The NetPro project is creating tools and services to facilitate communication and collaboration between distant students, and to manage access and control of project deliverables. NetPro project teams form cross-institutional learning communities. This new learning environment is a distributed system that facilitates sharing and peer reviewing of project deliverables and interaction in special interest group discussions, regardless of how studies are organised locally. The outcome of the project also includes practical handbooks for students, tutors and trainers to support them in making full and effective use of the learning environment. NetPro methodologies and tools are being developed by running pilot projects: the four streams of pilots are briefly described in the paper. A formal evaluation process is an integral part of the project and its preliminary outcomes are discussed.

Introduction: the NetPro project

NetPro is a European project that develops methodologies and tools for supporting network based project learning within the engineering curriculum. The unique approach applies principles found in collaborative (Johnson & Johnson, 1996), constructivist (Korhonen and Välimäki, 1995) and self-directed learning paradigms (Knowles, 1990). Computer networks are already used for distribution of learning materials, discussion based collaboration, submission of work, etc. However, there are no good tools available to support student-centred project-based learning activities. The NetPro project is creating Internet tools and services to facilitate communication and collaboration between distant students, and to manage access and control of project deliverables as well as electronic publishing. These tools simplify the management of project-based learning activities, saving time for staff and students. In NetPro, the project teams may naturally form cross-institutional learning communities. The outcomes of the NetPro project also include practical handbooks for students, tutors and trainers to support them in making full and effective use of this learning environment.

Project Based Learning and the net

Project based learning is a common form of collaborative pedagogy in engineering education. There are already many initiatives where advantages of new technology are being applied to support project learning (Acuna et al., 1996; Collis, 1997; etc.). In our approach the different project teams form a learning community where learning within and between international project teams is supported. This happens through sharing and peer reviewing of project deliverables, and interaction in special interest group discussions. A "deliverable" is a document submitted for assessment or review, such as an engineering design, a progress report, or a review of another group's work. The learning environment developed in the NetPro project focuses specifically on supporting project-based learning in international and multi-institutional contexts. It is based on process models with specific learning phases, and participants with precise roles. The custom Internet tools and services facilitate the communication and collaboration between distant students, as well as control of project deliverables, access to documents and electronic publishing.

For tutors the NetPro learning environment provides management tools, e.g. indexing of projects and their required deliverables and setting-up of collaborative learning activities. For learners tools are provided for distribution and sharing of project deliverables, collaborative learning activities, peer assessment and access to project and learning related information sources. Improving the efficient use of tutors' time is achieved through the Project Deliverables Centre database, part of the NetPro learning environment. It provides a structured system for allocating, monitoring and collating assessed work and for communicating with the student groups.

Inter-institutional activities

The benefits of network-based learning can be demonstrated within an institution, but they naturally lend themselves to inter-institutional working. The NetPro system has been designed to support collaboration between students from several universities. Most European universities follow similar curricula in the engineering field so in principle it is possible to have joint activities. However the philosophies and working practices of the various institutions are so diverse and ingrained that it would be futile to aim for a common structure, so the goal is to provide meaningful learning tasks for all participating students regardless of how their studies are organised locally. The first problem is working language: if the students do not share a common language then there is no point in expecting them to work together. The second problem is synchronising course content and phasing: co-operation is only possible if the classes study the same topic at the same time of year. If these two conditions are satisfied then joint working is possible. Experience has shown that cross-institutional co-operation is difficult to implement and the inevitable obstacles can only be removed by a motivated project staff.
Using an intranet to provide notes for students will usually entail some locally specific information, and this must be identified before the resource is shared. The NetPro learning environment takes full advantage of the inherently distributed nature of the world-wide web to allow local information to be embedded in a centralised system, thereby avoiding the difficulties of imposing uniformity. Even when student groups in different institutions are working on the same project, each group can be assessed according to local practice.

The Network Based Learning Environment

The NetPro learning environment is a distributed system where each participating pilot site has its own local learning environments integrated to the collaboration space provided by the project. The collaboration space is a database application with user specific Web interfaces which facilitates sharing and peer reviewing of project deliverables, and interaction in special interest group discussions. The application is used through a standard Web browser. Users do not need any knowledge of Web authoring or special tools to use the application.

Project Deliverables Centre

The Project Deliverables Centre (PDC) is the core of the NetPro learning environment. It has two primary purposes: to support knowledge sharing between students, and to ease the tutor's workload in high level project management. Students deliver their work for assessment or review by depositing it in a file and uploading the file

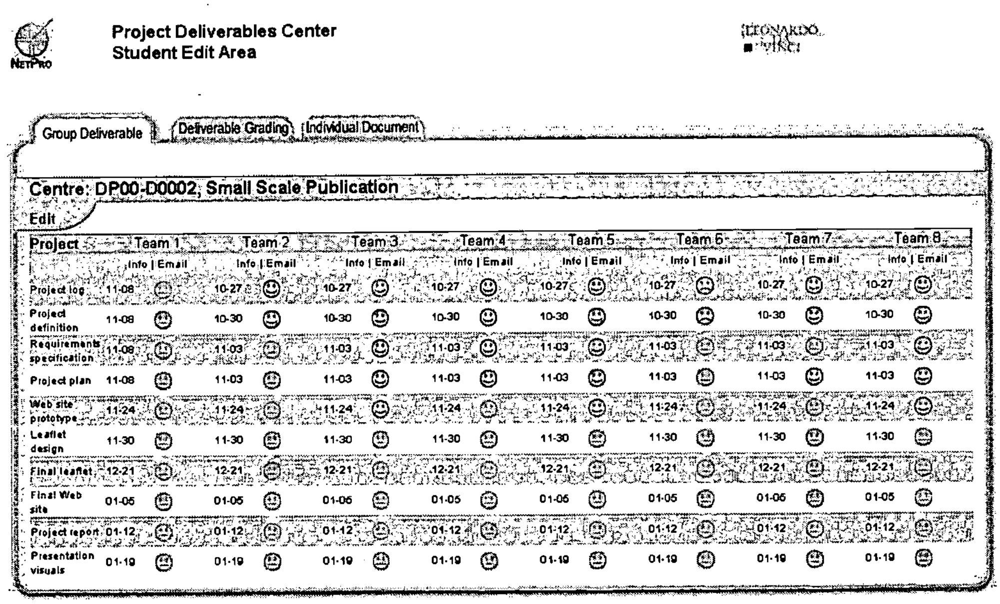

Fig. 1: Student view of a Project Deliverable Centre

to a Web server using a custom GUI. The main view of the PDC is a graphic which shows which items have been delivered, using a coloured-smiley metaphor (Fig.1).

Features of PDC

The Administrator view of the PDC helps the supervisor to modify data within different projects:

- create, modify and delete PDCs
- create, edit and delete student groups for a PDC
- define deliverables for a PDC
- assign groups for peer reviews
- view peer assessment results

When a new student-group is created, the system sends a computer-generated email to the student project manager giving the identity and password for access to their record, and other operational details. This student can then update their own group's data:

- view PDC
- edit group details
- deliver work for assessment or peer review
- access other groups' work for reviewing
- assess group members' contributions to the joint effort (peer assessment)

Peer review

Reviewing other groups' work can enhance the learning experience of project students, for both the reviewer and the reviewee. Different groups can design parts of the system using different approaches. After the designs have been completed and documented the groups can do peer reviews about these different approaches and see their benefits and drawbacks, so the all the groups can learn from each others' work.

The PDC allows the tutor to allocate cross-group review tasks, and it displays their status so that each group knows when their reviewee's work is available for review and when their own work has been reviewed. These peer reviews form part of the assessment requirement and are, like all deliverables, delivered by entering their URL into the appropriate field in the GUI. It is thus just as easy to review the work of a group in a remote institution as it is within one's own site.

Peer Assessment

The NetPro learning environment also includes facilities for the students within a group to assess one another's contribution by awarding grades against a given set of criteria. Each student can see whether their colleagues have completed this task, but the values awarded are concealed until everyone has done it. It is of course up to the supervisor to decide how to use these data.

Discussion spaces

The problem of communication among the actors of the learning process is a general issue and goes beyond the boundaries of the Netpro project. A successful exchange of information among students is, of course, very beneficial for learning, but it is not possible to force them to talk to one another constructively. With inter-institutional working, the problem is made worse by the impossibility of using face to face communication that must be replaced by some other tool. In NetPro, each project has available one or more open discussion spaces, called Special Interest Groups (SIGs). They are a sort of bulletin boards where course participants can read and write messages. Messages posted on SIGs are public: every project member can read and reply to them.

The Handbook

NetPro tools are, of course, very helpful to anyone developing network-based project learning. Tools alone, though, are not enough: adequate documentation and help must support the actors of the NBPL process to understand the methodologies and put them into practice. To complement the tools we are preparing a handbook which provides a step-by-step guide through the process, and each step of the process includes a planning/implementation tool. The handbook will include:

- checklists (e.g. process checklists or checklists on copyright etc.)
- templates (e.g. Word documents for course planning)
- case studies of good practices
- curriculum models
- guidelines/models for learning project manuals
- design guidelines for course web sites ("House Style")

The handbook includes extensive case studies that synthesise the experience made by the project partners in the pilot courses.

Pilot courses

The goal of the pilot courses is to test and evaluate the network based project learning methodologies, environment and tools developed in the NetPro project. The pilots' learning environment consist usually of a problem specification and assessment requirements that may be supported with related network based learning material and documentation. Traditional lectures, tutorials and laboratories integrate the NBLE. The students study the provided material and do what the problem requires. The tasks require subject-specific engineering knowledge and project-management skills to be applied. This work of students is defined as the student project, and it forms the context in which the NetPro team is developing the NBLE. The pilot courses are implemented in the real study context of students, i.c. they are fully integrated into the curriculum of their study programme and the students earn credit units by carrying them out.

Because curricula at the partner universities differ considerably and the project makes no attempt to harmonise them, common areas of subject matters in information technology have been identified and the pilot courses have been designed around them. Each pilot site is be responsible of organising the project activities locally in the way that fits its curriculum and local teachers and tutors take care of the teaching related to the project.

During the life of the project, four streams of pilot courses have been running and evaluated by the project partners:

- Interactive Web Application (http://pww.evitech.fi/nble/studies/courses/)
- Multimedia Authoring and Applications (http://pww.evitech.fi/nble/studies/programs/e4098/courses)
- Weather Station (http://pww.evitech.fi/netpro/pilots/ws/)
- Electronic System Design (http://www.esng.dibe.unige.it/netpro)

Within each stream, several individual pilot courses have been designed and carried out, in two separate runs of piloting activities. Because of the preliminary nature of the work and the institutional constraints, not all the pilots provide a full implementation of all NetPro features. Instead, each pilot usually stresses one or more aspect of the pedagogical scenario involved.

The goal for the students' projects in the **Interactive Web Application** pilot course is to design and develop an interactive information service application on the Web. The project integrates the knowledge and develops students' practical skills e.g. in application development methodologies, visual design, programming, project management and teamwork. Students' projects are organised as an application development process that covers the phases from an idea to a product. Students practice the use of basic methods and tools needed in project definition and planning, requirements definition, application design, and implementation.

The learning projects in **Multimedia Authoring and Applications** produce a multimedia product or service. The exact topic of the project was left open for each pilot site to define as the related course objectives and arrangements differ. The common subject matter was the design and production process of multimedia applications including: information content, interactivity, visual design, methodologies and tools used in production.

The objective of the **Weather Station** pilot is to establish and gain experience of a NBLE in the fields of physics, electronics and software engineering. The design of a weather station is used first for demonstrating the development of a simple electronic system in which physics, electronics and programming knowledge and skills are essential. The first implementations of the Weather Station pilot have focused into analogue electronic design.

Electronic System Design (ESD) stream of pilots has produced a learning environment for digital electronic design, investigating especially the applicability of the NBLE approach in the context of introductory courses (Donzellini, Markkanen and Ponta, 2000). It has also verified the functionality of the NetPro tools for managing large numbers of project teams, as well as the possibility of implementing new formats for inter-institutional co-operation.

Course-specific learning environments

In addition to the general purpose project management structure, a NetPro course may need a specialised environment supporting the student in the project development. It may consist of technical and pedagogical resources, such as multimedia trainers and simulators.

We developed a learning environment for digital electronic design for the ESD stream of pilots, in view of their particular nature of introductory courses. They target a student population non-homogeneous in terms of background and motivation and, therefore, they cannot replace completely traditional lectures with project-based activities.

The core of the learning environment for digital electronics is represented by simulators specifically designed for educational applications. They are extremely useful to students in many phases of project development, from producing drawings of digital networks and timing waveforms to checking the behaviour of the blocks designed for the project. Their pedagogical orientation avoids the unnecessary cognitive overhead that the students should take for learning how to use professional simulation tools.

Feedback from students and teachers

A comprehensive evaluation of the NetPro project has been carried out by a partner institution, Scienter of Bologna, Italy. It covers not only the experiences of students and tutors at the operational end of the scheme but also the management of the NetPro project itself. The following are extracts and elaborations from the evaluation reports.

Students' view

Students' data and opinions related to various aspects of the course have been collected by means of an anonymous questionnaire. The evaluation report is based on the analysis of 350 returned documents.
Below we show a brief synthesis of the opinions expressed by the learners about project-based learning:

- In general, students accepted to change their usual learning methodology.
- Learners appreciated to have more responsibility, more freedom and to work in a group.
- Although students show a high level of autonomy and maturity in carrying out their work, they still need some control and some guidance.
- Most found project-based learning closer to real-life cases and said that it makes learning much easier and more motivating.

The following views refer specifically to network-based project learning:

- Students would like to attend again a course involving network based project learning/project work. A few asked for some changes.
- Peer reviews were considered a good idea in principle, but many expressed concerns on their practical implementation.
- The interaction among students was, on the average, judged only marginal. Many complained about the scarce attitude toward communication of their peers and the overhead represented by the use of the SIG tools.

Of special interest is the synthesis of 99 questionnaires of the Electronic Systems Design 2 pilot (ESD2), because all the teams had the experience of the previous pilot course ESD1. The questionnaire was designed in a way to investigate the confirmation or denial of prior outcomes.
In fact, students confirmed many positive judgements expressed in the ESD1 evaluation. They, again, found NetPro useful, interesting and stimulating. They also appreciated more than before the possibility of working in teams, to learn to manage their own time and to develop material for the net.
A problem common to all pilots has been the reluctance of students in using SIGs. Many students found them time-consuming, awkward to use for the necessity of typing and using a foreign language, not able to provide timely information. In ESD2 we tried to encourage the communication on SIGs by assigning problems that required an intense exchange of information to define their final specifications. A comparison between the two project sites shows a vast increase of communication and an improvement on its quality.

Teachers' view

Teachers agree with students that project learning increases motivation of both actors of the learning process. They see NetPro approach as a very valuable one not only for project-based subjects, but also for those taught by traditional classroom-lecturing, where the project can form part of practical sessions and can be integrated into the curriculum. The main points highlighted by teachers concerning network based project learning were:

- NetPro tools facilitate management and supervision of projects
- Learning of personal skills is emphasised
- The sharing of knowledge is encouraged.
- The focus of the learning is on working processes, in addition to the factual content.
- Learners become the centre of the process, instead of tutors.
- Project work provides learning experiences that are similar to working life situations.
- The networked environment extends the boundaries of the learning community.

Key success factors identified by teachers were the following ones:

- The change in the tutor's role should be supported by the organisations.

- Networked learning activity support learning well but they needs to be carefully planned (integrated in the local curriculum, explained to the students).
- Project teams' failure to meet deadlines causes heavy problems for the networked learning activities.
- Students need to be motivated and to clearly understand the benefits of project work.
- The use of peer reviews was seen (but not by everybody) as entertaining and exciting, but this approach should be introduced in the first phase of the project so that groups can have real communication.

NetPro2: the continuation

The project resulted in novel pedagogical approaches and an original set of network based tools that support project based learning (PBL). The large-scale evaluation of these tools proved their effectiveness. However, during the validation of the pedagogical models and tools, the need to extend the existing approaches and to develop new ones has been identified. Therefore, a new proposal for 2001-2003 has been submitted to the European Union, in order to continue the activity, under the name of "NetPro 2".

The novel pedagogical models to be developed will respond to the need for closer integration of vocational training to working life. It will be solved by applying models of network based collaboration used in modern work organisations. The learning models and network tools will also be piloted in further vocational education courses where students are working by combining their work projects as part of their curriculum.

Current stable technologies accessible to educational institutions do not support effectively innovative pedagogical approaches based on models of collaboration used in modern working life (i.e. work of geographically distributed teams). The intensive interaction required by such teamwork has so far not been possible without expensive investments in special technologies. The technology is finally approaching the stage where many threshold-type of products and services, such as Internet based audio and video communications, data format for structured document interchange (XML), meta-data standards for educational purposes (ARIADNE, IEEE/LOM), will be available for larger user communities.

NetPro 2 will take advantage of these emerging standards to develop more realistic collaborative pedagogical models. The partnership will focus on the transferability of the tools as the emerging standards make this feasible. The project will also start the preparation for the large scale transfer activity by prototyping the concept of "NetPro Learning Communities". The long-term goal is to develop a self-funding organisation for promoting and developing project based learning on an Europe-wide scale.

Conclusions

A successful network-based learning environment for project work has been developed. It is useful for local work, but is particularly convenient for inter-institutional working including international co-operation. It has been used on several pilot projects, and development is continuing in a new project. The feedback of students and tutors is generally favourable. In addition, a "handbook" for tutors (in on-line form) has been prepared.

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Web Tools for Collaborative Project Learning

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Abstract: NetPro is an European project to develop methodologies and Web tools for collaborative project learning. The project is creating Web tools and services that facilitate the collaboration in cross-institutional learning communities. Tools for publishing, accessing and controlling of project deliverables have been developed, as well as tools to support collaborative activities such as peer reviewing of deliverables. The toolbox includes also a component for on-line peer assessment. The outcome of the NetPro project also includes practical Web based handbook for students, tutors and trainers to support them in making full and effective use of the network based project learning.

NetPro Project

NetPro is a European project that develops methodologies and tools for supporting network based project learning within the engineering curriculum. The NetPro tools facilitate communication and collaboration between distant students, and simplify the management of project-based learning activities, saving time for staff and students.

The project has developed am easy-to-use and functional set of Web based tools to support collaborative project learning. The tools are useful for local work, but are particularly convenient for inter-institutional working including international co-operation. The tools have been tested in several courses with more than 1500 users. The feedback of students and tutors is generally favourable. The tools significantly reduce the time that the instructor needs to spend on the administration of the student work. The tools are applicable in various pedagogical approaches where students need to produce work that can be uploaded into the Web for assessment or review.

Collaborative Project Learning on the Internet

Project based learning is a common form of collaborative pedagogy in engineering education. Although there are many variations of the project learning, often the collaboration between learners is strongly focused, if not limited, within one local project group. In the NetPro approach the different project teams form a learning community where learning within and between international project teams is supported. This happens through sharing and peer reviewing of project deliverables, and interaction in special interest group discussions. A "deliverable" is a document submitted for assessment or review, such as an engineering design, a progress report, or a review of another group's work.

NetPro Learning Environment

The NetPro learning environment takes full advantage of the inherently distributed nature of the World-Wide Web to allow local information to be embedded in a centralised system, thereby avoiding the difficulties of imposing uniformity. Even when student groups in different institutions are working on the same project, each group can be assessed according to local practice.

The NetPro learning environment is a distributed system where each participating pilot site has its own local learning environments integrated to the collaboration space provided by the project. The collaboration space is a database application with user specific Web interfaces which facilitates sharing and peer reviewing of project deliverables, and interaction in special interest group discussions. The inter-institutional learning activities have been designed to provide opportunities for collaboration between students from several universities, regardless of how their studies are organised locally.

For tutors the NetPro learning environment provides management tools, e.g. indexing of projects and their required deliverables and setting-up of collaborative learning activities. For learners tools are provided for distribution and sharing of project deliverables, collaborative learning activities, peer assessment and access to project and learning related information sources.

Project Deliverables Centre

The Project Deliverables Centre (PDC) is the core component of the NetPro learning environment. It has two primary purposes: to support knowledge sharing between students, and to ease the tutor's workload in high level project management. The main view of PDC is a graphic that shows which items have been delivered, using a coloured-smiley metaphor (Figure 1).

The PDC is an interactive database application that is used through a standard Web browser. User does not need any knowledge of Web authoring or special tools to use the application. The application can be linked to any Web page (or course site created with Web course tools) by inserting a single URL in the page. This URL is link to a script that interfaces with the relational database. The system has been implemented with mySQL and scripted in PHP, which are, in our case, running on an inexpensive Linux server.

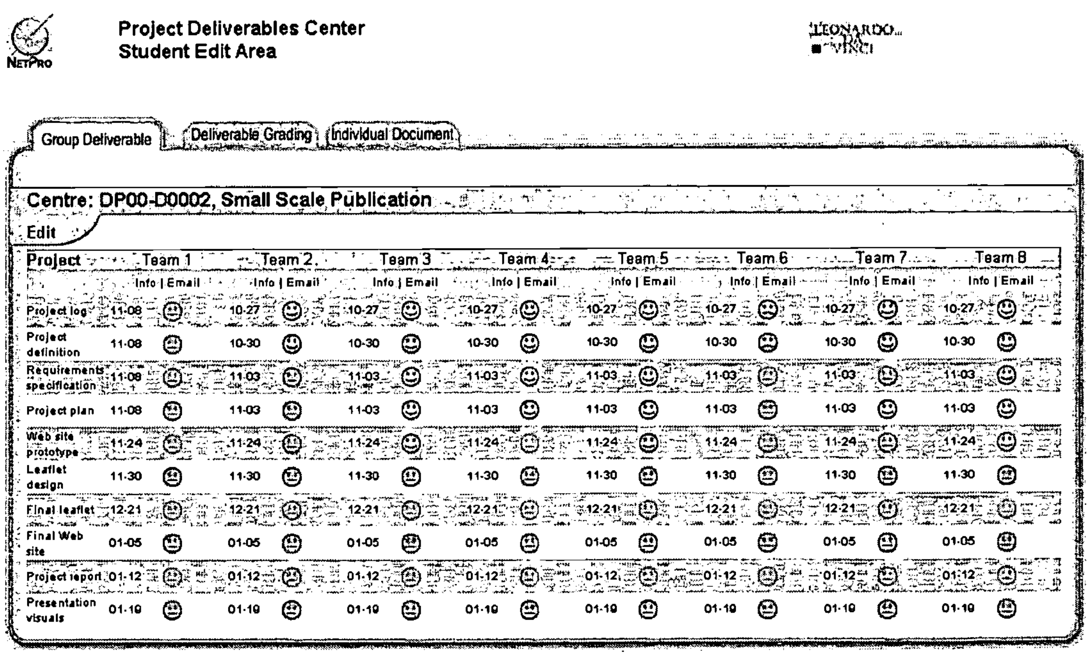

Figure 1: Main view of the Project Deliverables Centre.

Administrator tools

The Administrator tools help the instructor to establish and maintain Project Deliverables Centres. The PDCs can be categorised based on the discipline and subject matter that the PDC is related to. Instructors, who want to develop cross-institutional co-operation around student projects, can group their related PDCs into a Learning Community. For maintaining a PDC, the Administrator view provides various forms to:

- create, modify and delete PDCs
- create, edit and delete student groups for a PDC
- define deliverables for a PDC
- assign groups for peer reviews
- view peer assessment results

The PDC software has been designed so that the instructor can include in the learning environment only the features needed in the particular course. Optional features include peer review, deliverable grading, peer assessment, and individual documentation (e.g. learning log, portfolio).

Student tools

When a new project group is created, the system sends a computer-generated email to the project manager giving the identity and password for access to their record, and other operational details. The project manager can then update the group details and insert the other group members into the PDC. Features of the student tools are:

- view the status of deliverables
- deliver work for assessment or peer review
- access other groups' work for reviewing
- assess group members' contributions to the joint effort (self and peer assessment)

The instructor has a possibility to choose from two different ways that the students can deliver their work for assessment and/or peer review. The files can be uploaded through a Web form into NetPro server, or by providing an URL of a file existing on any Web server. In both cases only the URL of the deliverable is inserted into the Project Deliverables Centre and the file is located on a Web server.

Further Development

The project resulted in novel pedagogical approaches and an original set of network based tools that support project based learning (PBL). The large-scale evaluation of these tools proved their effectiveness. However, during the validation of the pedagogical models and tools, the need to extend the existing approaches and to develop new ones has been identified. Therefore, a new proposal for 2001-2003 has been submitted to the European Union, in order to continue the activity, under the name of "NetPro 2".

NetPro 2 project will develop new pedagogical models that are based on modern work practises, such as knowledge management and sharing, and geographically distributed teamwork. Current stable technologies accessible to educational institutions do not support effectively these kinds of innovative pedagogical approaches. The technology is finally approaching the stage where many threshold-type of products and services, such as Internet based audio and video communications, data format for structured document interchange (XML), meta-data standards for educational purposes (IEEE/LOM, SCORM), will be available for larger user communities.

Objectives of the Session

The objective of the session is to demonstrate the NetPro toolkit and show examples on how it has been used in pilot courses organised during the project. The procedure of setting up the learning environment and students' tools will be demonstrated. Participants will have an opportunity to try out the application themselves.

Intended Audience

Teachers and trainers interested in a tool that supports pedagogical approaches where students need to produce work that can be uploaded into the Web for sharing with peers, assessment or review.

AulaWeb: a WWW-Based Course-Support System with Self-Assessment and Student Tracking

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Abstract: This paper describes *AulaWeb* and its implementation experience. AulaWeb is an interactive training, self-assessment and tracking system of the student learning progress about one subject. This intuitive and easy-to-use tool is use-restricted for students and teachers of this specific subject and the whole interactivity is carried out by means of a computer connected to Internet and a WWW browser. AulaWeb has been designed to be implemented for any subject to be taught. The system, with the *ad hoc* contents, has been used by more than one thousand of Computer Science students at the División de Informática Industrial of the Universidad Politécnica of Madrid (ETSII-UPM)

System description

AulaWeb is a WWW-based interactive training system and allows a student of a specific subject to study the subject contents, to deliver practices and to do self-assessment exercises (Martínez et al. 2000, García-Beltrán et al. 2001). Students and teachers only need a computer connected to Internet and a WWW browser to take advantage of all the application functions. The system architecture, the graphic user interface design and an on-line help system make easy the user interaction with it. The system uses a set of databases:

a. Subjects and users database, including students (personal data and learning activities record) and teachers
b. General resource database: subject theoretical contents, on-line calendar, references, WWW links, newsgroups and related software
c. Self-assessment system questions database
d. Electronic survey database
e. Access statistics database (by hour, day, month and year)

and includes the following four modules (the last three modules need a password authentication for students and teachers):

An information system module about the subject

This non-restricted module is open to all users and incorporates theoretical contents, general information about the subject: teachers, syllabus, frequently asked questions, timetable, calendar, bibliography, references, WWW links, related software, previous exams and practices and solutions, chat rooms (similar to ICQ), newsgroups and forums. No programming required: there is a system wizard in order to help the teacher to add or update contents.

A collect and deliver module of practices, homework and exercises

First of all, the teacher can use an assistant (no programming required) to publish an exercise for his group of students. Then each student can retrieve it and send, using an *ad hoc* form, an electronic file with the answer of the exercise in HTML, Word or another format. The file is stored in a documental database, and the corresponding teacher can access to it. Once the content of the exercise is revised, the teacher can mark it, and send his comments to the student. Also, the teacher can publish the exercise solution and controls the group of students that have sent it.

A self-assessment module

The self-assessment modules is based on a question database about the subject, with a friendly and easy-to-use interface for adding, updating and activate/deactivate questions. The students can configure an exercise depending on the number and difficulty level (five levels) of questions and the didactic units of the subject. The teachers can also configure exercises for a student or a group of students. The student can interrupt and postpone the end of the exercise in any moment, in order to revise the acquired knowlegde. After that, the student can carry on with the exercise. When concluding it, the system allows the student the possibility to check his exercise and to compare his answers with the right solutions. The resolution of the test provides the user's level in that moment and updates the values of the database. The evaluation of the exercise is, therefore, automatic and the student and his/her teacher can access the results of the student self-assessment activities. So, the system allows the teacher to track the student progress during the courseware. Moreover, the system provides some statistical tools to compare the theoretical and experimental difficulty level of the questions and to revise the first ones.

A booking module of computers in labs for students

This user-restricted module provides the administration and management of educational and training resources. For instance, students and teachers can do the booking of computers and classrooms for the laboratory practices.

Results

AulaWeb has been applied at the ETSII-UPM since 1999 as a didactic support to all the computer programming courses taught in the Computer Science Department. Students and professors have been able to use the system anytime, from anywhere there were a WWW terminal, during the whole courseware. For example, during the last implementation course more than 500 students did more than 5000 self-assessment exercises. The system have helped the students in these Computer Science subjects, and also assisted the professors to evaluate the students and to know exactly the level of the students and adapt their subjects to the students group they had to deal with.

AulaWeb is also been applying to high school students with learning problems in subjects like Algebra, Geometry, Arithmetics and Statistics.

Conclusions

A WWW system for the assistance of students and teachers has been developed. This software solution gives the possibility to each student to select his particular training trail and to contact to his tutor and other students. The system helps the teachers in tracking his students performance progress during the course periods. With the adequate contents, AulaWeb can be implemented for any subject to be taught.

Acknowledgements

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SPECIFICATION OF AN ONLINE PROGRAMME FOR SOUTH AFRICAN TEACHERS

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Abstract: This paper reports on the development of an online teacher education programme for South African teachers at the University of South Africa (UNISA), a distance education institution. Currently, no online courses are offered in the faculty of education. The Internet being used only for email communication and administrative support. The paper represents work in progress and reports on the specification endeavours in the development of a Master of Education programme. Three areas regarded as critical in specification are addressed, namely technology, teacher- and student characteristics.

Background

Online education is reported in the literature as a mechanism that can be used fruitfully in distance education programmes (Muirhead, 2000). Higher education institutions are turning towards online education in order to meet the needs of clients who cannot attend classes on a full-time basis. Time and cost to clients are advanced as major reasons to the move towards distance education (Raymond III, 2000). The University of South Africa has been providing distance education for over fifty years, mainly through print-based materials circulated through the postal system. Telephone, audio and video conferencing infrastructure are well-developed although the latter is not used extensively. Recently, a students online system was launched which provides electronic mail contact with lecturers and administrative support. The study material that is available online is equivalent to the print-based material only. The practice of dumping study material used in the print version (or in the contact sessions in full-time study) is not regarded as good practice in online education (Volery & Lord, 2000). As such, an online programme for Masters of Education (science education) is being developed. Besides increasing accessibility and embracing institutional transformation (Volery & Lord, 2000), the rationale of developing an online programme is to equip teachers with the knowledge and skills to use computer technology in schools. The premise is that teachers need a model that they can follow in implementing a paradigm shift from transmitter of knowledge to mediator of learning and other roles prescribed in the new Outcomes-Based Curriculum in South Africa. A study by Muirhead (2000) indicated that teachers who use computer technology often do not have confidence because they received no formal training in using the technology. The development of the online programme was started in January 2001 and will be piloted in the 2002 academic year. The project is at the specification stage.

Specification

Specification was informed by the following principles. Enhancing teaching effectiveness in online education requires consideration of three main variables , technology, instructor characteristics and student characteristics (Leidner & Jarvenpaa, 1993; Volery & Lord, 2000). Technology characteristics relates to reliability, quality and medium richness. A rich medium is one that allows for both synchronous and asynchronous communication and supports a variety of didactical elements (text, graphics, audio and video messages). Instructor characteristics include attitude towards technology, teaching style and control of the technology. When a number of instructors are involved, as in a programme, instructor characteristics becomes crucial. This is particularly evident when instructors complain that the development of an online course is labour intensive. Of particular interest to this study is student characteristics. In the literature variables such as prior experience, having a computer at home, personality, the geographical area of origin and self-efficacy seems likely to influence enrollment and performance in online courses. In a study of social influences and Internet use, Klobas and Clyde (2001) reminds us that quality and access are not the only factors associated with online education (Internet). They aver that the context is also critical. The results of their study indicated that social influences on Internet use for work and study are very broad and probably very powerful. Social influences significantly change perceptions of the Internet, its value, and a person's ability to use it.

The context of the project is therefore essential. Currently, approximately fifteen students are registered on the print-based version of the Master programme - raising questions as to its accessibility. The university does not provide tutor sessions for postgraduate studies, especially in courses and programmes with small student numbers. Interaction and collaboration among students is therefore problematic. All the students registered for this programme are school teachers, mostly in secondary schools. Six staff members are involved with the instruction of ten compulsory modules which weighs 50% of the programme. The other 50% is a made up of a dissertation of limited scope. Assessment is through written assignments, examinations and portfolios.

The product of the specification endeavour is now described. The transition to online education provides opportunities for restructuring the programme. Collaborative learning rendered impossible by geographical constraints becomes possible. Action learning, which is necessary to enhance development in the workplace, especially in developing nations, becomes possible. An outcomes based education approach can also be accommodated. Learning can thus be structured to address issues and problems in the workplacc rather than covering content. The dichotomy of tutored coursework (examination based) and research (dissertation) can be transformed into an integrated action learning experience. Students will interface with a limited number of lecturers, thus enhancing the learning experience. Based on these considerations, the following structurc of thc programme is suggested.

The programme will follow the *action learning* approach. Courses will be issue-led and problem based. Each lecturer will be responsible for managing a collaboration unit of 20 candidates. Learning sets of 5-6 candidates will be drawn from the collaboration unit. All material and interactions will be online. Since tutors cannot be employed to lead sets and thus constantly monitor online interaction, lecturers will be set advisors for scheduled compulsory set meetings. Other communication will be through the web forum and email. For coursework, interactive computer-based systems will be used (eg WebCT). To entrench online education and action learning features in the programme, the coursework component will be marked as follows. Participation in web forum (5%), participation in set meetings (5%), group assignments (10%) and portfolio of an action learning project (15%).

Successful specification hinges on the three principles described earlier. Challenges to meet the specification above rests in the following. The availability of suitable technology in the university infrastructure. Candidates will probably need support in accessing the technology. Commitment from management to finance such endeavours is therefore pivotal. A change in university tuition policy to accommodate diverse assessment is needed. Professional development needs of the staff needed to implement the project and freeing them from other duties need to be prioritised. Finally, issues related to student characteristics needs to be considered. The social transformation imperative requires capacity building of previously disadvantaged candidates. The latter may however not be socialised into taking perceived *risks* associated with online learning. The immediate benefit of going through all the trouble of learning the technology before actual learning, and the paradigm shift required by action learning, may pose problems in enrollment for thc programme.

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The Development of Componentware-Based Software for Learning English as a Foreign Language

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Abstract: We have developed three component-based software applications, and fifteen reusable software components for English as a Foreign Language (EFL) education. Componentware is an object-oriented software development method that uses components as essential building blocks. An advantage of the componentware methodology is in meeting requirements for computer usage in the real educational world. We can categorize teachers into three groups: advanced, intermediate, and beginners. The advanced group develops components, and provides them to the intermediate group; the intermediate group is able to use components for their own unique designs and can provide new educational software, which they provide, using pre-existing components, to the beginner group—the beginner group is able to make use of the software in classes. This flow enables computer-based education to be implemented more effectively. All of the three applications described in this paper can be used for EFL education. This paper describes the developed components and applications.

Background

Although a large number of multimedia computer-based teaching materials have been developed for both classrooms and self-instructional learning, in practice, these materials have not become prevalent. Some of the reasons are that 1) commercial software is for the most part too costly, 2) after a teacher or student obtains an educational software package, the application is likely to become obsolete, possibly after one year, due to rapid changes in multimedia technology, and 3) commercial software is designed to be non-specific/universally used, and thus is often unsuited to individual classroom requirements because instructional methods (and student comprehension) are highly variable and specific to unique educational environments. One solution to this problem is for the individual teacher to create his or her own computer-based teaching materials in the same way as he or she makes printed materials with word processors. However, developing multimedia teaching materials requires computer programming, which may be an insurmountable obstacle for teachers who want to develop such materials. As a solution to this dilemma, we propose a componentware methodology. Componentware is an object-oriented software development method which uses and integrates components as essential building blocks (Aoyama, 1996; Jacobson et al., 1995; Udel, 1994). Componentware methodology allows us to develop software systems in both a top-down and a bottom-up fashion. This is an essential aspect of educational software systems development. The bottom-up approach can allow a teacher to easily develop a new educational software system by assembling pre-existing components. In the case where a teacher wants to develop a new type of teaching material, the top-down fashion can be adopted to break down a teacher's requirements into functionally modular components. Another advantage of the componentware methodology is in meeting requirements for computer usage in the real educational world: We can categorize teachers into three groups--an advanced group able to develop original program components, an intermediate group able to assemble pre-existing components into educational software, and a beginner group who can use pre-existing educational software systems in their classes. The advanced group develops components, making full use of their specialized knowledge and provides them to the intermediate group; the intermediate group is able to make educational software by using given components (i.e. they can produce specialized software systems without specialized knowledge); and the intermediate group is able to provide educational software to the beginner group—the beginner group is then able to make use of the educational software in their classes. If this flow from the advanced group to the beginner group is made to function smoothly, computer-based education can become more effectively and easily implemented.

Our aim is to create this flow, on an experimental basis. In researching how multimedia computer systems and software could best contribute to education, we focused on the educational field of English as a Foreign Language (EFL). In the EFL field, teachers have not only been using multimedia devices such as tape-recorders, CDs, and videotapes, but also have been using computers from the advent of the institutional computer lab. In order to increase the developmental-efficiency of both EFL education software and reusable components, we divided the ingredients for EFL education into three parts, that is, a) English Skills (listening, speaking reading, and writing), b) Learning Methods (the practice and it's ascertainment), and c) Supplemental Tools (tape recorder, video, dictionary, and etc).

Next, we will describe the component-based educational software and software components that we have developed from the three ingredients of EFL education, above.

Description

We have been developing educational software and software components for EFL education using an iterative and incremental method. First, we developed "a Hypermedia Pronunciation Power Program (HPP)" (McCarthy, Matsuno, and Swan, 1996) (see figs. 1,2), which aimed to help EFL students improve their listening and speaking skills. We defined nine reusable components in developing the HPP program. These components can be used to develop educational tools for the English Skills of listening and speaking; improvement of ability though practice and it's ascertainment, in terms of Learning Methods; and, HPP allows for the use of Supplemental Tools: a tape recorder and video. Second, we developed a "Multimedia Authoring System for Teaching EFL (A-MATE)" (Matsuno, Tsutsumi, and Ushijima, 1999) (see figs. 3,4), which aimed to help a teacher belonging to the "beginner group" to make several types of quizzes for teaching EFL. We reused five out of the nine HPP components, and made two new components in developing the A-MATE program. These components can be used to develop educational tools for strengthening Learning Methods. Third, we developed a "Multimedia Bilingual Dictionary for JFL/EFL Learners (MBD)" (Gilbert and Matsuno, 2000a) (see fig. 5). MBD is a multimedia bilingual dictionary for beginning students of Japanese or English. We reused four components out of eleven pre-existing components, and built four new components. These components can be used for developing various dictionary tools (Supplemental Tools). Currently, we now have fifteen components, and are developing a new educational program, a "Multimedia Vocabulary Concordance and Academic Lexis (VOCAL)" (Gilbert and Matsuno, 2000b) (see fig. 6), for students in the Sciences using components which enable students to strengthen reading and writing English Skills. Below, we will describe in more detail these three programs as well as the program currently in development.

A) HPP: Hypermedia Pronunciation Power

HPP aims to help EFL students to improve their listening and speaking skills. HPP includes video clips of a native speaker pronouncing individual sounds, words, and sentences. Students can then imitate mouth positions as well as the sound of a native speaker. In addition, students can record their voice and can compare graphically their intonation with that of a native speaker. Moreover, students are able to practice their listening with environmental noise added intentionally. This feature is useful for EFL advanced-class students who can understand the speech of native speakers relatively well, but have difficulty with variation and environmental interference.

HPP is composed of five sections for EFL practice: the *Explanation Section, Listen and Repeat Practice Section, Visual-Voice Section, Minimal-Pair Practice Section, and Quiz/Games Section*

The Explanation Section

The *Explanation Section* presents a diagram of the organs of speech, the phonetic alphabet, and a consonant and vowel chart in this section.

The Listen and Repeat Practice Section

The *Listen and Repeat Practice Section* allows students to do "listen and repeat" type exercises (see fig. 1). Students can select the vowels/consonants, and then also select those words they wish to practice. As shown in Fig. 1, students can listen to and see a video of the teacher. Thus, students are able to study the tongue position, mouth, and lip movements produced by a native speaker.

The Visual Voice Section

The *Visual-Voice Section* allows students to see both the waveform and the spectrogram of the phonemes of a word which the teacher pronounces (see Fig. 2). HPP also allows students to record their own voice, and shows this waveform and spectrogram as well. Thus, HPP allows students to compare their voice with the teacher's, both visually and aurally. This method has been used for teaching speech pronunciation to the deaf (Potter, Kopp and Green, 1947) as each phoneme has a characteristic (visually apprehended) waveform and spectrogram.

The Minimal-Pair Practice Section

The *Minimal-Pair Practice Section* allows students to practice listening to minimal-pair words. In Japanese, for example, there is no difference between the "th"-sound and "s-sound," and the "l"-sound and "r"-sound. Thus, typical Japanese people often have great difficulty distinguishing "sink" from "think," and "light" from "right." Minimal-pairs are composed of paired word-sets similar to those above.

The Quiz/Game Section

The *Quiz/Game Section* allows students to test and verify their listening ability. HPP is able to give quizzes of minimal-pair words, and students then answer the quizzes. In this section, HPP does not show video clips. If students were able to see tongue positions and/or mouth movements, they could then possibly infer the correct answers. Students can however see the video clips after they answer the quiz, and so can confirm tongue positions, etc. HPP *randomly* chooses 10 pairs from the minimal-pair word list (the sample database contains 50 pairs—a teacher can increase this database), and also *randomly* chooses one word from each pair selected and then displays this word to quiz the student, each time the student practices. So, HPP *randomly* plays either "light" or "right" from that particular (light-right) minimal-pair. Due to this feature, students are unable to predetermine the correct answer.

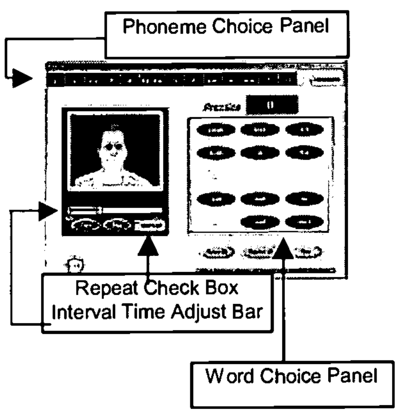

Figure1. HPP Listen & Repeat

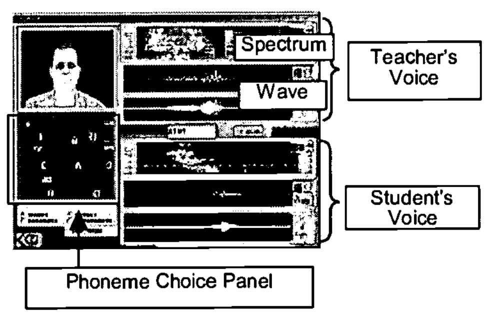

Figure2. HPP Visual Voice

Evaluation of HPP

Quantitative Evaluation

A t test was used to compare the difference between pre- and post-test scores on students' listening and pronunciation ability. Average listening-ability scores rose to 79.1% in the post-test, from a pre-test average score of 70.5%(t=-4.69, p<0.001), and average pronunciation-ability scores increased to 77.2% from 39.8% (t=-6.15, p<0.001). The pilot study indicates that HPP appears to be a useful tool for improving both English listening and pronunciation ability.

Qualitative Evaluation

A student survey was conducted using two separate research instruments. The first asked students to rank, in order of preference, which one among conventional media types such as CDs, cassette-tapes, video-tapes, and laser-disks, was most suitable for certain tasks. In the second survey, students were asked seven questions relating to HPP usage and functionality. Students' responses to HPP were quite positive.

Components of HPP

We developed the following components to be reusable: (a)a fundamental utility component group, consisting of (i)high quality timer, (ii)count up/down timer, (iii)data randomized shuffler, and (iv)file operations; (b)voice recording and playing component; (c)video recording and playing component; (d)voice spectrograph component;

(e)oscilloscope component; (f)voice mixer component; (g)volume control component; (h)multiple-choice quiz component; (i)and a multimedia database component.

B) A-MATE: A Multimedia Authoring System for Teaching EFL

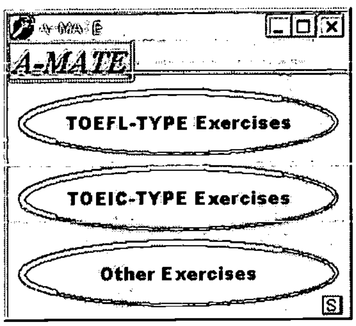

Figure 3. Main Menu

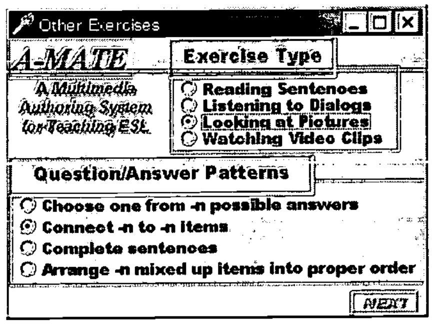

Figure 4. Sub Menu of "Other Exercises"

A-MATE aims to help a teacher to create Web-based exercises and quizzes for their classes without requiring any programming. An EFL teacher will be able to create various types of exercises by preparing teaching materials, according to a simple format, without the need to use any programming code. A-MATE will be able to automatically create the appropriate HTML/JavaScript forms and pages by extracting necessary information from prepared materials.

The user interface of A-MATE should be as easy to use as possible, so that an EFL teacher can devote his or her main energies to developing teaching materials, rather than struggling through a computer program. After our analysis of TOEFL and TOEIC exercise texts, as well as EFL textbooks, we found that we can abstract typical EFL exercise activities as follows:

1) Present example problems utilizing a (multi-)media type and format.
2) Choose one out of a group of question/answer patterns.

We have plotted our program strategy to produce student exercises based on above two EFL development activities adopted in general:

1) A teacher chooses one exercise pattern from the group of exercise types.
2) The teacher also chooses one question/answer pattern from the question/answer groups.

That is basically all that a teacher has to do to create Web-based exercises and quizzes for their classes.

Components of A-MATE

In order to develop A-MATE, we reused five out of nine HPP components, which are (a), (b), (c), (g), and (h), added two features to the component(i) of HPP in order to manage the quiz "type" and "difficulty," and developed (j) a "new quiz generation" component which generates "Fill-in blanks" type quizzes, "Connect -n to -n items" type quizzes, and "Arrange items into proper order" type quizzes.

C) MBD: Multimedia Bilingual Dictionary for JFL/EFL Learners

There are various types of electronic dictionaries and software on the market, but not many are compiled for beginners. A beginning-level CAI dictionary can incorporate features important to both EFL and Japanese as a foreign language (JFL) learners. For instance, 1) many EFL beginners have a strong desire to acquire accurate English pronunciation, but it is difficult for these students to pronounce English words correctly (even with aural cues), without demonstrable knowledge of the mechanisms of pronunciation, such as tongue position, lip movements, etc., so, to benefit learners, video clips of a native speaker pronouncing terms can be included in the dictionary software; 2) For JFL learners, dictionary word look-ups often include unknown kanji, which can create frustration and confusion—therefore, rapid kanji-to-kana translation can be provided for all kanji appearing in the dictionary; 3)Typical dictionaries do not contain semantic look-up categories, which are beneficial to learners and speed learning. Through software implementation, it is possible to design a variety of look-up methods and particularly, lexical look-ups can be included in the dictionary design; Both EFL and JFL learners can benefit by hearing as well as reading all terms and sentences contained in the dictionary, in both languages—voice-synthesis technology allows for this possibility. Thus, we began the MBD project in order to effectively eliminate shortcomings and aid learners in their desire to acquire a target language. Essentially, novel voice-synthesis elements have been integrated into the MBD program and pilot-tested. Program software allows the database to be accessed and searched by several methods, including: 1)Word Entry; 2)Partial-Word Entry; 3)Jump Searches & Jump Searches Across Languages; 4)Lexical Category Searches; 5)Lexical Correspondence Searches. Program software also allows for text search-strings to be entered in the Roman, kana, and kanji alphabets.

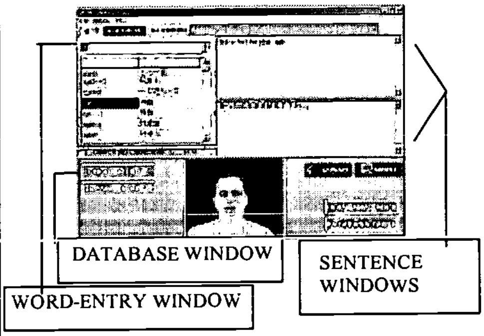

Figure 5. Screen shot of MBD

Figure 5 shows a screen shot of MBD. For JFL learners, a means of converting kanji to kana has been implemented—the learner right-clicks the mouse and selects "KANA" from the menu that pops open. The kana associated with the kanji then appear in a small window. EFL learners can benefit from associating written English, with its many spelling idiosyncrasies, to the spoken word. Students can practice English by playing multimedia clips that demonstrate a native-speaker's mouth-movements. For both JFL and EFL learners, all mirror-sentence pairs can be listened-to by utilizing the text-to-speech voice-synthesis feature, which functions in either language. We believe that these design features can make a contribution to foreign language education and provide enjoyable learning opportunities for students.

Components of MBD

We reused components (a),(b),(c),(g), and (i) of HPP, and made four new components: (k) a full text search component, (l) a dictionary component, (m) a Japanese Kanji to Hiragana converter component, and (n) a Text-to-Speech synthesis (TTS) component. Currently, MBD is accomplished through one associated external software package for the converter component (the Japanese "language pack" freeware support associated with the Microsoft Internet Explorer 4/5 browser (IE-4/5)), and two external packages for the TTS component (IBM's "Via-Voice" for English TTS, and Catena's "D-Talker" for the Japanese TTS.). Concerning the TTS, MBD allows users to switch to another speech synthesis engine, if users have an available speech synthesis engine that uses Microsoft Foundation Classes.

D) VOCAL: Multimedia Vocabulary Concordance and Academic Lexis

Although computer-based concordance programs are available for the researcher, a multimedia concordance program has not yet been authored that is specifically designed to both meet the needs of academic, learner-centered reading programs, and which seeks to increase student comprehension of scientific texts in ESP (English for specific purposes) settings. The VOCAL program presents a computer assisted language-learning (CALL) software design and rationale for a tripartite concordance and lexis that reflects the three major groupings of English vocabulary deemed particularly relevant for English for academic purposes (EAP) science study, as well as other academic fields. The ultimate goal of the program under development is to enable vocabulary study to be further integrated into EAP reading classes, with the potential of accelerating students' comprehension of the vocabulary, texts, and contexts in which the vocabulary items are contained (see Fig. 6). The VOCAL program consists of several modules. The SRT (Source Reading Text) module is the central module of a projected multi-module, multimedia CALL reading program, designed to provide (a)vocabulary, (b)reading materials, (c)student assessment, (d)test creation, (e)data collection/compilation of study and test histories, and (f)grading functions for the teacher (or independent student). Teachers and departments will be able to utilize the total program as an educational tool in designing distance learning and student self-study courses, as well as integrating the program into courses which make use of computer labs.

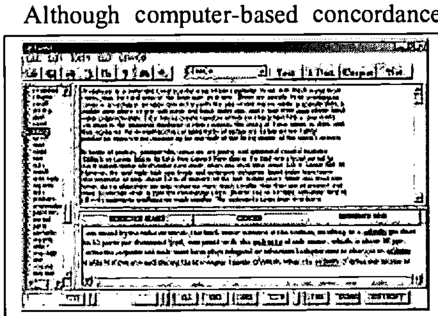

Figure 6. VOCAL Program

Components of VOCAL

Concerning the VOCAL program, we are reusing components (a),(b),(c),(g),(i), (k), (l), and (m) without alteration, and are creating an additional component for the concordance function.

Conclusion

We have described three serviceable programs, and a newly designed program for EFL education. We made fifteen components in the course of developing the three programs, and designed one additional component for the new VOCAL program. The "reuse rate" of existing components in each of the programs is 71% for the A-MATE program, 56% for the MBD program, and 89% for the VOCAL program. Although the reuse rate of the existing components of the MBD program (the second program developed using existing components), is lower than that of A-MATE (the first program), this is because the MBD needed several special components for Japanese language processing and speech synthesis. As shown in the results of the VOCAL program, the reuse rate of existing components of a new program will generally increase as additional programs are developed. Typical EFL learning activities aim at improving three abilities: communication ability, reading ability, and writing ability. All of the programs we described here can be used for improving these abilities: the HPP program can be used for improving communication ability, the A-MATE program can be used for improving all three abilities, the MBD and the VOCAL program can be used for improving reading and writing abilities. The beginner group (one of three groups we categorized teachers into, in the background section of this paper) is able to use all of the programs as-is. Further, the fifteen components in the overall componentware environment can be used by the intermediate group for their own unique designs to produce additional EFL educational materials. As a practical matter, a student who had taken only one introductory course in C programming was able to create a useful application for English dialogue-practice in two days using pre-existing components (this does not include time spent preparing instructional materials such as video-taping and digitizing). We will report our findings in more detail after documenting further case studies.
Outside of the field of EFL education, if a programmer in the intermediate group wants to develop a Spanish language learning program for instance, he or she would be able to create the program by assembling the pre-existing components without having to acquire a knowledge of sound analysis or text analysis. (Of course, such a developer would have to have knowledge of the Spanish language.) As well, the oscilloscope component, which was designed for HPP, can be used to simulate oscilloscopes for observing electro-magnetic properties, such as radio-wave frequencies. In the future, the advanced group will be designing and building various, additional components and offering them to the intermediate group. In this way, a large number of useful educational programs will become available for teachers interested in utilizing CALL programs specifically tailored to their needs, in diverse educational settings.

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E-Learning Has to be Seen as Part of General Knowledge Management

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Abstract: In this paper we will argue that mankind is just about to take one more big developmental step due to continued progress in information and communication technology. Current and further developments are making huge bodies of knowledge available to everyone, everywhere and whenever needed. This has deep implications for all of mankind, but particularly also for the whole teaching and learning process.

Humanity on the Road to a Collective Organism

The proverbial "cavemen" lived in small groups: different tribes were basically autonomous, i.e. independent of each other. Even a single person was able to survive at the then usual standard of living for years without outside help if necessary. However, slowly more and more interaction between different population groups developed, starting with trade between neighboring tribes and turning into long distance trade of growing proportions. As a by-product different parts of the world became increasingly dependent on each other. With urbanization, industrialization and Taylorism the web of mutual dependence started to be incredibly dense: nobody in our Western civilization can survive without activities of many others anymore, at least not at the standard of living we today appreciate. In a way, individual persons have turned into a collective organism, into a new kind of "animal": mankind. We as persons resemble cells in animals, or ants in an anthill, or cogwheels in big machinery, much more than we resemble independent, autonomous individuals. When we will sit together at lunch, we will sit in rooms built by persons from numerous professions: on furniture fabricated by some other sector of our industry, eating food coming from a huge agricultural complex; we will eat with tools such as glasses, plates or spoons yet originating in an other part of our society...and all of us belong to still a completely different type of profession.

What is true for physical things like food or furniture just mentioned is equally true for knowledge. Once it only existed in isolated brains of persons who may have communicated it to their children or pupils, more often by showing rather than what we would call teaching. Yet, over time knowledge became a more widely available commodity: by archiving it in books, by introducing schools and universities, by communication between a community of scholars. Consider how even just a few hundred years ago knowledge was "fragmented", large libraries rare, the exchange of knowledge even between giants of science like Newton and Leibnitz by means of mail slow and cumbersome. However, we are now already in the process of leaving large and easy accessible scientific libraries of books behind, in favor of materials available over some kind of communication network, the World Wide Web (WWW), its successors or variants. This allows not just easy access to huge bodies of information but also impromptu discussions, criticism and comments: individual pockets of wisdom are merging into one large pool, individuals not just being networked for their physical needs but also their knowledge needs.

This new animal mankind will have, as it is sometimes said, as blood the transportation systems of our world, as muscles the energy networks spanning all continents, as nerves the glass-fiber or wireless information channels, and as brain a mixture of human brains and huge data bases.

We Have Seen Nothing Yet

When we look at the largest (and at this point also the most chaotic library) the world has ever had, WWW, it is clearly starting to have some impact on many areas of life. There is a growing amount of information on just about any topic available, a growing number of transactions (from booking a flight to ordering a book) are possible, and communication between physically arbitrarily far apart persons is avalanching.

Before we discuss what this means for education as one application area it has to be clearly understood that what we see now is just the "tip of the iceberg", the real changes and challenges are still before us. It is worthwhile to list some of them:

- The number of books and particularly journals on the WWW will increase dramatically
- The number of learning, teaching and training material on the WWW is going to multiply
- However, despite such growth it will become easier to find reliable information in the field desired due to three facts: (a) "information portals" (sometimes now also called vertical search engines), (b) "meta-information" and "grades" that will be attached to documents to allow more specific searches than is - profiles" that will assure that persons receive (automatically and in time intervals they decide on) information on topics of their interest.
- Most important of all, the WWW is going to turn increasingly from an information medium to a communication medium; this change will take many forms. Email is going to further explode but will slowly be integrated into knowledge-pools; discussion "forums" or "bulletin boards" will gain more popularity, expert online advice will be increasingly available, just to mention three of the many variants visible on the horizon.
- Knowledge management (KM) now in its infancy will gain much weight in the decade ahead of us. The idea comes from the frustrated statement of a director of some organizations who once said: "If our employees just knew what our employees know, we would be a much better organization". We believe that anyone in charge of a substantial group of persons will agree that it would be great to get (at least part of) the knowledge of persons in that group into a computer system so that everyone can profit from it: this is what KM is all about.
- In connection with KM there is also our vision of "active documents". The idea is this: whenever you see a document in WWW (or in your internal database) you can ask (e.g. type) an arbitrary question and the document (!) gives you immediately the desired answer. Sounds like science fiction? Well, it is not really. A good approximation can and has already been implemented by the group in Graz. The basic idea is that when documents are available to e.g. 100.000 users than after the first 1.000 users have seen them, asked questions and the questions have been answered by experts, the other 99.000 users are very likely to ask similar question. The KM system remembers all questions asked and their answers. When someone else types a question the system "only" has to decide whether a semantically equivalent question has been already asked before, and if so, the system can give the answer without expert consultation.
- However, the biggest and most dramatic change will come from the fact that PCs and Laptops and such will fade in the background, and will be replaced by very small yet powerful devices that will act as computers that are hooked (wireless) into the WWW or its successor. Such "omnipresent computers" (let us call them OCs) will be available within the next 5- 8 years and will be a necessary part of the life of everyone: all persons will always carry such an OC with them. (We are always referring to our Western world, not the whole world). It is the OC and the successor of the WWW that is going to shake the fundaments of many of our cherished and important activities, including communication and education.

The Omnipresent Computer (OC)

The Omnipresent Computer (OC) will be a cellular (mobile) phone with high communication rate. Just remember the (in)famous UMTS auction that has recently taken place in Germany to be able to introduce wireless telephony with higher bandwidth suitable for transmitting pictures, movies, etc. The OC will have a variety of standard functions that come with it, and some of the more obvious are listed below:

- It has an integrated camera that shoots both still pictures and videos. However, it is not just your digital photo or video camera; rather, due to its zoom function it can act as high power telescope or as low-power microscope; since it is able to work in the infrared spectrum it produces pictures both at night or in dense fog, and, yes, of course it acts as video phone. Make no mistake: the attraction of a video phone is not just that you can see the person you are talking to but you can show to that person what is going on around you: a view of your current vantage point in Graz, or a part of the movie you are just watching, or your children under the Xmas tree when you are calling your parents on Xmas day, etc.
- It is a full-fledged PC. So whatever you do today with your PC, you can do with the OC. And of course you can work with the WWW. "Work", because you may not just want to surf around, you may want to send some mail, participate in a discussion, ask someone for an opinion or perform some transaction.
- The OC will have a built-in global positioning system. Whether this is satellite based or will use the grid-points of the wireless communication system to determine the current position is anyone's guess. However, it will not only allow you to locate exactly where you are on a map or consult the pages of a relevant guide book, but is likely to offer much more: sensors that determine the direction the person is looking in will allow to explain exactly what you see right now; speed sensors may help you to answer questions such as "how long is it still going to take me to reach the restaurant where I booked my table"; road maps will turn into "backseat drivers", i.e. your OC will tell you exactly when to turn at some junction, etc. And maps will be dynamic: when it is very hot lakes and beaches will be highlighted, as will shops selling umbrellas when rain is impending. And the right kind of food place will be shown to you depending on the time of the day, your location, the direction and speed of your movement.
- The OC will also be your electronic wallet. Securely and anonymously you will be able to pay both in the real world (i.e. shops) and the virtual world of WWW or other electronic shopping malls. Sooner or later, cash, credit cards and such will be as unknown as means to pay as gold coins are today.
- The OC will have both speech input and speech output; this will be convenient in many ways. It will also mean that it will act as your personal translator. When you use English/ German, you will talk into your OC in English and it will generate a fairly good translation into German for your counterpart who feels more comfortable in this language.
- Of course the OC will be a portable radio, a TV and the equivalent of a CD player. CDs will be by then replaced by other devices (like MP3 files stored on the OC), TV will have changed (when you want to watch a movie you just select one from a data-base and play it), and the radio will also have continued to evolve in what it offers: the same station different types of audio depending on your personal profile. The stations may not transmit to you like today, but via the WWW which you happen to receive maybe wireless! Clearly, you will have access to all information on the WWW, but you may also carry a selection of electronic dictionaries and books directly with you on the OC without needing the WWW.

You want to buy such an OC? Ok, just wait five years or so. But don't be disappointed if the first OCs do not have all the functions described; they will have enough surprises that have not been mentioned! Also, don't be surprised that the OC might not be much larger than your wallet, that some version may come as wristwatch, and some may be small enough to fit into some boy- cavity. How about instead of a porcelain tooth filling?

It is obvious to ask: How is it possible that such a universal device can be as small as described? Even if one accepts that computer chips will get very small and will require only little power (that may come from a re-useable battery or some way of generating energy from the human wearer), how can one use such a device if it "clearly" has no room for a display of good quality?

Well, the "clearly" is put in quotation marks on purpose: technology that allows displays to be folded, or rolled, or feels like a piece of paper but really is a display (the digital ink of MIT) is advancing. Most important, it is quite possible that we will not use screens in the future at all. Rather, to look a bit in the future, we might be wearing glasses that direct the audio output of the OC directly to the ear and the video via glass fiber to the front, projecting the picture through the pupil directly on our retina: projecting two different pictures for the two eyes the image can be three-dimensional and can act as "overlay" over what you see through the glasses. Thus, when you look at something, your OC (if you have chosen this option) gives you as overlay a description of what you are seeing, potentially with all kinds of additional information. Cute for a tourist who gets all the details he wants as he looks at a building, maybe more than cute for learning purposes!

Thus, receiving visual and audio information from the OC will be easy. At this point it is not clear which input device will win-out: keyboards that consist of cloth and are part of your jacket, voice activated input, or other input device that are currently experimented with. I will show a few pictures in my talk. I cannot include them in the printed version for copyright- reasons, but if you check with any of the WWW search engines under +computers +wearables you are in for a surprise if you have not seen such gadgets before.

There are other issues. How are the various parts I have described networked, what additional sensors and devices might be useful and available: for the purpose of this paper what counts is one fact: before the end of this decade information and communication tools will be omnipresent, will be used by everyone, and will be small enough that one may hardly notice them or that they are in use.

What Does This All Mean for Education?

It needs little imagination to understand that such new technology will influence many of our habits, our life-style and our work. And this surely includes all aspects of education.

The very first question that comes into ones mind is: if all information or human knowledge is present everywhere at any time anyway, is learning still a necessity?

The answer - and some may breathe a sigh of relief - is "yes". Not only is it unclear how we can think within information in our brain, even the retrieval of information is a non-trivial matter, particularly since we are just starting to learn that remembering content is often easier than remembering the source (i.e. where we found the content).

Thus, learning will remain, but will be quite different from what we now often see on the WWW:

When we look at the WWW today we find thousands of efforts to use it for educational purposes. However, most attempts are limited to a sequence of HTML pages, sometimes including interactive features like quizzes or simulations, and often a smattering of communicational features based on email.

From what has been said above it should be clear that WBT or as it is mow often called "e-Learning" can and must be much more than this. It must include powerful collaborative features, use the WWW and other sources a omnipresent background library, and must be based on the assumption that different persons have different knowledge backgrounds and different learning styles.

Thus, an ideal "e-Learning environment" must include at least partial solutions of the following issues:

- Educational material comes in small modules that have meta-data associated with them to be able to find what one wants. The modules must be related by a "dependency network" to allow individualized instruction.
- Using the dependency network mentioned it is possible to customize material for each user as follows: when a module is selected the system determines all modules that are necessary to understand the one chosen: by asking questions the system determines which of those "auxiliary" modules have to be presented first before the actual module of interest can be used.
- In ideal environments, the system should not only customize the knowledge level as explained above but also the learning style (more audio, more video, more haptic actions, etc.) most suitable for the current learner.
- As persons work through the material they must be able to add material and links for their own benefit, or for the benefit of later users. I.e., the system must provide a powerful "annotation mechanism" including authorization for individuals and groups.
- Users must be able at any point to consult background libraries, be it on the server they are currently working with or somewhere else on the Internet or the Intranet; and they must be able to incorporate such

information found for themselves and for others. Note that this is just one of the features that assures that the material gets richer (more knowledge is generated) as more persons use the system.

- Users must be able at any time to chat with others online, to work with discussion forums, to use collaboration spaces and to ask experts. Note again that the questions and the answers given will enrich the educational material, turning documents into "active documents" as mentioned earlier.

Summarizing, the traditional notion of "courseware" that is made available once and for all for users has to be replaced by the notion of a network of learners working with and enriching existing material, their isolation broken by the Web, their individual level of knowledge and style of learning respected by the system. Then and only then can e-Learning be successful and is an important component of knowledge management.

First attempts in this direction can be found in a number of systems. The GENTLE system (GEneral Networked Teaching and Learning Environment) at http://www.gentle-wbt.com is one of them. It is now available free of charge for universities and schools. It is marketed by the knowledge management company Hyperwave at http://www.hyperwave.com. It is available free of charge for non-commercial use for schools and universities, see http://www.haup.org.

Summary

In this somewhat provocative paper we have tried to argue that powerful networked computers (OCs) will be omnipresent within a decade, and will influence all areas of education. We have tried to show that "WBT" or "e-Learning" should not be seen a isolated phenomena but as part of knowledge management.

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Situation Learning: A New Approach to Knowledge Mediation

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Abstract: Situation Learning (SL) is a new hypermedia knowledge module for on- and off-line use. The presented solution offers a new approach to knowledge module presentation that is different from the majority of presently used approaches. The interactive component of the SL approach increases students' involvement and motivation for learning. Learners can experiment and investigate within the 'virtual world' of the SL knowledge module. Such experimenting and interacting with different knowledge presentations makes it possible to construct own specific knowledge thus making the factual knowledge more permanent.

1. Introduction

Many scientists [Bates94] [Lennon94] [Maurer94] [Maurer97a] [Maurer97b] [Maurer99a] [Maurer99b] [Maurer99c] [Valley95] have observed disadvantages of early attempts in CAL (Computer Assisted Learning) such as the courseware being strictly bound by subject matters and the presentation techniques making it difficult to alter the content of the courseware. Knowledge Based Courseware (KBC) is a more recent approach that tries to improve disadvantages of CAL KBC, with separate knowledge representation, merges artificial intelligence approach with CAL and CBT (Computer Based Training) approaches. However, the main goal remains the same, which is to effectively develop computer-based learning materials that facilitate learning in the best possible manner. An experience provided in the virtual world can be considered, where people would have a chance to learn incidentally [Holzinger99], without special effort, similar to small children where the learning process through trial and error is part of life. As [Stilborn96] expressed..." *our aim should not be to replicate the classroom on the desktop, but to use the technology available to us through the Internet to significantly improve the teaching / learning process."* Research has been focused on finding ways that help people to learn how to solve problems and perhaps enable them to adopt new ways of reasoning. The learning process should be interesting, easy and it should be fun to learn. It also should fit with everyday tasks and the working environment in order to achieve optimum results. Therefore, information technology should not be used to automate an existing learning process that no longer meets the requirements of the society, but to enhance a new one.

2. SL

Situation learning presents a non-hierarchically structured hypermedia knowledge module. The learning goal is embedded in the context of a situation. To get maximum involvement and attention a situation has to be created that is interesting for the users. A storyline that users can identify with is most preferable. An example of a well-known and easily understood situation by the majority of people is the "waitress example". The learning objective of this story is, "how to carry a load correctly"[1]. Users

[1] When carrying loads incorrectly we may also risk ankle or knee injuries and / or referred pain of the lower back area (to mention only few possible issues).

are confronted with the situation where a waitress has pain in her wrist while working. There are many different suggestions provided as to what the waitress should do. Some suggested actions are correct, others provide only a temporary solution, others again could cause severe inflammation. While trying to find the solution for the waitress, users learn incidentally the optimal behaviour and also the correct way of carrying the load. Situations are subject and domain specific e.g. emergency room where medical students have to decide which tests should be made first in the case of a head injury patient and the sequence of actions to be taken. The idea of situation learning is to create a variety of different plausible courses of action that will eventually lead users to the decision that yields the most appropriate action.

General Idea

A Situation Learning knowledge module can consist of one or more related situations. The term "Situation" in the context of Situation Learning denotes a specific simulated environment in which the learning objective is embedded. The situation is a collection of different scenes that are related in the sense that they describe a certain event or task. The "scene" consists of several hypermedia and HTML documents (e.g. on request available additional information). The displayed hypermedia document consists of an image, video / audio, text, meta-instruction and for example four selections. Only a few possibilities (in general 2-6) are offered to users. Based on users chosen courses of action, they then proceed to the next scene and eventually to the end of the situation e.g. summary. Each consecutive scene is different and depends on the previously made choice. Users are stepwise being confronted with the consequences of chosen courses and on their choices made. With the help of the "virtual" world users can explore where a chosen course of action could lead them in the "real" world. In the same way, users can safely explore possible outcomes when less appropriate choices are made. Using an SL knowledge module, users get the opportunity to learn appropriate responses for different situations / cases. Such opportunities enable users to improve their ability to discern relevant from irrelevant information and to combine unrelated (or less obviously related) elements. The interaction provided within each consecutive step encourages users to think about the case and to reflect back on their own knowledge base. Based on this they make a decision. In this way SL effectively facilitates the decision-making process.

A knowledge module presented in SL mode has the following expectations of learners:

- To explore circumstances with the help of situations (to get text and picture information, to acquire provided additional information and eventually to leave the situation to search external sources and acquire any further related information)
- To make choices / decisions (based on the facts provided and given possible solutions, users should decide the appropriate course of action)
- To understand the evaluation of their choices (through immediate feedback and feedback through path evaluation where all courses of action are transparent and evaluated)

Through the process of utilising knowledge acquired learners can build their own mental concepts e.g. can check the understanding of the material learned within the concept. Situation learning may bridge the gap between isolated learning of theory and practical work i.e. applying theoretical based learning to a practical situation. Situation learning is a way of facilitating the natural learning process, whereby the successful acquisition of new facts is enhanced by the learners ability to consolidate this information with their own knowledge base and experience. Such links allow people to master very complex or seemingly unpredictable situations. Situation learning helps to build and improve learners' mental model. Several use cases are described in [Pivec01].

Prototype Implementation

Each presented scene of the situation can be divided into four main areas as follows:
(i) situation description - upper right, (ii) meta instructions - upper left, (iii) user selection - lower left, (iv) media display - lower right part of the screen.

The upper right part of the screen is used for scene description. In this area a short text description is displayed that explains the current situation. This screen area can also be used to set a link to a page with additional information or a list of additional sources or to a background library. Below the description, on the lower right screen side, there is the area reserved for media display. With help of multimedia, e.g. pictures, animations, videos and other types of multimedia objects, users can get additional information about the scene or visual help to create a mental picture of the scene.

The left screen side is reserved for the interaction with users. On the upper left side messages concerning the further progress of the demo and the tasks that have to be carried out respectively are displayed. The users are e.g. asked to make a selection as in the example above or are told to proceed to the summary or to have a look at additional information source e.g. lecture chapter, video presentation, etc. The lower left side of the screen is for users interaction based on multiple choice selection. The number of selectable possibilities ranges from 2 to 6 items. This means that by selecting one of the suggested courses of action users get to the next scene as shown in the example above. In exceptional cases only one possibility might be given with the intention of guiding users through an out-tunnel leading to a specific scene or a summary.

3. Integration of SL Knowledge Module into the Hyperwave eLearning Suite

At first the SL knowledge module prototype implementation was an independent application that one could use with a regular browser such as Netscape or Internet Explorer. In further research the integration of the SL knowledge module prototype example into the Hyperwave eLearning Suite learning made it possible to investigate:

- Whether the environment supports such an application type like SL knowledge modules and to what extent authoring is influenced.
- How the SL knowledge modules can benefit from the environment.

At present the Hyperwave eLearning Suite environment supports only linear approaches such as behaviourist teaching. The learning material in Hyperwave eLearning Suite is structured much like an electronic book and supports so-called "step-by-step" learning. The material is presented to students in a way that facilitates the understanding of material in a certain area like physics, mathematics, statistics, etc. The students have the possibility to browse through the topics following their own interests and preferences.

Within the SL knowledge module a complex situation is presented to the students. Students, encountered with the problem, are expected to work through the situation to be able to solve the problem. Students can navigate through the situation based on their choice of one of several offered alternatives. To be able to choose one, students have to reflect on the problem presented along with several possible combinations of causes and consequences. At the same time students could benefit by having the possibility to use all of the different communication capabilities offered within an on-line learning environment, as in the case when they work with linearly structured learning material. Students could then mark difficult scenes, ask questions, make public notes and post hints for other students. Questions and answers could be visible to all students as well as help others to understand the specific scene or to point out the purpose.

Within the following subchapters the application of the communication support provided and resulted advantages when working with the SL knowledge module are outlined.

Annotations

The Hyperwave eLearning Suite system supports private and public annotations (Notes and Question/Answer Dialogs). Public Hyperwave eLearning Suite notes can be used by teachers and tutors to give hints in certain scenes. Some relevant explanation or additional material can be pointed out when using public notes. Students' attention can also be drawn to relevant chapters of the courseware that provides background information necessary for better understanding the particular scene or the situation. Students can use public notes to warn other students, to give hints, or to pose questions. With the application of a public note of the type question, a student can ask the tutor what they are expected to do in case they do not agree with any of offered courses of action. Because the note is public and visible to all other course participants, others could benefit from the answer to help solve similar dilemmas.

Private notes are used mainly to comment on a certain course of action so that the student's reasoning can be recalled and reviewed whenever he or she returns to this point in the future (see Figure 1). To consider an example, a scene has been annotated by a student. In the first field of the form, the student has written the title "Attempt one" that indicates that student encountered the situation for the first time. In the field "Content", the student has written a brief explanation why this particular course of action was chosen. Changing the value of the field "Rights" from public to private assures that this note will be visible only to this particular student. When working through the situation again, he or she can read the note and get information about the decisions made in the past. Using this information combined with experiences learned when working through the SL knowledge module, students can reflect on past decisions and make new choices. The system's notes feature making it possible to comment the reasoning within each scene, is a powerful tool that facilitates knowledge acquisition.

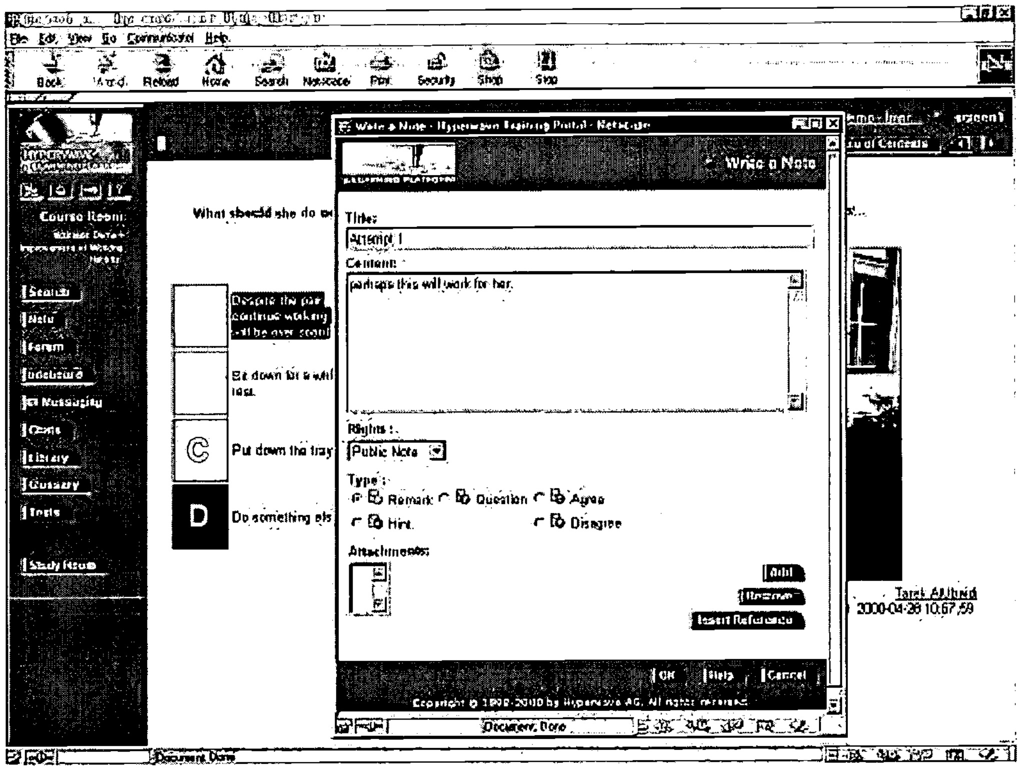

Figure 1: Annotations

Discussion Forum

Using the Discussion Forum within Hyperwave eLearning Suite, certain topics related with the SL knowledge module and points of interest to all students can be discussed, different students' misconceptions can be pointed out, and additional knowledge sources can be published.

In this particular prototype application of the SL knowledge module, one of the possible topics for discussion could be how the previously presented problem of carrying a tray is relevant and how it can be applied in practice. Similarities to carrying suitcases and shopping bags could be outlined. The tutor could also invite students to share their experiences with carrying heavy loads with the group. The group could then discuss those examples and outline different ways of preventing injuries that could occur, if the action is undertaken in an inappropriate way. At the end, the tutor could summarize the discussion and point out several video clips that augment the discussed topic.

Messaging

Messaging is an internal communication facility with similar functionality to e-mail. A tutor can use messaging to send a hint or additional information to a student or a group of students. For example, the tutor can make a suggestion to the students to work through the SL knowledge module several times before taking the exam. The tutor could also provide additional explanation as to which topics in the SL knowledge module are relevant in particular. The provided example with all its variations makes it possible to apply the acquired theory to real-world situations.

Chat

In the Chat module students can discuss in real-time details about a situation and exchange their experiences and thoughts. Students can use private and general or course specific chat. Using private chat, a group of students could work together through the SL knowledge module discussing which choice to make and working on compromise solutions. General chat can substitute the informal class related conversations that takes place in the hallways.

4. Evaluation

For the evaluation of the SL knowledge module, the waitress prototype application was used. The situation was presented to two groups of people with completely different background knowledge. One group had knowledge of health care and professional injury prevention. The other group had background knowledge in computer science (e.g. students and people working at the IICM).

The evaluation was done in two different ways. With the first group an evaluation in the form of a demonstration was made, whereby the prototype application was presented and the SL principle was briefly explained. The opinions were collected in an informal way, through discussions and informal interview i.e. one-to-one conversation.

For the second evaluation the prototype application was published in the Hyperwave eLearning Suite as a course. The participants had the possibility to work with the application at any time appropriate i.e. when they had time and want to explore the situation. The evaluation conditions (of environment and of application use) were very similar to the real practice. Each participant then answered the questionnaire distributed via e-mail and delivered the response also in an electronic form.

The SL approach was very well accepted. Some positive opinions came from those with knowledge of medical injury prevention where one of the comments was that exploring a SL topic is much more thrilling than watching a small video clip about the same topic. Another opinion was that SL can be used for the knowledge mediation in many different ways (e.g. situations for stress management, therapy, professional injury prevention).

Most people indicated they would prefer to get additional information (i.e. at least additional explanation and eventually deeper medical information) about the topic presented in the evaluated prototype. This shows that SL, due to its informal structure, is an appropriate tool to be used for motivating of learners to seek out more information about a certain topic.

Difficulties appeared because of misunderstanding the text of the situation (that was written in English) which appeared to influence the work with the situation. This indicates that the descriptions and expressions used in situations should be appropriate for the target population and should be applied to SL as a general rule.

Furthermore, it can be said that the SL proved to be successful. The result of the acceptance was the L I F E (Leben-Inspiration-Fortbewegung- Essen) project, financed by Fonds Gesundes Österreich. The goal of the project is to educate the population in the areas of fitness, stress regulation and nutrition, in order to increase the common awareness of the importance of these factors on our lives. Furthermore, citizens can thus be encouraged to take responsibility for their behaviour and to realise the possible consequences of their present life-styles. SL modules were created for knowledge mediation in each of the topic areas (fitness, stress, nutrition).

LIFE uses primarily the Web as a medium for the content mediation. This means that the targeted population is in general young people and the population that uses the Web. SL modules have been further embedded in the environment from Infomed-Austria (www.infomed-austria.at). Infomed Austria is a medical portal server that provides additional features such as discussion forum, public and personal annotation possibilities, expert advice, additional medical contents and rated medical references, etc. LIFE will also be published in an off-line version of Infomed Austria server in an edition of 1000 copies. CD with LIFE content will be distributed for free over the Infomed-Austria server and make presentations at different press conferences and discussions.

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MBA on NetAcademy as a Reference Model for Media-Supported Higher Education

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Abstract: This paper gives a brief overview of a concept of online learning communities introducing a reference model for learning communities. Using the example of the "Executive MBA in New Media and Communication" at the University of St. Gallen, the article shows how an online learning community can be implemented. The reference model for learning communities was followed for designing this community.

1 Introduction

What is media-supported learning? Some think that a presentation with some fancy graphics on a computer and beamer already qualifies as media-supported teaching or learning. But the mere employment of music or graphics in a lecture does not justify the use of the term "media-supported". Media supported learning is not only enhancing a lecture with fancy technological gadgets, but a complete program including communication and document-sharing technologies (e.g. the Internet) (Mohd Najib & Zawawi 1999). It can excellently be utilized to enhance the building of a learning community. In that case, media provide not only knowledge in a network in the form of hypertexts on a content side, e.g. using Internet technologies, but the participants of an educational program can also benefit personally from a network that is developed in online supported learning communities (Paloff 1999).

Some may argue "why not media-conducted learning, then"? There is a difference between distance and online learning. Distance learning is clearly a form of learning where teacher and students are in different places, and often work at different times on a class. A mixed concept integrating online and offline learning methods and using the advantages of both kinds of learning communities is media-supported learning rather than media-conducted learning Euler 2000b).

This paper pursues two goals:

- *Introducing the concept and the goals of online learning communities:* We show some advantages of learning communities, define the terms "online learning community", and introduce the reference model for learning communities.
- *Illustrating a way of designing an online learning environment:* Using the learning community of a Master's program at the University of St. Gallen, we show how an online learning community can be modeled.

2 The Structure of a Learning Community

Developing communities is an important motivation aspect for students not only on a professional, but also on a personal level. The exchange between the group members helps to assess and enlarge their own knowledge. Simultaneously, studying in a group is easier because different points of view of a topic are presented and more aspects are considered; the mutual, thus mostly deeper, examination of learning materials helps to extend knowledge. Mutual studying also creates a feeling of affiliation that can tie a learning community together even after the training. Maximal affiliation of members to the community is reached by considering formal learning goals as well as common social interests. This is an important aspect in the context of the shifting demands of today's professional environment. Fast-changing standards require the increasing ability of professionals to continually learn and enlarge their knowledge. A learning community environment tries to prepare students for this requirement by creating team situations and in showing forms of learning that may appear in a professional environment as well.

Furthermore, learning communities are an appropriate vehicle to acquire soft skills such as empathy that cannot be learned in a standalone environment (Paloff 1999). In this context we correlate soft skills mainly with social skills, e.g. problem solving skills, team skills, or self-reflection competencies etc. (Becker & Carnine 1980), (Euler 2000a).

The learning community also shifts responsibilities for lecturers. Firstly, learning is no longer focused on one-teacher-many-learners-scenarios but favors group and self study. This allows the lecturer to assign content preparation and presentation to students and to encourage them to active participation, thus culminating in stronger learning experiences and deeper knowledge. Secondly, learning is no longer a teacher-learner-only relationship, but also a learner-learner relationship. Students take responsibility for each other and consult the teacher if they can't solve a problem in their team, thus allowing the teacher to concentrate on difficult problems and to spend more time coaching students who need help more intensively.

2.1 Definition of Online Learning Communities

A *community* is a group of actors (Armstrong & Hagel 1996) who are connected by a common interest, common goals, or common actions in a commonly used channel system (Schmid 1997a). The channel system is part of the medium through which the exchange between the group members is maintained. According to Beat Schmid, a medium is a system consisting of the components logical space (semantics and syntax of a common language), channels, and organization (the structure with the definitions of roles and their rights and obligations, and the process with protocols and processes) (Schmid 1997a), (Schmid 1998) . A community can be called an Internet-based community (online community), if it uses the Internet as its "channel system" for exchange between the members (Lechner & Schmid 1999) , (Mynatt, Adler, et al.. 1997) , (Rheingold 1993) .

An online *learning* community (Harasim 1995) , (Paloff & Pratt 1999) has learning as its common interest. Actors involved can take on certain roles and the resulting rights and obligations in the community, in a narrow point of view: teachers and students; in a broader understanding: teachers, students, staff, alumni, or corporate partners. When designing this community, it is useful not only to consider the advantages of online media, such as flexibility and independence of place and time, but also the advantages and approved methods of the traditional university, such as bonding between group members and sharing of experience through group work. A successful online learning environment, e.g., would be the depiction of a university on the online learning platform, including a classroom community and a campus community.

- The *classroom community*, the community within the course or in the "classroom", is mainly determined by learning objectives and teaching arrangements; this "formal", closed community follows a didactically structured course design (e.g., a study program or training course); the formation of several sub-communities (e.g., student groups, project teams) is possible.
- The *campus community* characterizes a campus-wide, more informal community and reflects the "campus life" that takes place beyond the didactically planned study offers; it is designed comprehensively, focusing on informal exchange of knowledge and experience.
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2.2 A Reference Model for Learning Communities

This chapter shows a potential way to design an online learning community including the two sub-communities (classroom and campus). Platforms of Internet-based learning communities can be modeled – referring to the media reference model for communities of Beat Schmid (Schmid & Lindemann 1998) , (Stanoevska & Schmid 2000) – in four designs (derived from four views) (Seufert & Gerhard 2000) . Since campus and classroom communities have different focuses and different functions, the design for the two is shown separately (see Fig. 1).

- The **organizational design** shows the community view. It defines the structure of the community, the community interests, the actors and roles, their common language and the process with protocols and guidelines for the community. The organizational design is adapted to the needs of a specific online learning community. Differing focuses and goals of campus and classroom community require different roles, languages, and protocols for those two sub-communities.
- The **interaction/ process design** is seen from the viewpoint of the implementation view and connects the preceding organizational design with the subsequent service design. Based on the organization of learning communities and supported by the services offered by the platform for learning communities, the processes and scenarios are depicted. The (media supported or presence) phases of particular learning processes are designed. Considering the learning community as a whole with its specific contents and activities as well as the sub-communities with their campus and classroom situations, interactions and processes will be specialized to the needs in that context.

Community View	**Organizational Design:** Campus Community: Roles, Protocols, Language Classroom Community: Roles, Protocols, Language
Implementation View	**Interaction/ Process Design** Campus Scenarios: Campus Management, Social Processes Classroom Scenarios: Course Management, Learning Processes
Service View	**Channel Design:** Campus Services for Campus Community Classroom Services for Classroom Community
Infrastructure View	**Technological Design:** Campus Components/ Classroom Components (Internet (www), Intranet, Groupware, synchronous/asynchronous Communications Technologies, Content-Management-Systems,Course AuthoringTools)

Figure 1: Reference Model for Online Learning Communities (Seufert 2000)

- The **channel design** represents the service view; the channel systems and services offered to the different communities and their members are described and the web interface is determined. We take the processes and scenarios that we have defined in the interaction design and think about how to support them best.
- The **IT design** is presented from the perspective of the infrastructure view (technological aspect). In this part, the decision about where to develop which new technological tools and where to use which standard tool is made. For spotlighting the user needs, not the technology, the level "IT design" is only performed after the community, its interactions and processes, and the required services are specified.

This general reference model for learning communities can be utilized for the modeling of learning communities which perform all their communication and learning processes on the Internet, but also of learning communities combining attendance classes and online phases, using the Internet for certain functions and selected learning processes only. We now want to show how we used the reference model to develop an online platform for the MBA program at the University of St. Gallen.

3 Developing the MBA Platform

Beginning in February 2001, the Institute for Media and Communications Management (mcm *institute*) at the University of St. Gallen offers a new "Executive MBA in New Media and Communication". Students in this Master's program will achieve competencies in business administration, knowledge about technological and economical components of new media, and the interaction of new media with sociological aspects. An online learning community for (partial) support of the "traditional" (or on-campus) learning community is created for several reasons: Firstly, following the goal "learning new media through new media", we think that hands-on experience with new media is a critical factor for successful dealing with this complex topic. Secondly, the goal of the MBA community is to create a feeling of life-long affiliation and to provide a network for all members of the community. The online community can be a platform for easy access of all members, on and off campus. And, last but not least, the goal of preparing the students for life-long learning can be reached through establishing a learning community among the students, and through creating strong bounds of the community members to the MBA community.

Establishing the structures and services required for this MBA learning community is part of the ongoing development of an already existing Internet platform, the "NetAcademy", an online instrument for discussion, publication, and knowledge exchange of research communities. The goal is to create a flexible and generic platform for both the scientific community and learning communities for exchange within and between those communities.

3.1 The NetAcademy as Generic Platform for Learning Communities

Following the idea of Beat Schmid (mcm *institute*), the NetAcademy (www.netacademy.org) was founded in 1997 as a platform for the exchange of knowledge, for publications and discussions (Schmid 1997b). It is an interactive online Handbook (e.g., digital libraries, connected with glossaries) for research communities. At the moment, researchers of five research communities in the field of media and communications management exchange their knowledge on this platform (Lincke, Schuber et al... 1998).

In autumn of 2000, the NetAcademy was made accessible for learning communities. The first Internet-based learning community on the NetAcademy will be the "Executive MBA in New Media and Communication" of the mcm *institute*. Numerous services already offered to the research communities by the NetAcademy (e.g., the libraries) will be used by this learning community as well. Additional services, such as curriculum catalogs or teaching templates, will be developed specifically for this community "type" on the NetAcademy platform.

Connected to the NetAcademy is the idea of a "generic" platform, i.e. a new research or learning community can choose and combine existing services of the NetAcademy according to its needs and also add other required services.

3.2 Modelling the MBA Community

The reference model for online learning communities provides a framework for the development of our MBA community. We follow the approach of depicting a university on the Internet platform and therefore also distinguish between classroom and campus community. At a (real) university, numerous activities are located in each room or location, therefore we arrange each MBA service in the online room logically corresponding to a room at the real university.

Processes that are related to the formal goals of the classroom community, such as lectures, group work, discussion about class subjects and the supply with course material are located in the vicinity of classroom community. They therefore take place in the *classroom*.

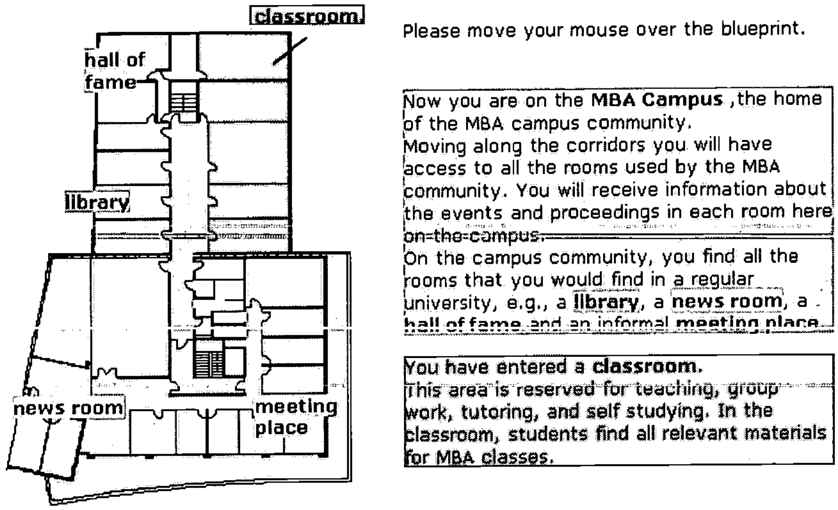

Figure 2: Sitemap – MBA Community: Rooms and Locations

Processes related to campus activities (such as applications, research, general news, etc.) and social activities are located on the campus area of the online platform. You will find, e.g., an application center, a library, a meeting point, and a news room. Figure 2 shows a (graphically enhanced) screenshot of the MBA webpage's sitemap. Visitors, students, etc. will find brief descriptions for all the rooms in the MBA community and gain quick access by clicking on a room.

3.2.1 Community View

Referring to the MBA program, actors involved perform their roles as students or faculty in the closer classroom community and as students, faculty, alumni, staff, or corporate partners in the campus community. Each actor fulfills certain functions and obeys either more formal protocols, e.g., curriculum structure or assessment rules, or follows more informal social protocols, e.g., interpersonal behavior, netiquette, etc. MBA community members develop their own language by establishing a common understanding and use of certain words and/ or phrases the may be defined in a glossary.

The example of a "thesis marketplace " shows how the previously described model for online learning communities can be concretely utilized for the MBA community. The marketplace is located in the classroom and is a new service, therefore being implemented by the MBA group. The main idea is to bring students' topic requests and faculties' topic and tutoring offers together. Several actors are involved in this marketplace: students who act as willing thesis writers, on the one hand, and faculty members who act as thesis supervisors and tutors, on the other hand. (see Fig. 3). All actors have a common understanding ("language") of theses (e.g. what size a thesis should have, which genre of work a thesis has to be, etc..)

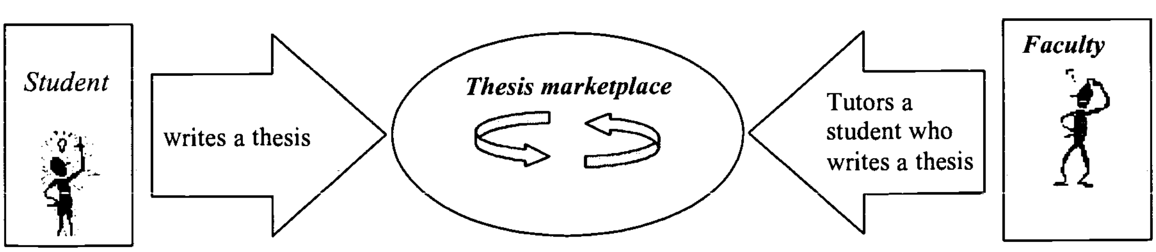

Figure 3: Concept of a Thesis Marketplace

3.2.2 *Implementation View*

The implementation view concentrates on the processes and interactions in different scenarios in learning communities. The activities defined in the community view are now examined in terms of their process and scenario involvement. Every scenario encounters several phases not all of which have to necessarily be media supported but can also contain face-to-face elements. Structured work orders can be generated for some processes that are strongly automated (e.g., subscribing newsletters); other phases can be structured only basically (e.g., interactive face-to-face sessions).

Table 1 shows a process related to our example, the thesis marketplace.

Phases		**Student**	**Faculty**
Beginning phase	Topic search	1. Student places a topic request on the thesis market place 3. Student chooses one of the offered topics	2. Faculty member places several topics he/ she is willing to supervise.
	Partner search	4. Some students look for a writing partner 5. Two ore three students decide to work together on a topic	6. Faculty member admits the student team
Writing phase	Tutor search	7. Student team searches for tutoring or has questions about its thesis	8. Faculty member answers the questions
Grading phase	Evaluation and Rating	9. Student team delivers its thesis for evaluation an rating	10. Faculty member grades the thesis

Table 1: Thesis Writing Process

3.2.3 *Service View*

Pursuing the idea of the NetAcademy to provide modular services some or all of which can be chosen by each community, the MBA community was able to integrate already existing services of the scientific platform (e.g., the library modules, case repository, newswire). Other services that had to be developed were designed modular to allow their use by other communities.

Our example: The "thesis marketplace service" (see Fig. 4) offers a platform for trading topics and finding supervisors or students who are interested in working on specific topics. Later on, the service can provide support in phases of tutoring. To support these (already depicted) processes we develop some tools for the thesis marketplace:

- In the *cooperation tool*, students can place a topic proposal and search for a supervisor, a tutor, and writing partners. Faculty members can provide topics and search for students interested in those topics, and they can respond to students who require tutoring services;
- Materials can be exchanged in the content *repository tool;*
- Administrative issues are covered in the *managing and reporting tool.*

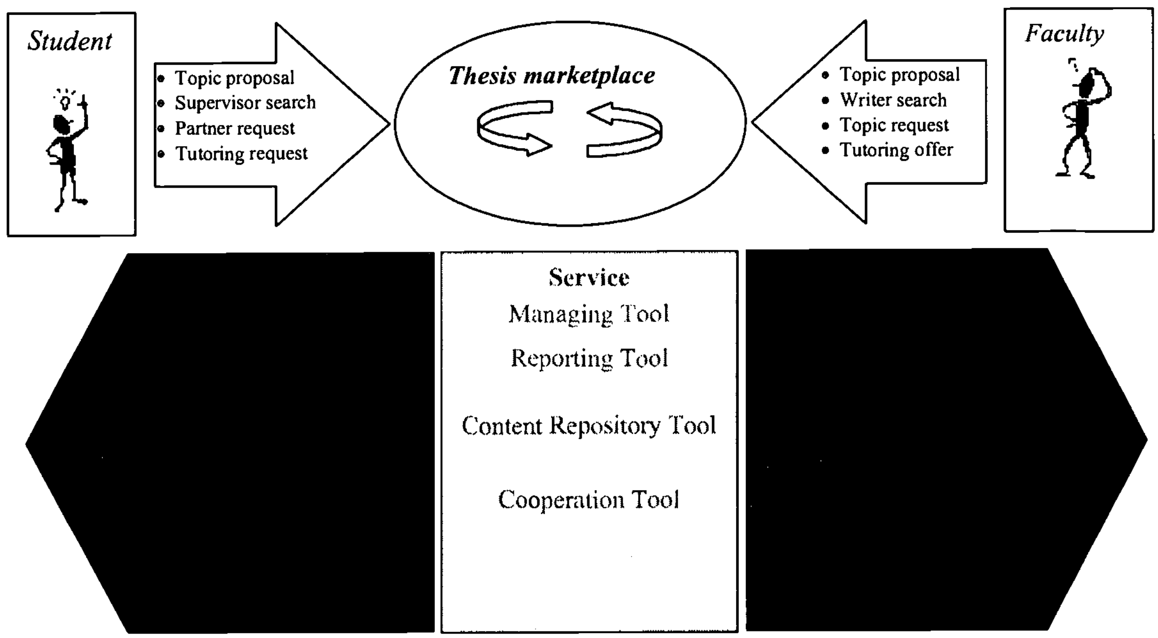

Figure 4: Thesis Marketplace Service

Although the marketplace is used only for the thesis context in the MBA community, its use is neither restricted to this specific learning community nor to theses. It could be used by a scientific community for coordinating book chapters as well as by a learning community for handling all kinds of assignments.

3.2.4 Infrastucture View

The technological design of the MBA community includes the supply of discussion databases for team work, synchronous chat tools, asynchronous discussion tools, content databases for class materials, cases, and assignments, etc. Also, it includes the graphic design of the platform which is managed in a separate design repository to allow quick adaptations independent of the technological design.

The decision of how to implement the infrastructure is not only determined by the three layers above but also by several other circumstances, such as already existing technological framework, financial and personal resources, time frames and so on. Considering those prerequisites, a trade-off between choosing a low-cost standard service solution and a high-cost customized service solution or even development of new services has to be reached.

The services provided by the NetAcademy already exist and can be adapted or customized. For other services, there are very good market solutions available. Some are very specialized and require complete customized development. The MBA platform is therefore implemented as a combination of standard software (e.g., Lotus LearningSpace) and individual software solutions engineered on Lotus Domino technology (used by the NetAcademy).

4 Conclusion and Outlook

We have given a brief overview of the concept of learning communities. A reference model for learning communities was introduced. We then showed how an online learning community can be implemented, using the example of the "Executive MBA in New Media and Communication" at the University of St. Gallen. For designing this community, we followed the reference model for learning communities. To allow members of the learning community easy handling, we followed the idea of depicting a university on the web platform.

We now stand at a point where the conceptual work is almost finished, and the implementation phase is in its peak. We plan an extensive test phase before students arrive, but are convinced that a lot of adjustments are required. We see the critical factor for acceptance and use by the community members in the fulfillment of their needs. Therefore, continuous diligent observation and critical investigation of student, faculty, staff, guest and business partner needs will be our everlasting challenge to lead the MBA online learning community to success.

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Closed-Loop Adaptive Education

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Abstract: Closed-loop adaptive education is an emerging concept that integrates object-/objective-based adaptive interactive multimedia instruction (IMI), intelligent tutoring system (ITS), and modeling and simulation technologies. The result is an inherently learner-focused approach that manages mastery of knowledge and skill learning objectives dynamically. The following is a discussion of our approach to implementing the closed-loop paradigm. We discuss what we view as the major components of such an approach, including the Learner Model, adaptive IMI, and simulation-based adaptive education. We conclude by discussing how these elements can be combined within a closed-loop system.

Introduction

Closed-loop adaptive education is an emerging concept that integrates object-/objective-based adaptive interactive multimedia instruction (IMI), intelligent tutoring system (ITS), and modeling and simulation technologies. The result is an inherently learner-focused approach that manages mastery of knowledge and skill learning objectives dynamically.

The closed-loop, object-/objective-based adaptive education concept has evolved over several years (Morris, *et al.*, 2000; McCarthy, *et al.*, 2000; McCarthy, *et al.*, 1998. McCarthy, 1996; McCarthy, *et al.*, 1995a,b; McCarthy, 1994; McCarthy, *et al.*, 1994) and is conceptualized below (see Figure 1). At the core of this approach is a dynamic Learner Model. The Learner Model contains current mastery information for all covered learning objectives, as well as data relating to learner characteristics, instructional history, and feedback history. The Learner Model sends and receives data from a family of domain and instructional expert software that guides the learner's instructional experience. In addition to considering the state of the learner (captured in the Learner Model), the experts consider the goals of instruction (captured as course data). Armed with current and historical information on the learner, and the goals of the course, an adaptive learning system can employ IMI- or simulation-based learning and assessment activities (shareable content objects; SCOs) that are linked to specific learning objectives.

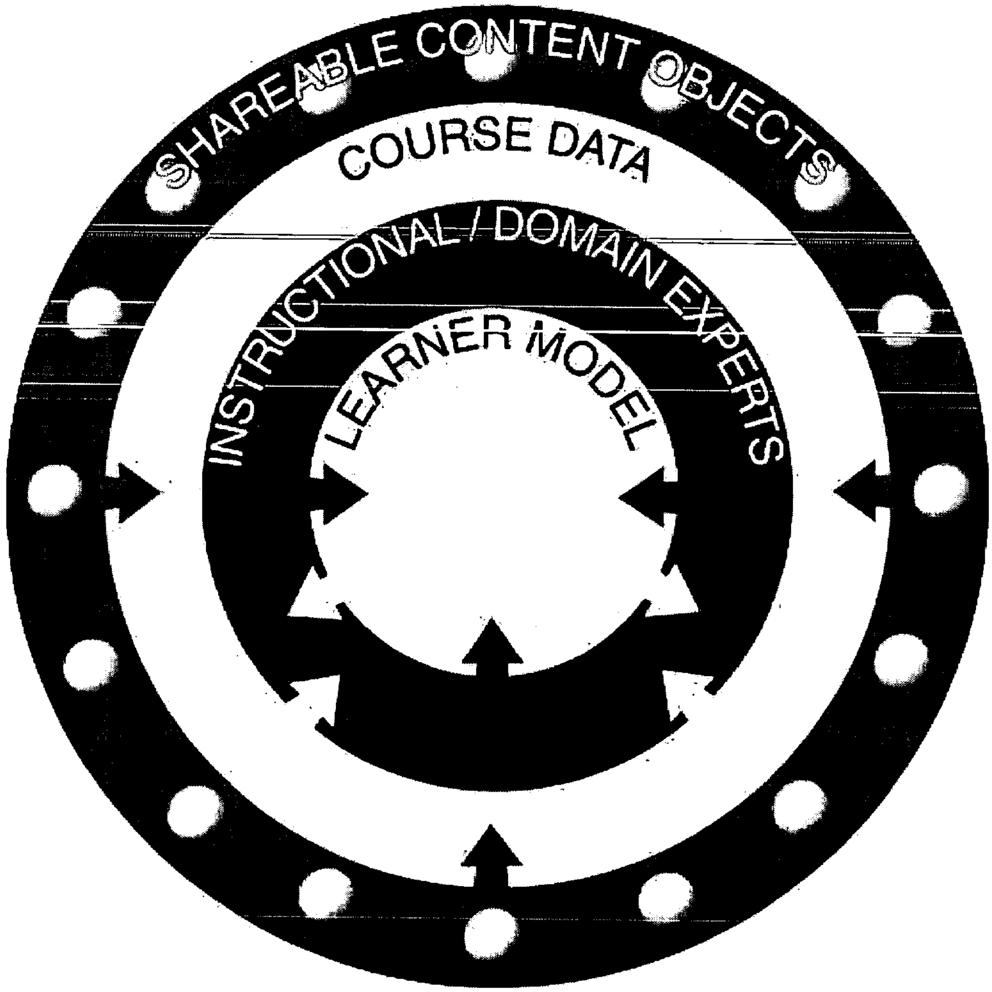

Figure 1. Closed-loop Adaptive Education Approach

The following is a discussion of our approach to implementing the closed-loop paradigm.

Major Components

A closed-loop adaptive education approach is supported by interaction among the following components:

- Learner Model,
- Instructional Engine for adaptive IMI, and
- Instructional Engine for Situated Learning.

In this paper we discuss our approach to implementing each of these components.

Learner Model

An objective-based Learner Model is the cornerstone of the adaptive education approach supporting both adaptive IMI and simulation-based education. The Learner Model represents what a student knows and does not know based on recorded mastery of learning objectives. The Learner Model is student-specific; each student has his/her own Learner Model.

Essentially, an individual's Learner Model is a database comprising:

- Learning objectives for a given student and associated mastery status,
- Learner instructional history (record of IMI instruction),
- Learner feedback history (record of scenario-based coaching), and
- Learner characteristics.

The Learner Model can be updated in real-time for automated education methods or non real-time for semi-automated or manual education methods. In other words, updates to the Learner Model can be accomplished automatically during education by the education system itself or manually by instructors. Manual updates to the Learner Model can be facilitated using automated and semi-automated data collection techniques.

Automated Adaptive Interactive Multimedia Instruction

In an IMI context, adaptive education implies an instructional engine that delivers IMI that is tailored to specific, identified student needs. Here, automated adaptive IMI refers to the capability to automatically create and deliver an "individualized education plan" (*i.e.*, IEP) at run-time, based on the student's mastery of defined learning objectives, available content objects that support those learning objectives, course/instructional definition data, and instructional history. In other words, adaptive IMI is defined as the capability to create an IEP and deliver tailored multimedia instruction based on individual needs reflected in the Learner Model (see, for example, McCarthy, *et al.*, 1998; McCarthy, 1996).

Each learning objective is associated with one or more methods of teaching the content associated with the objective (see Figure 2). The media content plus the data that describes the content (*i.e.*, metadata) and associates it with the learning objective is referred to as a Shareable Content Object (*i.e.*, SCO; Dodds, 2001). SCOs may be grouped as necessary to provide the requisite instruction and practice for a given learning objective. The number of SCO groups per objective represents the number of different ways to teach that objective.

In a similar vein, each learning objective is associated with one or more methods of assessing mastery of the objective. Therefore, assessment SCOs can be created in the same manner as content SCOs.

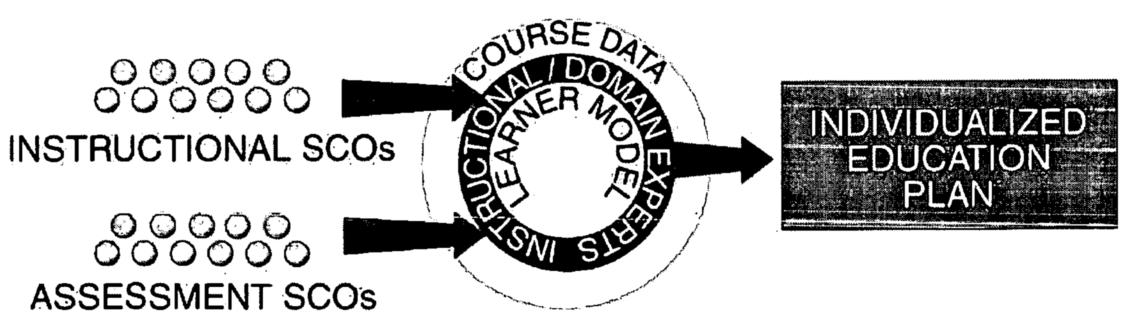

Figure 2. Adaptive IMI Instruction

Using learning objective mastery data, instructional history, and learner characteristics from the individual's Learner Model, as well as information about course goals stored as course data, the instructional engine creates an IEP that utilizes available SCOs. The instructional engine then executes the IEP by providing content, practice, and assessment activities until mastery of the requisite learning objective(s) is attained. The on-going IEP is updated as these activities are presented to the student and he/she responds.

Simulation-Based Adaptive Education

In a simulation-based context, adaptive education implies an "expert instructor" that creates a scenario tailored to specific, identified student needs (based on learning objectives from the Learner Model) and provides coaching that is sensitive to the student's needs and task demands. Automated simulation-based adaptive education refers to the capability to automatically:

- Create a tailored event-based scenario based on the student's mastery of requisite learning objectives (Stretton, *et al.*, 1999; Stretton, *et al.*, 1997a; Stretton, *et al.*, 1997b);
- Monitor and assess student performance during the exercise;
- Provide feedback to the student as required during the exercise;
- Update the Learner Model; and
- Develop an IEP (IMI, simulation-based exercise, *etc.*) to remediate deficiencies and facilitate mastery of those learning objectives yet to be mastered.

Fully automated simulation-based adaptive education for an individual employs an intelligent tutoring approach. This approach uses artificial intelligence (AI) technology to create an instructional system that can sense and adapt to the needs of an individual student. In a simulation-based context, adaptive education implies an "expert tutor" equipped with a wide range of instructional tactics to assess, diagnose, and remediate the student during an exercise. Remediation methods may vary as they are tailored to the student's level of understanding.

The primary components of an intelligent tutoring system (ITS) are:

- Domain Expert - A software module that represents the knowledge of an expert in the subject-matter domain, and assesses the student's performance.
- Learner Model - The Domain Expert updates the Learner Model in real time as the student interacts with the simulation.
- Instructional Expert - The Instructional Expert, based on input from the Learner Model, generates a tailored scenario to support mastery of required learning objectives during the exercise. Then during the scenario, the Instructional Expert takes input from the Learner Model and the Domain Expert, and produces an instructional decision. It is the Instructional Expert that determines whether to intervene in the student's activity, what issue to address if an intervention is warranted, and which type of intervention to employ.
- Learner-Device Interface - The interface is the medium of communication between the student and the ITS. The Learner-Device Interface creates the learning environment by presenting the student with engaging stimulus events and by providing the student with the ability to respond to those events.

A description of how these components interact during a simulation-based education session is presented in Figure 3.

For simulation-based education, the student is placed in a situated learning environment in which scenario events invoke expectations in a Domain Expert. The Domain Expert monitors the student's response to scenario events and assesses whether expectations were met or violated. These assessments are then passed to the Instructional Expert and used to update the Learner Model. The Instructional Expert, using the input from the Domain Expert and information from the Learner Model, determines the appropriate instructional feedback and provides it dynamically (audio, text, pointer, modify scenario, present IMI, *etc.*). This cycle of stimulus event, student action, assessment, and feedback continues throughout the exercise (see, for example, McCarthy *et al.*, 1995; McCarthy *et al.*, 1994).

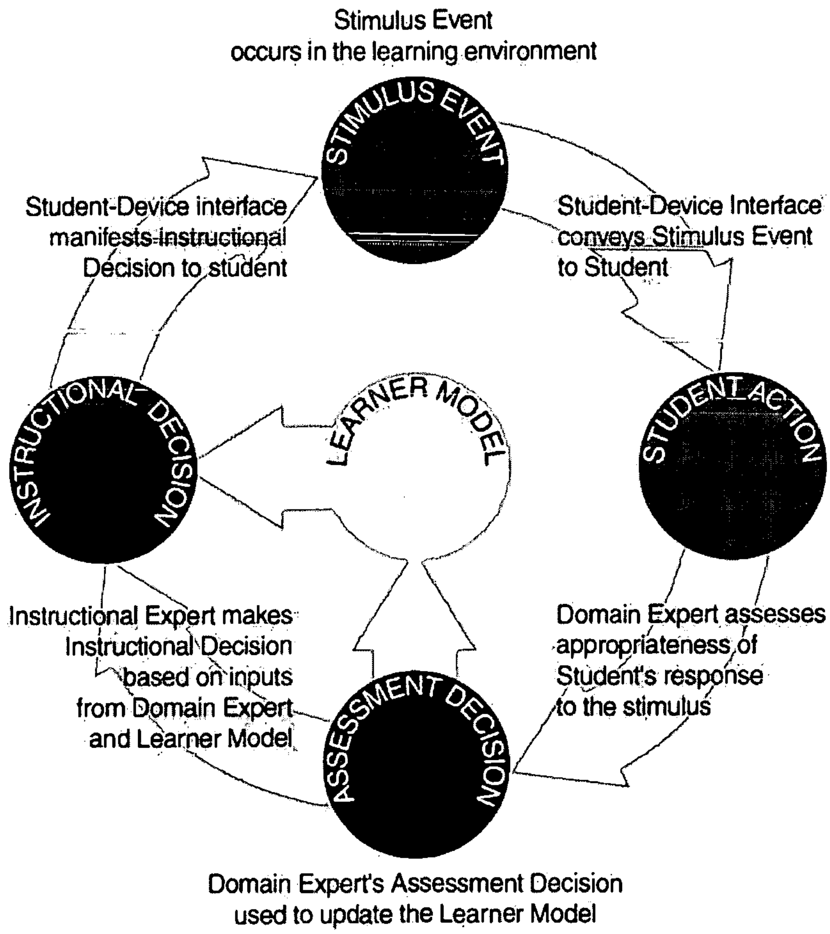

Figure 3. ITS Cycle of Interaction

Closing the Loop

Combining the fully automated IMI- and simulation-based adaptive learning approaches results in a true, automated closed-loop education system that supports individual education (Morris, *et al.*, 2000, McCarthy *et al.*, 2000). For example, suppose that a student has problems with some specific procedure during a simulation-based refresher education assessment exercise conducted on a personal computer. This deficiency would be noted and his/her Learner Model would be updated to reflect lack of mastery for the associated learning objective(s). The Instructional Expert, using the Learner Model as input, would create an IEP that uses IMI to address the particular learning objective(s). The student then works through the IMI until he/she masters the learning objective(s). This mastery can then be confirmed in another simulation-based assessment exercise using a scenario tailored to stimulate demonstration of mastery of the required learning objective(s). This paradigm can be accomplished without human intervention.

Although our discussion has focused on individual education, the power of the closed-loop approach can also be applied to team development. The team setting provides opportunities for assessing different types of learning objectives and supports different types of instructional approaches, but the essential framework remains constant: Mastery of learning objectives (individual/team) is monitored in media- and simulation-based learning environments and leads to the construction and execution of tailored instructional plans.

Varying degrees of automation can be applied to the above model where necessary; however, *the core component remains the Learner Model.* It is the Learner Model that provides the glue for the adaptive education approach by providing the data to the human and/or machine that specifies the degree of mastery for all required knowledge and skill learning objectives for every student.

Conclusion

Closed-loop adaptive education represents an exciting evolution in the realm of interactive learning that has broad applications within the educational community. Students can learn new concepts, practice associated skills, and be assessed on their mastery of the requisite knowledge and skills, all under the supervision of the Domain and Instructional Experts that interact with the integrated Learner Model. Because the Learner Model is endorsed in real-time and contains in-depth information regarding student mastery of required learning objectives and instructional history, the human instructor can target his/her efforts to those students requiring additional help or greater challenges. Closed-loop adaptive education supports initial instruction, refresher instruction, and on-demand instruction with equal ease.

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Online Pedagogy as a Challenge to the Traditional Distance Education Paradigm

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Abstract: This paper briefly discusses the educational context at The University of Southern Queensland (USQ), Australia where many courses are delivered solely online. It provides a comparison between online and traditional distance education and reflects on how online pedagogy challenges traditional distance education pedagogy. The pedagogy of print-based distance learning materials has tended to incorporate instructional design strategies aimed at providing an independent learning experience. Internet technology has created opportunities for interactive and collaborative learning which represent an alternative to traditional, autonomous approaches to the delivery of academic content.

Introduction

In recent years, use of the Internet has developed phenomenally, and worldwide access to communication and information technologies presents educators with opportunities to create learning environments different from those possible with preceding technologies. The Internet provides instant access to a huge range of resources (information and human), with the ability to search across and within web sites and the facility to work collaboratively with colleagues at a distance.

The traditional paradigm of education and training has been based on standardisation, conformity and compliance. Typically, teaching has been conducted by giving large groups of learners the same content in the same amount of time, and for on-campus students, at the same time. Learning is often directed by a trainer or teacher, with learners having little opportunity for self-directed learning or interaction with peers. However, changing expectations reflecting the move to a knowledge society mean that learners are demanding customisation of their education/training and employers are requiring graduates who display initiative, adaptation to diversity and problem solving abilities.

Traditional Australian Distance Education Context

The traditional distance education paradigm, within the Australian context, has been that of the "Birdsville student" - a remote student, an independent learner, with a standalone package of study materials. The independent learner model is similar to what some refer to as "content-learner" interaction (Miller & Miller 1999) with learners having little or no interaction with others. To use the opportunities provided by the Internet, there is an obvious need for the design of learning environments which use the interactive capabilities to the best advantage and are not merely the transformation of print-based material to online delivery.

Online Pedagogy – Design of the Learning Environment

At the USQ, an institution with twenty-five years' experience in the delivery of distance education, online pedagogy is aimed at shifting learners from passive to active learning, from teacher-centred to learner-centred environments and from decontextualised tasks to authentic, meaningful experiences. The online environment creates an opportunity for interactive and collaborative models of learning, including the creation of learning communities involved in interactive activities using electronic discussion areas. It also enhances the independent learner model by providing media-rich resources and the opportunity to self-manage learning in a flexible mode (McDonald & Reushle 2000). Many of these learning strategies have not been available in the traditional print-based delivery of distance education which, for access and equity reasons, has often been designed within the framework of independent learning.

The collaborative learner model acknowledges the importance of the co-construction of knowledge through collective learning and peer exchange, often referred to as a many to many learning experience with less of a focus on instructor contribution.

In educational literature (Bates, 1999; Jonassen, 2000), it is argued that learning within a constructivist environment promotes meaningful learner engagement and critical, creative and complex thinking by learners. This paper has a focus on communication technology, while noting that other technology-based learning/teaching tools such as Jonassen's (2000) 'Mind Tools' also support 'engaged' learning by students. The idea of constructing knowledge using technology, rather than using technology as an information-gathering tool, is an important aspect of online pedagogy. Conversation and collaborative tools (such as online discussion groups) enable communities of learners to negotiate and co-construct meaning for problem solving and knowledge construction. Online discussion groups can provide a permanent record of discourse, a collective memory resource for subsequent reinterpretation. Buckingham-Shum et al. (2001) discusses different learning media and techniques used for closing the gap between distance students and their tutors. However, they note that the Internet is widely acclaimed as a medium to revolutionise distance teaching, but its primary role to date has been the convenient publishing of 'digital paper' plus simple hypertext, and that convincing examples of shared, networked multimedia are still relatively scarce.

Conclusion

Interaction is an integral component of learning, and communication technology has provided opportunities for educators to implement this at a distance. If the "ideal" educational experience is the Oxford style interactive tutorial, is this where instructional design efforts for the online environment should be focused – -
interaction using electron

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Transforming Educational Media through Imperceptible Digital Watermarking Technologies

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Abstract: This paper explores the application and implications of imperceptible digital watermarking technologies in learning environments. Using Digimarc MediaBridge™ software, traditional print educational content is transformed into digital media that challenges the boundaries of text, audio, video, and graphic elements.

Few resources are more prevalent in schools than textbooks; yet, in many cases, textbooks inadequately address the needs of students and teachers. Outdated information is common due to the nature of textbook adoption cycles, and the information often is ill-suited to the curriculum and assessments. It can also be argued that textbook development is driven by market demand and that states with large student populations have the greatest impact on textbook development. Some states, such as Texas, are experimenting with replacing textbooks with laptop computers; however, this does not eliminate the need for quality instructional media. The World Wide Web, with its vast resources, can be burdensome to teachers charged with searching for the most appropriate information and media for their students. Compounding this is the assertion that individuals read from a computer screen approximately 25% more slowly than from a printed page. While this problem could be solved by using 300 dpi screens, the expense of these high-resolution screens makes them an unlikely option at this time (Nielsen, 2000).

Another possible replacement for traditional textbooks is e-books—single-purpose devices that display reading materials in ways similar to traditional books. Two of the most current types of e-books range in price from $200 to $600 and rely on proprietary file formats, making them less attractive (Ditlea, 2000). According to Steve Ditlea (2000) "At some point in the future, however, e-books and print are bound to diverge. Lurking amidst e-publishing today is the notion of multimedia books that seamlessly incorporate hypertext, sound and animation" (p. 78).

In the midst of the growing e-book industry, imperceptible digital watermarking, a technology most often associated with copyright protection (Dugelay & Roche, 2000) offers a viable alternative to the single-purpose devices known as e-books, particularly in learning environments. At the present time, e-books do not appear to be replacing print media but rather supplementing it (Ditlea, 2000), indicating that print-based textbooks are likely to remain dominant in classrooms for some time. The continued use of textbooks is not necessarily undesirable. McKnight, Dillon, and Richardson (1996) state, "We have had nearly 500 years experience of using printed textbooks, and they not only support a wide range of applications, but users also have such a strong mental model of their generic structure and organization that they can successfully adopt an equally wide range of usage strategies" (p. 631). They further suggest that while hypertext can support activities that would be difficult, if not impossible, to accomplish with printed text, we must be sure that these capabilities are used in pursuit of valid learning tasks: "It is not sufficient that we can browse a million pages on our desktop, or link 100 articles together for rapid retrieval at the click of a mouse button: such capabilities are only important in terms of their utility to human learners. Yet there are few signs that most learning scenarios require such support, and little knowledge on how we might best provide it in terms of usability, even if it were required" (p. 631).

There is much to be learned about how to best use the technologies available to us to support teaching and learning. Shneiderman (1998) contends that exploring vast holdings of information has become increasingly difficult as the quantity and diversity of the information has grown. He suggests that while the computer is an effective tool for searching this information, it is far from adequate. He points out that novice users are often impeded by cumbersome user interfaces.

It appears that a logical approach to designing the dominant instructional media for classrooms is to begin with what McKnight, Dillon, and Richardson describe as our most successful information technology—the printed book. We propose to develop a prototype interactive textbook using digital watermarking technology, commercially available from Digimarc. Digimarc MediaBridge™ technology creates an imperceptible digital watermark consisting of XML-based mark-up language embedded in a graphic or other media element. With the aid of an optical reader device, such as a digital camera connected to a computer, Digimarc MediaBridge™ software "reads" the watermark, activates a standard Web browser, and delivers the user to a specified Web site. The Institute is currently exploring digital watermarking as a means to supplement print media with current, up-to-date information delivered via a safer, more efficient Web environment. It is important to note that this interactive textbook is an extension of text information. Any function now possible on the Web, including chat, interaction with experts, data visualization, and virtual reality also is plausible within the context of the interactive book. We are also actively considering potential uses of an imperceptible digital watermarking scheme for various forms of data, including audio, two-dimensional graphics, video, three-dimensional models, animation sequences, and other digital media elements.

We have selected a widely adopted middle school science textbook as a basis for the prototype. Typically static information is presented in a generic textbook format and organizational structure; other information is dynamically linked to the printed page with an imperceptible digital watermark. For example, students exploring the immune system can use information created by content experts such as the National Cancer Institute or the National Institutes of Health. They can view videos to better understand the experience and need for using an iron lung or listen to audio interviews of survivors of major epidemics. Students can visit the Howard Hughes Medical Institute on-line and participate in a virtual lab simulation to better understand the role of antibodies. Students studying AIDS and HIV can use real, up-to-date data provided by the Centers for Disease Control (CDC) or the AIDS Education Global Information System (AEGIS) for their own analysis and study. We intend to transform one chapter of the textbook into an interactive textbook prototype that will demonstrate appropriate and effective uses of electronic media.

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Laptops, Learning Outcomes and Abayas

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Abstract: This paper introduces a case study in its earliest stages that will study the impact of technology infusion throughout coursework and the preservice teachers choice of technology usage for teaching assignments and practica presentations. Zayed University has made a commitment to the infusion of technology throughout university education for all students based upon the limitations described in research regarding stand-alone classes on teaching. Early data suggests frequent student choice to use technology in a variety of ways, but that actual usage may be mediated by physical conditions in the teaching.

Introduction

This case study will inform teacher preparation regarding the effect of an immersion in technology on the selection of technology supported instructional strategies at the classroom level by preservice teachers. The study will follow three cohorts of students through their teacher training program at Zayed University which includes field experience increasing in responsibility over four semesters and a one year internship. The students will complete from four to eight semesters program that includes a significant amount of English language training, technology education, and Arabic and Islamic Studies courses prior to entering the teacher preparation program.

To set the stage—the place has a familiar feeling. The grass is green, flowers bloom on the campus lawn, classrooms are full of students, a students sit on a bench studying, another group is in the library, faces intent, professors bustle about. This is a university campus. All of these students are wearing black abayas which cover them from head to toe, many peer over a veil. They are all young women. Everyone is carrying or attending to a laptop computer, and the green grass is in a courtyard amidst palm trees under a hot desert sun.

This is Zayed University located on the Abu Dhabi campus in the United Arab Emirates, a small oil-rich Arab Gulf state. Designed on an American model with predominantly western teachers and programs and with English as the language of instruction, the university is new. Opened in 1998, ZU is now functioning with approximately 2500 students and 300 staff on both the Dubai and Abu Dhabi campuses and is known locally as the 'Laptop University'. The mission of ZU is "to produce graduates who are masters of the computer, well grounded in the academic disciplines, fully prepared in a professional field and capable of providing leadership in the home, community and nation". Within a strong commitment to provide an outcomes based environment for all students, the six colleges offer majors or specializations to students beginning in their third year of university study: Arts and Sciences, Business Sciences, Communication and Media, Education, Family Sciences and Information Systems. The young women who study in these colleges are viewed as the future of the UAE.

The current educational paradigm of the United Arab Emirates is very traditional and generally described as teacher technicians transmitting the presently limited curriculum provided by the Ministry of Education and Youth. A very teacher-directed lesson format is delivered with no technology supported or experiential opportunities for students in most of the government schools. In partnership with Zayed University, a constructivist theory base for teaching and learning, a focus on learning outcomes rather than teacher input, and the integration of technology as a tool of teachers are the component parts of this joint change endeavor of the College of Education. The change process requires the preparation of new teachers who are problem solvers, inquirers, action researchers and leaders who are able to fuel the new learner-centered approach.

While the present state of technology in government schools is weak, the technological support of the future is considered to be much brighter. The graduates of ZU are all computer fluent in technology-enhanced instructional practices. Preservice teachers interact with professors via interactive reflective journals that are web-based, they prepare electronic professional portfolios that showcase the instructional products the student has learned to develop, they access their grades via the Internet, participate in courses supported by Blackboard.com, and they demonstrate their achievement of outcomes required for graduation from the influencing change in the schools is an important component of each course.

Method

Students in the study will belong to three cohorts of students with each cohort starting the teacher education program successively. Each cohort contains approximately 15 students who are all Emirati national women who have been educated during the early years of compulsory education and who have high grades culminating in a secondary school diploma. Each woman has completed general education requirements (although varied between the three cohorts) and maintain a 2.5 grade point average on a 4 point scale. Cohort 1 students entered the university in 1998 and began the teacher preparation program during fall semester 2000. Cohort 2 students entered the university in 1998 and 1999 and began the teacher preparation program during spring semester 2001. Cohort 3 students entered the university in 1999 and will begin the teacher preparation program during fall semester 2001.

Students choice of technology, manner in which it is used, reasons for selection/nonselection will be gathered through faculty evaluation of projects, micro-teaching, and practica teaching. Reasons for use and non-use will be gathered from student interviews about their choice of instructional tools in their projects.

Preliminary Findings

Observations and review of student selection of technology for instructional purposes began Fall Semester 2000. Following are some of the preliminary findings that suggests, but is as of yet inconclusive, that technology is selected more frequently by students immersed in an environment of technology than those who have had stand-alone course with the promise of later application.

Limited generalizations from early data are:

Students (n=15) working in a more student-centered environment of a private American format school, have been observed to use computers and projectors to display pictures of base-10 blocks in various configurations to teach about place value, and by a second student to provide primary source material while teaching a lesson on an Islamic principle.

However, students use of technology for instructional support has been mediated by the environment of the classrooms where they teach. Classrooms that are not able to be darkened required some problem-solving as to backgrounds and text color. At present, students in this environment seem to be selecting technology support for teaching less often. New lessons have not been taught since the problem-solving session has taken place

Students observing and teaching in the traditional teacher-directed government schools (n-13) emulate these methodologies in presenting micro-teaching assignments and in planning lessons for the mentor classroom. Students to date do not regard the modeling of more student-centered strategies or use of technology supported instruction that they observe their professors using as choices while they are in these placements. The students of Cohort 1 who had this assignment have moved to more student centered approaches this semester.

However, these students use technology to show pictures of interactions between students and use of technology to facilitate transmission of content knowledge through such things as diagrams of water movement through the stems/leaves of plants, the water cycle, diagram of nuclear power plant to support an activity the preservice teacher leads during a micro-teaching lesson on the university campus. A number of the students developed fill in the blank worksheets that were projected onto a whiteboard so that students could work collectively on completing the sentences by writing the required vocabulary words onto the board. One aspiring computer teacher used her computer to demonstrate how to use a component of an application while directing her students to use their own computers to open and use the application to accomplish a product to be submitted at the end of the lesson.

This paper describes a study in progress and data collected to date is highly inconclusive, but suggests potential patterns of interest. The authors appreciate all feedback given and ideas that emerge from collaborative dialogue. While initial student interviews regarding decisions to use technology for various components of the teaching enterprise have not yet been conducted, it is believed that these will inform the project.

Learning with cyberfriends: The development of professional reflection-on-action skills through online partnerships

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Abstract: One the crises facing the professions is the scepticism surrounding the nature of professional knowledge and whether individuals can cope with the increased complexity of society and the changing demands of the workplace. Tertiary institutions have now strengthened their links with industry and have produced lists of attributes and communication skills they aim to cultivate in graduates. In order to develop these skills students need to be able to reflect on their learning experiences, integrate them with prior knowledge, self-evaluate and develop their own decision-making and planning processes. Online technologies can be used to support the process skills underpinning reflection-on-action (*reflexivity).* The development of reflexivity is presented in the context of an online tertiary unit where students proceed through the cycle of action, reflection, planning and abstract conceptualisation by engaging in a range of communication skills including peer assessment and problem solving. The study shows how online tasks can support reflexivity.

Introduction

Information and communication technologies have the capacity to support a wide range of learning goals and are now integrated into teaching approaches of many higher educational institutions. Laurillard (1993) for instance suggests that computer-based learning has a major role in promoting quality learning outcomes such as:

- self-directed learning and increased student autonomy;
- keeping the educational system in line with technological development;
- increased information literacy, ensuring that graduate skills are in tune with those of employers; and
- increased productivity and efficiency in higher education.

Through computer facilitated learning, students can access WWW sites, bulletin boards and on-line resources to support their own learning and consequently promote the development of generic research skills, information literacy, retrieval and management of data. However, many students find their experience in tertiary institutions too general or out of context, and cannot transfer these skills into realworld contexts, or link them with prior knowledge (Taylor, 1997). The use of information technology within a structured environment can offer learners contextualised support within which to anchor their learning and reflective skills.

Development of reflective skills in higher education

One of the characteristics of being considered professional is having the capacity for self-direction and being able to apply practical strategies and skills in contexts that require them. Professionals have a body of expertise that is developed through experience within community of practice and lifelong learning skills. Boud and Keogh (1985) suggest that the capacity for self-directed learning includes elements of independence, dependence and interdependence and propose that these form a continuum whereby the learner progresses from dependence, to independence and then to interdependence (Figure 1). Each of these stages requires learners who are able to reflect on and assess their own skills and capacities.

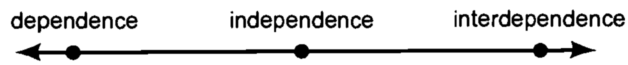

Figure 1: Continuum showing progress from dependent to interdependent learning

It is widely accepted that graduates should not only be technically competent but they should also be skilled in communication and teamwork, have social and global awareness, be self-directed and be prepared for life-long learning. However it is much less clear how these "soft skills" are best developed in undergraduate students in the context of their studies. One recommendation is that pedagogy needs to change from transmissive, didactic approaches towards transformative, student centred approaches. In the present study, this has been achieved in the context of a project-based unit of study, involving both individual and group work, located within a Web-based learning environment.

Theoretical framework: experiential learning and reflective processes

According to several theorists, authentic learning occurs only through reflecting upon personal experiences (Dewey, 1993, Schön,1990). Reflection is often defined as a process that enables connections between the various elements of an experience, and Dewey refers to reflection on experience as a learning loop that 'runs back and forth' between the experience and the relationships being inferred. The concept of the learning loop has gained popularity through the work of Kolb (1984) and his four stage experiential learning model in which learners move through a series of phases involving experience, reflection, generalising/theorising and planning. Therefore, the ideal experiential learner will be able to:

- involve themselves in new experiences without bias
- reflect upon experiences from multiple perspectives
- integrate their observations into logically sound theories, and
- use these theories in decision making and problem solving.

This kind of practice is being promoted by new accreditation processes for graduate engineers in Australia (Jolley, & Radcliffe, 2000) and has the potential to deliver on many of the recommendations about graduate attributes now recommended by Australian Universities (McLoughlin & Luca, 2000).

The terms reflection and reflexivity need to be clarified at this point. *Reflection* has a focus on phenomena more divorced from the practitioner, whereas *reflexivity* is reflection based on personal experiences of learning, which fundamentally changes the relationship between the learners and the learning process. To illustrate this point Argyris (1988) distinguishes between single-loop learning and double-loop learning. Single loop learning occurs when the learner detects an error and corrects this without questioning or altering his/her learning approach. Double loop learning occurs when errors are corrected by examining and altering the learning processes and the actions surrounding learning in general. The distinction is important as reflection merely changes the outcomes of learning, while reflexivity changes the person and the process. Schön (1995) also makes a similar point by distinguishing between *reflection-in-action* and *reflection-on-action*. Refection-in-action is tacit and is designed to improve action and performance. Reflection-on-action (reflexivity) is a higher order skill designed to improving self and future practice. These processes can be supported and fostered in Web-based learning environments.

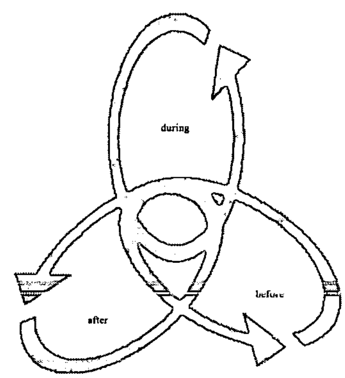

Figure 2: Reflection before, during and after experience

Design of the learning environment: using technology to support reflection

The connectivity and communicative possibilities offered by online technology make possible a range of cognitive and metacognitive processes including the capacity to reflect, both individually and as a group. Reflective dialogue using computer-mediated communication is enabled when learners engage in collaborative tasks (McLoughlin & Oliver, 1998). Revision, reconstruction and rethinking of ideas occurs when tasks enable students to exchange ideas, comment on each others' work and engage in critical self-assessment (Seale & Cann, 2000). In other studies, both individual and group reflection are fostered when gaps and contradictions in knowledge are identified and by using technology to support self-explanation and articulation of ideas. In this case, the emphasis is usually on immediate reflection rather than reflexivity, which is the higher order cognitive process. In the study reported here, online debate and problem solving were regarded as the primary mechanisms to support both individual and collaborative reflexivity. The combination of problem solving tasks with collaborative social discourse were investigated as triggers of metacognitive thinking in the learners who participated in the study.

Context of the study

The context of the study was tertiary level online unit in project management that is part of a degree program in Communications and Multimedia. The unit of study on project management is currently delivered on-line using WebCT software, and is available on-campus and in the distance mode of study. Project management skills such as needs analysis, design specifications, storyboards, concept maps, evaluation, legal issues, quality auditing, and scheduling are developed and applied in the creation of a Web site by "project teams", or small groups of students who work collaboratively as they would in an industry context. The objective of the team project is to promote team and client collaboration skills by focussing on a common task. Learning and assessment processes are integrated throughout the duration of the one semester unit. The assessment consists of project team-based work, team problem solving, peer assessment, individual reflective reports, a client mark and individual postings to a weekly online forum.

Assessment in the online unit is based on authentic tasks planned for their relevance to workplace settings. Students worked in teams to create a product that is offered to clients (peers) for evaluation, and tested for functionality in a real context. Working online enabled students to provide multiple forms of peer support though shared tasks, teamwork, collaborative work, and opportunities for feedback and peer review. These supportive processes developed communication skills while creating an affective climate of support for thinking skills, discussion, negotiation and reflective processes.

Theoretical framework: experiential learning

Through the design of problem solving tasks, the project management unit introduced learners to situations and ways of working with others that were experientially based. The processes of learning were emphasised from the outset and students were encouraged to have ownership of the learning, assessment and reflection processes. For Kolb (1984), the actual experiences people go through become the starting points for learning, and this underlying educational approach was reflected in the design of the online environment. Emotion and reflection are also an integral part of the cycle of learning, and reflective processes are intrinsic to learning from experience. In an experiential learning cycle, the learner passes though each of four stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Our design ensured that we linked the experiential learning cycle to the online environment and the collaborative tools afforded by the technology as follows:

- *Active experimentation:* Students engaged in the discussion and resolution of problems through online discussion using multimedia tools to support the display of responses (eg., Cox, 1994).
- *Task engagement*: Peers analysed the output of the task, and compared problem-solving approaches through discussion, email and conferencing activity (Bonk & Cummings, 1998).
- *Reflection:* Individuals analysed and reflected on the learning tasks, group processes and self-development as they tested new ideas and perspectives in virtual learning groups (English & Yazdani, 1999).
- *Formation of an abstract concepts:* Utilising peer and tutor feedback, students developed understandings of key course concepts through engagement with new ideas supported via communications networks (Collis, 1998).

Process and Content

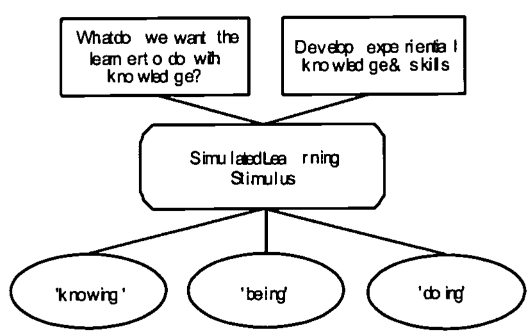

Figure 3: Course pedagogy

Experiential learning was reinforced in various ways through the course pedagogy, which focussed on both process and content aspects of learning. (See figure 3). Students participated in decision-making processes by choosing and defining a topic for their project, creating and managing their own development team and negotiating peer assessment. The design was based on pedagogical and curriculum philosophies that acknowledge group work, peer feedback and support as essential to the development of independent learners and practitioners (Candy, 1994; Boud, 1985). Reciprocity in giving and receiving peer feedback provides learners with opportunities to deepen their interpersonal skills. Through these processes they also developed reflective skills, and learnt to monitor their own learning and appreciate the contribution of others to their learning. Thus, by focussing on learning process and peer supported activities, the learning tasks took on a broader perspective, to include the totality of the learning experience while consolidating those aspects of professional learning that would enable the learners to develop transferable skills.

Student reflections on problem solving strategies

The student participants formed four teams who engaged in problem solving, giving feedback on each others' solutions and peer assessment processes. These students completed authentic problems, where they were required to implement these skills in a 'real' environment, with 'real' clients and produce -'real' product. This work place component is designed in order to engage students in a range of experiential learning tasks in which they give feedback on each others' performance in groups and reflect on their own and others' performance. In the first task students were asked to reflect on the problem-solving processes they had engaged in while solving problems and then asked to articulate these during class discussions. This enabled the students to reflect on their own strategies, to identify areas of weaknesses and to conceptualise ways of addressing those weaknesses. Students were asked to write down the major strategies used when solving problems. As shown in Table 2, the salient features of student problem solving strategies were:

- researching the topic thoroughly;
- reading the question carefully and considering different angles;
- checking that the content used is correct;
- comparing ideas with other students; and
- brainstorming to consider different views and ways of approaching the problem.

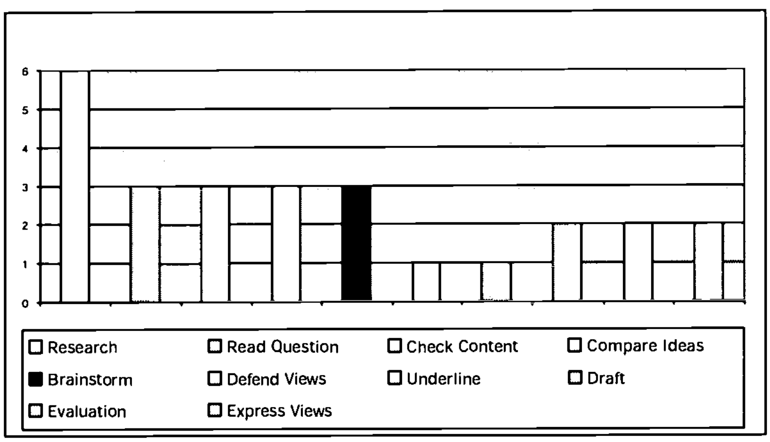

Table 2: Summary of student responses to problem solving tasks

While these processes represent some of the major elements of expert problem solving strategies (Lipman, 1991; Paul, 1994), they nevertheless do not include all of the possible expert problem solving strategies such as planning, testing possible solutions, revising and checking details.

Student perceptions of peer feedback as support for learning

Students were encouraged to articulate the changes they would make to their solutions in the light of feedback from peers, and to use this feedback to improve their own learning and problem solving. This form of reflective practice is part of experiential learning and supported by the work of Mezirow (1990) who emphasises the role of critical reflection in self-directed learning. On-line learning can support critical self-reflection and peer reflection by providing access to others' work, but the actual reflective process needs to be facilitated by a tutor. Comments made by learners on how they would improve their problem solving strategies included the following:

- *Do more research;*
- *Plan my time;*
- *Read the questions and predict what the solution might be;*

- *Develop my solution further with examples; and*
- Add specific details on various points and provide examples of these.

In addition, students were asked to document and explain the impact of peer feedback on their own learning approaches. They found this task unusual, and had not previously considered that other student views would influence their own ways of thinking and problem solving. The responses demonstrate that students did in fact adopt a deep approach to learning and that the peer support promoted reflection and further dialogue. Table 3 provides examples of comments made and links these comments to implicit learning processes. The learning processes identified in Table 3 are indicators that student learning was enhanced by peer support and feedback and that participants raised their awareness of other's perspectives and became more aware of their own strategies.

Table 3: Reflections on individual conceptual growth

Student comment	Learning process
I learn to see things from a different angle	Conceptual change
I found it helpful to see what others had said and how they had different views	Consideration of multiple perspectives
Critical feedback helps me develop my solutions and see my poor points	Self evaluation
I learnt that there were many aspects that I might have considered by brainstorming	Strategic learning
You learn how people's positions can vary greatly and you have to be open	Openness and a sense of inquiry
Being able to see and hear others' feedback is good for my learning and brings up points that I had not considered	Acting on feedback

The tasks that fostered reflective practice were built into the learning environment and also integrated with the assessment tasks that students were required to complete. Each assignment required students to record their reflections on self, task and others. Table 4 shows the summary of typical responses from individuals.

Table 4: Summary of reflection on self, task and others

Self	Task	Peer collaboration
Increased knowledge breadth	Capacity to anlsyse problems	Changed relationships with colleagues
Development of evaluation skills	Improved planning processes	Evaluating claims
Improved group communication skills	Increased ability to heck & monitor progress	Dealing with power relations
Enhanced relationships with colleagues	Enhanced skills in gathering data	Improving participation and negotiation skills
Expansion of personal vision	Increased awareness of whether task goals had been achieved	Becoming more attuned o the needs of others

Conclusions

It could be argued that the best way to make expert knowledge accessible to non-experts is to foster the use of reflective activities on successes and failures. This was achieved in the online environment by enabling group and individual reflection through both online and offline activities. In the study reported here, this combination proved to be very productive, where reflection was systematically built into the environment through both task design and assessment. The learning activities helped students develop responsibility for their own learning, and gave them the scope to develop personally and professionally. The technological support afforded by online communication tools and asynchronous conferencing were integral to the development of the course.

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Investigating processes of social knowledge construction in online environments

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Abstract: On-line forums provide opportunity and potential for collaborative work, dialogue and study that can increase the flexibility of learning while motivating participants. By enabling teacher-learner and learner-learner interaction online systems can support the essential elements of a learning conversation by providing scope for discussion, dialogue and interaction. It is argued that this medium presents a socio-cognitive educational domain, unique in its potential for dialogue, participation and collaboration and a departure from face-to-face didactic paradigms of learning. Often, the types of verbal interactions and the means by which new knowledge is created on-line are not well understood. The paper provides frameworks for tertiary teachers and moderators of computer conferences that can be applied to the analysis of processes and activities that occur in text-based conferencing.

Learning on-line: Social aspects of knowledge construction

Theories of social learning emphasise that learning involves social processes and the use of tools. There is much common ground between sociocultural theory (Vygotsky), situated learning theory and cognitive apprenticeship theories (Brown, Collins & Duguid, 1989). All theories emphasise that use of tools, both tangible and intangible including language and technologies shape thought and action. Research on computer conferencing has been positive about its potential and outcomes, promoting its advantages and merits as a form of socio-cognitive experience. However, it may be best to adopt a more skeptical and critical view and to question whether the advantages of computer conferencing may be exaggerated. While online forums claim to enrich student learning and collaboration, many researchers have dedicated their effort to ascertaining whether in fact text-based interaction leads to learning outcomes (Hammond, 1999;.McConnell & Banck, 1998; Hara, Bonk & Angeli, 2000; McKinnon & Aylward, 2000). Recently, online forums have been lauded because of their capacity to sustain collaborative learning by enabling sharing of views, resources and ideas through peer support. It is claimed that the social, interpersonal and interactive features of online forums are most supportive of collaborative dialogue, as they reduce isolation and increase group participation in learning.

From the perspective of assessing student learning, it is important to establish how knowledge construction is achieved within a computer conference, and how text-based interaction achieves learning outcomes. By conducting an analysis of the dynamics of on-line forum discussion, it is possible to understand the depth of inquiry, the quality of dialogue and outcomes of interactions and to build on these aspects in order to improve the design of conferencing activity.

Context of the study

The final year students in the Interactive Multimedia course at Edith Cowan University are required to develop skills and expertise in project management. A unit of study on project management is delivered on-line using WebCT software, and is available on-campus and in the distance mode of study. Students learn about project management methods (such as needs analysis, design specifications, storyboards, concept maps, evaluation, legal issues, quality auditing, scheduling and costing) and put them to practice by creating a web site in project teams. The objective of the team project is to promote team and client collaboration skills by focussing on a common task.

Students are continuously assessed throughout the duration of the one semester unit. The assessment consists of project team-based work, task-team work, peer assessment, individual reflective reports, a client mark and individual postings to a weekly forum. Participation in the conferencing task is continuously assessed throughout the semester. The task team assessment requires the team to publish a short summary paper on the bulletin boards at the beginning of the week on an aspect of project management such as team dynamics, legal issues, scheduling etc. and to raise issues for discussion. The task team is also responsible for moderating the discussion during the week and then providing a synopsis at the end of the week. Usually students assume roles within the forum so that each team member participates in a task such as production of a short outline/issues paper discussion moderation or synopsis and summary.

Students are assessed on bulletin board contributions which account for 30% of their total mark. Participation in the forum is compulsory. There is little intervention by tutors in the discussion forum except to provide explanations and procedural information when required. Students are left to develop a discussion which is relevant to the assigned topic and the forum is therefore truly "student centred". The structure of the weekly contributions and roles of team members do not vary, and each week there is a forum leader, questioner and summariser of information.

Investigative Questions

The focus of the research was to evaluate the educational potential of the forum by investigating the quality of interactions that occurred. Specifically, the aim was to investigate:

- the nature of the text-based interactions and whether the contributions were educationally valid and led to
- knowledge-construction processes or merely social interchanges;
- the nature of group information processing and group dynamics
- whether students regarded the discussion forum as a serious learning tool.

The primary objective of the research was therefore to analyse the value of the discussion forum for knowledge construction, to refine the assessment instrument used by tutors, and to assess the activities planned for the forum. A further goal was to go beyond the superficial counting of utterances and quantitative analysis of messages to a deeper understanding of communication and learning processes on-line. The need for more research in this area is becoming more urgent as off-campus modes of delivery utilise computer conferencing and several Web-based course support systems provide functionalities that enable discussion between learners. Up to now the adoption of computer conferencing has flourished despite the paucity of research and theory on which to base its contribution to knowledge development in learners.

Linking on-line discussion to learning

The on-line forum developed for Project Management is an asynchronous learning environment in which group collaboration takes place through the mediation of technology. The participants in the on-line forum in the first semester 1999 could be regarded as a community of adult learners. Some learners had extensive practical experience in project management for interactive multimedia. Others were relative novices. The aim of the forum was to provide a constructivist learning environment where participants could share knowledge, discuss ideas and contribute to each other's understandings of important issues in the management of multimedia development.

In reviewing literature relevant to this unique community of on-line learners, a socio-constructivist perspective seemed most appropriate. The socio-cultural approach to learning requires close examination of the contexts in which the learning occurs, and is illustrated in the work of a number of practitioners and researchers (Aviv & Gola, 1997: Bonk & Sugar, 1998;Gunawardena, Lowe & Anderson, 1997; Laurillard 1995). A social-constructivist approach to learning is also reflected in the words of Säljö (1994: 91) who states that ' .. it is important to consider seriously the role of communication and interaction for learning, and to employ analytical perspectives in which the natural habitat for individual action is shared human activity'. Analytic approaches consistent with this focus on communication and interaction are linked to socio-cultural theory.

Approaches to the analysis of on-line talk

Recently, there have been several attempts made to provide an analysis of 'cybertalk', though examination of the transcripts of text-based discussions (Eastmond, 1995; Gudzial, 1998; Jarvela et al, 1999; Salmon, 2000). At the same time there is well-documented evidence of strongly opposing views as to how talk should be treated as evidence of learning and of thought (Edwards & Westgate, 1994). Among the approaches to talk-analysis which have contributed to our understanding of classrooms there are several: sociolinguistic, ethnographic, conversation analysis, systematic observation, and interaction analysis, each with a distinctive array of analytic procedures and conventions for setting out transcripts of data, drawing inferences and analysing cognitive processes.

Originating with Flanders (1970), interaction analysis describes and categorises various forms of instructional practice that take place between teachers and students where there is a teaching-learning speech transaction. Such categories tend to be prescriptive and narrowly defined, reflecting static rather than dynamic patterns of interaction. All categories are *a priori*, and assigned to the talk by observers who systematically record occurrences. As the categories are predetermined, this seriously restricts observation of behaviours, as only those categories defined in the observation schedule are recorded. Other studies have used variations of the coding process. A recent study of peer interaction during collaborative writing with computers (Kumpulainen, 1996) used a system of analysis which classified linguistic utterances according to the functions displayed. In a study of the development of scientific reasoning, Azmitia & Montgomery (1993) used a coding scheme to quantify features of scientific reasoning which included justifying solutions, evaluating, clarifying, questioning and explaining. This research, like that of Nastasi & Clements (1992) was based on the Piagetian concept of cognitive conflict, which related success in problem solving to the degree of conflict or verbal disagreement that arises among peers. The data analysis procedures were nevertheless of interest to the present study as they highlighted the role that dialogue and transaction played in supporting reasoning and testing of ideas which are outcomes expected of tertiary students. A related approach to data analysis is content analysis (Henri, 1992), which highlights critical dimensions of the learning process and conducts an analysis on a multilevel basis, assigning behaviours to different features of the learning process. Henri developed a content analysis model based on four dimensions, relating to the educational quality of messages. Four dimensions were proposed for transactions:social, interactive, metacognitive, cognitive. A further dimension relating to the analysis was A quantitative dimension, to reflect the total number of messages posted by one person, as an indicator of the level of participation. Henri's method of analysis has been elaborated and transformed by Gunawardena, Lowe and Anderson, (1997) who propose a social constructivist approach to knowledge building in on-line environments. Their analytic model proposes that knowledge construction moves though five phases (I) sharing ideas (2) discovering different perspectives (3) Co-construction of knowledge (4) Testing and revision of ideas (5) metacognitive awareness of newly constructed knowledge.

Methodology

The study used a combination of research instruments and approaches. The researchers conducted a transcript analysis using the text-based interactions of the weekly forum and created a survey instrument which elicited students' views. This approach enabled triangulation of data sources and provided multifaceted analytic tools with which to analyse the dynamics and processes of on-line discussion.

Survey

The survey instrument consisted of two sections each with a number of Likert scale questions. Part one focussed on the knowledge creation aspects of the forum (Table 2) and asked students to rate the value of the forum in terms of its relevance, opportunities for collaboration, reflection, discussion, exposure to new ideas and understanding. Part two of the survey asked students whether the forum supported group work, collaboration, feedback and collective goals.

Table 2: Summary of survey instrument dimensions

Knowledge building questions	Group work questions
• Topics discussed were relevant	• The forum assists group work skills
• There were opportunities to deal with original topics	• There is commitment to group discussion
• WE can develop novel views and ideas	• There is a need for the forum
• There is opportunity to consider many perspectives	• There is scope for in depth discussion
• The forum fosters reflection	• The forum supports sharing of ideas
• There is opportunity for integration of new knowledge	• The forum gives opportunities for team work
• The forum increases my understanding	• The group acknowledges contributions

Transcript analysis

The analysis of the forum transcripts consisted of a number of procedures. In the first stage of analysis, the overall pattern of talk was reconstructed by means of a concept map showing the flow of interactions, and the number of postings that each thread attracted from students. This visual approach enabled the researchers to make sense of the data. The second stage of analysis involved assigning each message to one of the phases of the model. Discrepancies were discussed and an agreement on coding was concluded from these discussions.

Table 4: Summary of content of the messages in weeks 4, 5 and 6

Categories for data analysis	week 4 *n=94	week 5 n=97	week 6 n=56
Phase 1: Sharing & Comparing • statements of observation, examples and descriptions	**68**	**63**	**37**
Phase 2: Discovery and exploration of difference • Questions, clarifying statements, identifying different views	18	22	12
Phase 3: Negotiation of meaning and co-construction of knowledge • Negotiation, identification of common ground, joint meaning making, statements of compromise	6	9	5
Phase 4: Testing and revision of ideas • Testing of ideas, hypotheses etc against personal knowledge	3	3	2
Phase 5: Awareness of newly constructed knowledge • Metacognitive statements, reflection, summarisation of agreement	0	0	1

*n= number of statements in this category

Results

Because of the amount and complexity of data in each of the weekly discussions, it was decided to investigate only a portion of the whole corpus and to analyse three consecutive weeks of the forum discussions. Weeks 3, 4 and 5 were selected for content analysis, and the researchers assigned each message in one of five categories. Table 4 shows the total number of messages posted for each of these weeks and the number of messages in each phase.

The results indicate that most of the forum messages were in the first category of *comparing* and *sharing information*. These interactions were forms of social interchange between group participants. There was little evidence of construction of new knowledge, critical analysis of ideas or instances of negotiation. Instead, it could be concluded that the majority of on-line interactions were related to the elaboration of existing beliefs and knowledge (Table 4). This exchange of information consolidated participants' existing knowledge schemata and therefore performed an important aspect of the learning experience. However, while this kind of activity added little to the knowledge base, it nevertheless offered a forum for display of existing knowledge. The forum did not appear to foster testing and revision of ideas and negotiation of meaning. Table 4 shows that only 1%-3% of contributions could be categorised as knowledge testing and awareness of knowledge building.

Student perceptions of the discussion forum

The responses to the survey instrument were tabulated and displayed using descriptive statistics. The survey instrument provided insight into learners' perceptions of the knowledge construction opportunities and group work processes. The survey instrument was designed to determine learner perceptions of the conferencing experience, and to explore student attitudes to the dimensions of knowledge building and support for group work in the forum. The results of the questionnaire were every positive, showing that students found the discussions relevant, engaging, a source of new ideas and capable of increasing understanding. However, the quality of the on-line interactions showed that the majority of exchanges did not contribute to new understandings or to revision, challenging of ideas and reflection. With respect to group work, students perceived the forum as affording opportunities for group discussion, clarifying ideas, team work and group feedback . The open-ended questions showed that students considered the process very time-consuming, but appreciated its capacity as a communication tool.

Discussion

The analysis of data gathered from the transcripts showed that participants engaged in display of knowledge, comparison of ideas and elaboration of personal knowledge. The processes underlying these exchanges were social and participatory, and did not involve learners in conflict, challenging or revision of ideas. According to constructivist theory, knowledge building involves learners in negotiation of meaning, reasoning and reflection on authentic tasks and engagement in conversation where knowledge is revised (Luarillard, 1995). These processes were not evident in the dialogue, although student perceptions of the discussion forum showed that they were positive and committed to group processes. The forum was supportive of group dialogue, social cohesion and sharing of ideas, and for many learners these aspects of on-line dialogue consolidated their understanding and were regarded positively. The fact that this pattern of interaction characterised the discussion forum for the entire duration of the course may have conditioned participants to engage in surface level processing and display of knowledge. The dominant social transactions and protocols that occurred can be classified as communication, negotiation and consolidation. This findings concur with those of Jehng, (1997), who emphasises that psycho-social messages tend to dominate in online forums and that virtual groups tend towards social and collaborative interactions.

Implications for practice

The study provides evidence that if forum discussions are to become knowledge construction events, we need to provide orientation and support to learners to help them engage in critical analysis of their own views and revision of concepts in the light of multiple viewpoints and disconfirming evidence. This can be achieved by the tutor modeling the kinds of processes that aim at inquiry into concepts, rather than display and comparison of existing ideas. It would also require students to learn how to articulate their current understandings and misconceptions. However, this process is constrained by the need to socially edit one's contribution in order to appear 'correct' and to maintain the illusion of being knowledgeable. Affective concerns in relation to computer conferencing should also be considered, as social constraints operate to constrain open inquiry and construction of new ideas, particularity if all contributions are being assessed. Group moderation, task design and the scaffolding of dialogue towards refining, defending and elaborating ideas is essential if participants are to move beyond display of ideas.

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Computer supported problem-solving: Enhancing thinking skills in science

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Abstract: *In this paper we bring together two different strands of research and apply them in the development of a technology-based metacognitive support tutorial. The first strand of research relates to the finding that effective problem-solving can be fostered by enabling students to apply metacognitive strategies when solving tasks. The second finding is that metacognition is best developed through process-based approaches in which structured forms of social interaction and learning are implemented. We describe a web-based tutorial being developed at the University of New England that is based on these two findings, and which helps to develop the metacognitive skills of first year science students. The tutorial is designed for students in Biophysics, Biology and Chemistry, studying both internally and externally. Metacognitive skills are fostered in the tutorial by developing learners' awareness of the problem-solving approaches of their peers and experts, by offering modeling and coaching in problem-solving strategies and by employing pedagogies that enable learners to monitor and self correct their own problem-solving approaches and become more reflective learners.*

Introduction

In this paper we discuss a project that is directed towards the effective development of metacognitive skills among first year science students. We do this in the light of current findings on the lack of well-developed metacognitive skills in learners and also by drawing on our own experience of teaching in a regional university catering to both internal and external students.

The changing profile of students currently entering universities in Australia is creating pressure for change in teaching approaches. Current student intakes include students from diverse backgrounds with a significant proportion arriving without a strong background in science. This requires university teachers to support learning in what is for many first year students a new area of learning. Diversity in learning backgrounds also characterises the student body. Many external students have been away from study for a number of years and may not have the learning skills required for tertiary study. Moreover they may feel a sense of isolation in not being able to work co-operatively or see the quality of their own work in relation to others enrolled in their units. It clearly is important to generate positive feelings of success in study by integrating appropriate learning skills in the teaching of science. Separate study skills programs can lead to short term improvement in some learning strategies, but are less successful in the longer term. "Students do not always apply strategies they have learnt to other contexts, because they are unaware that they are relevant to the task. It may be that even when they recognize that a particular strategy is relevant, they do not know how to apply it" (Chalmers & Fuller 1996). In our experience many students do not see the relevance of general study skills programs as they cannot apply them directly to what is being taught, and often and their first priority is to complete the next assignment. Recent studies on constructivist learning in science have in common a movement away from teacher driven paradigms of learning, a greater emphasis on understanding how students approach their own learning and the use of constructivist, small group techniques to foster higher level cognitive goals.

Harnessing technology to support thinking processes

As information and communications technologies for both on-campus and distance education students are developed, progress is being made in using this technology to teach science at the university level in exciting new ways. For instance, in chemistry, innovative, interactive visualisation programs give students vastly improved opportunities to understand processes occurring at the molecular level (Kozma, Chin et al, 2000). In many science subjects simulations of processes and experiments allow students to explore concepts in new ways, enabling them to become self directed learners. For example the Cognition and Technology Group at Vanderbilt (CTG, 1992) has developed and evaluated multimedia based instruction that is designed to help students to think, reason and solve problems.

Networked learning environments enabling student-student and student-lecturer communications are now open, flexible and more democratic through the use of email, bulletin boards and chat rooms, while students enjoy the autonomy of gaining access to expertise worldwide through Internet resources. However, structured learning environments that support specific skills relevant to problem-solving in science are much needed. In response to this, there is also a growing emphasis on developing higher order cognitive skills among university science students (Barouch, 1997), (Sleet, Hager, Logan & Hooper, 1997), (Bucat & Shand, 1996). Essentially what matters most in learning in the sciences is the capacity to analyse and classify data, to gather evidence about solutions, to solve problems and to apply and test theories. Clearly, the knowledge base in science is expanding too fast to ensure that students cover all aspects of scientific knowledge within the duration of a university course. The alternative is to offer students learning experiences that allow for conceptual exploration and acquisition of the thinking skills needed for their future learning. It is on this assumption that we seek to develop an online environment for development of metacognitive skills.

Teaching science: Problem-solving or content coverage?

Let us consider briefly how first year science subjects are taught in many universities. Over emphasis on rote learnt content and terminology still characterises much science teaching at tertiary level, to the detriment of student learning. First year biology students typically have to cope with as many new terms as a students learning a new language, apart from trying to understand the new concepts being introduced. If lecturers still hold to a transmission approach in their teaching combined with a focus on content coverage, this forces students into surface learning approaches.

Another characteristic of university science subjects is that scientific concepts may be largely removed from the everyday life of students and real world applications. Students in chemistry must struggle with unfamiliar names and symbols, while they also need to understand new concepts, which are often presented in a decontextualised, abstract manner. Often the pace of delivery is such that there is little opportunity for students to understand new concepts in a qualitative way first, to explore them and to verbalize their ideas, before applying these concepts to less familiar situations. However, teaching in science need not be about content coverage, factual recall and the application of formulae, but about problem-solving.

There is a vast literature on problem-solving in the sciences, which is a largely untapped resource (Gabel, 1994). There is also a growing emphasis on developing higher order cognitive skills of university science students (Barouch, 1997, Sleet, Hager, Logan & Hooper, 1997, Bucat & Shand, 1996). Problem solving is the skills most central to successful learning in the sciences, and this assumes that students can generate questions and apply metacognitive skills to help them achieve solutions.

Metacognitive skills in science learning: Operationalising the concept

The term metacognition refers to a learner's knowledge about his or her processes of cognition and the ability to control and monitor those processes as a function of the feedback the learner receives via outcomes of learning (Metcalfe & Shimamura, 1994). Thus, two essential components comprise metacognition: knowledge and control. Metacognitive *knowledge* refers to what a learner understands and believes about a subject matter or a task, and the judgments s/he makes in allocating cognitive resources as a result of that knowledge (Flavell, 1987, Brown, 1987). *Metacognitive control* refers to the tactics and strategies a learner devises to achieve specific learning goals and the degree to which the learner organizes, monitors, and modifies those operations to ensure that learning is effective (Jacobs & Paris, 1987).

With regard to metacognitive control, Schraw (1998) explains that attention resources, existing cognitive strategies, and awareness of breakdowns in comprehension are all enhanced by metacognitive knowledge and skills. Learners who use both improve their academic performance. Thus, metacognition is important to an understanding of learning in the sciences because learners must regulate their cognitive tactics and strategies in order to construct meaning from their reading, lectures, and laboratory experiences. Moreover, as science, physics, chemistry, biology, etc. are new and relatively unfamiliar informational fields, learners have to be more active, exploratory and self-regulated during the comprehension-building process (Tergan, 1997).

Development of metacognitive skills in tertiary contexts

To date much work on developing metacognitive and problem-solving skills has been done at the primary and secondary level (De Jong, 1992). Research at tertiary level is less, but there have been studies in the sciences in physics (Mettes 1987), mathematics (Schoenfeld, 1985) and computer programming (Volet, 1991; Volet , McGill & Pears 1995). In Volet's (1991) study, computer programming students coached in the use of a metacognitive strategy for writing programs over a semester achieved better overall course results than a control group. Longer term benefits were also seen in that more of these students enrolled in and passed the advanced computing unit in the following semester.

Outside the area of science, business economics students given a series of sessions over the academic year related to orienting (problem identification or task definition) achieved superior results, not only in this subject, but also in a statistics unit (Masui & de Corte, 1999). Both these studies emphasize the importance of the design of the intervention and metacognitive training for effective outcomes.

Design stages for the online environment

Based on extant research on metacognitive training, a We-based tutorial has been developed to support the metacognitive skills of science students. The environment for metacognitive training will combine Web-based scenarios with problem simulations in order to engage learners in actual problem-solving and reflection on their own problem-solving strategies. Eight phases of learning are involved.

In *Phase 1* the concept of metacognition is operationalised. For the problem in question, the students need to become aware of the problem-solving processes involved. For example this requires analysis of the question, planning a solution, selection of strategies and self monitoring skills that can be used.

Phase 2 involves the design of the problem environment. For particular problems in a topic in Physics or Chemistry for example, examine the different ways in which an expert and a novice student might answer the problem.

The problem is then presented to the student to work on in *Phase 3*. Student responses are monitored in *Phase 4* to decide if any Intervention (Phase 5) is required. *Phase 5* presents students with a scenario or problem where they are assisted in the processes and procedures of problem-solving, and made aware of their own problem-solving strategies.

In *Phase 6*, successful students are presented with further problems in the topic area to check whether they have transferred the strategies learnt during Phases 3 and 4. If they have not, training continues. In *Phase 7* students are given the opportunity to reflect on their problem-solving. The final *Phase 8* involves a refinement of the training to create design guidelines for a problem-solving environment in different subject areas (biology, physics and chemistry) in order to foster metacognition.

Instructional design principles applied to metAHEAD program to support metacognition

How might these instructional design principles to develop metacognitive awareness and problem-solving skills be implemented in a technological environment? In the design we have combined both constructivist and adult learning principles to support student self-direction on problem-solving and reflection.

The design of the environment must builds in from the beginning three important implications of social constructivist theory concerning reflective thinking. First, in order to foster reflective thinking students need *multiple sources of feedback* on their understanding gained through social interaction. Second, reflective thinking will most likely occur in situations where *problems are complex* and meaningful to the student. Third, *reflective thinking* requires the student to organise, monitor and evaluate their thinking and learning to come to a deeper understanding of their own processes of learning. Bearing these aspects of reflection in mind, the technology-based environment can provide scaffolds to enhance reflection through four types of feature (Lin, 1998), (Elen & Lowyck, 1999). MetAHEAD supports the following processes:

Process displays: where the strategies adopted by the student are explicitly shown what they are doing in performing a task. Both the processes used by the student and the responses created by the student will be made visible, thus enhancing self-awareness.

Process prompting: asking students to explain what they are doing at different stages throughout their problem-solving procedure.

Process modelling: Students will have access to data bases and video displays explaining what, how and why other students and experts do what they do in solving a specific problem.
Reflective social discourse: This is an online discussion space where students share their learning experiences and gain feedback from a community of learners.
To evaluate the success of the tutorial, it was considered important to assess the degree to which the program was successful in supporting metacognition, rather than produce evidence that problems had been solved. Two types of evidence were gathered< process evidence and product evidence. Process evidence was gathered during problem solving while students discussed their strategies in action using a bulletin board, while product data in the form of written learning logs indicated how students worked though problems.

Implications for practice in other settings: Designing problem-solving tasks

In creating a supportive environment for development of metacognitive skills, we have not limited our focus to developing metacognitive skills with individual students studying science. Instead, we have created a social, interactive Web-based environment that provides support for metacognitive skills such as the development of self-reflection, peer-assessment and revision.

These generic aspects of design have implications for the development of metacognition in other settings. Student awareness of their own skills, self-directed learning and intergroup communication between learners is fostered by Web-based functionalities, such as bulletin boards and shared discussion spaces. We assume that a limited number of problem-solving and metacognitive skills are applicable to the domains of chemistry, physics and biology as taught in first year of study. Nevertheless we assume that many aspects of successful metacognitive development require knowledge of the subject domain, thus we situate the training within particular disciplinary knowledge rather than attempting to develop a decontextualised set of metacognitive competencies and skills. Metacognitive skills are developed in functional contexts providing multiple domain application examples and experiences.

The selection of contextualised problems for students is an important one, with implications for practice in other settings. Too much of what is required at present in first year science is concerned with factual recall and only exercises lower order cognitive abilities. We intend to progress from the level of drill type exercises to more ill defined, real world problems involving higher level cognitive abilities. One of the objectives of MetAHEAD is to bridge the development of metacognitive skills across a range of subject areas, integrating subject learning with metacognitive skills training. By explicitly and continually emphasizing metacognitive aspects right from the outset, significant benefits will occur for students.

Conclusion: Supporting metacognitive processes in computer supported environments

The project described here is the initial phase of a two-year research project dedicated to development of metacognitive skills in science. We believe that students' metacognitive skills can be developed significantly by taking a proactive approach and by designing an environment specifically for problem-solving and metacognition. Teachers who are expert in one or more of the respective domains come to the teaching/learning transaction with well-rehearsed knowledge about their own skills and procedures in the domain. For a teacher, this metacognitive knowledge has developed over years, for example, through professional expertise, personal reflection and making observation of student learning, and noting conditions and situations in an everyday environment that reveal relationships and realities of pertinent phenomena. Indeed, most teachers begin to derive significantly more metacognitive knowledge when they actually teach. That is, the process of teaching drives them to think of the material in terms of the way the information will be learned. New learners, on the other hand, come to the subject matter domain naive with respect to this knowledge.

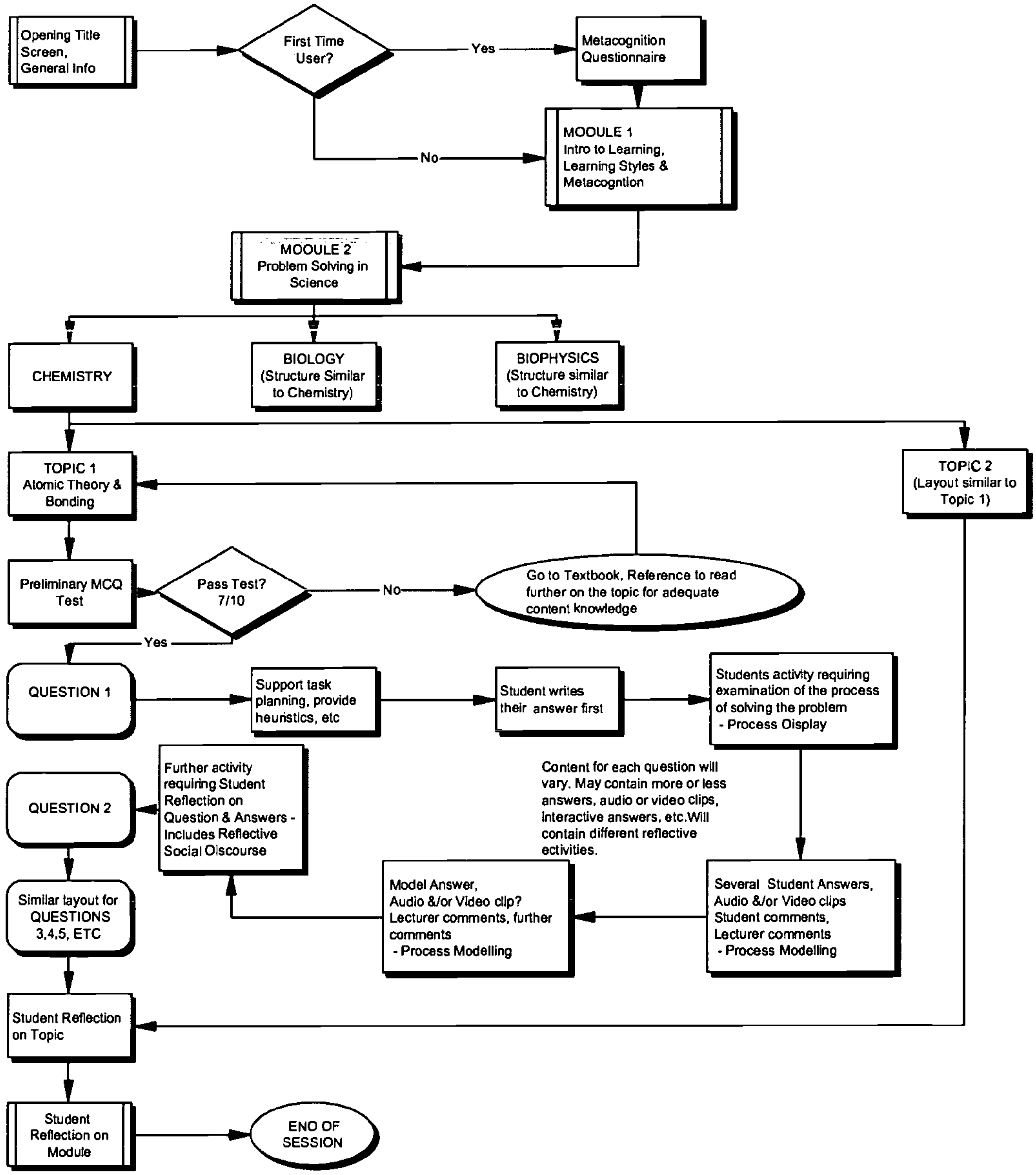

Figure 3 Flow chart diagram for metAHEAD tutorial

This project proposes that metacognition can be developed in contexts that engage students in self-monitoring their own problem-solving approaches, in scenarios where they can ultimately use that knowledge. This requires creating real life anchors for development of problem-solving skills and enabling students to explore, test and review their own strategies. Though the project is still in the initial phases, we anticipate that the research will result in significant changes to the way teaching in the sciences is currently conceptualized.

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PROMOTING SELF-REGULATED LEARNING IN AN ON-LINE ENVIRONMENT

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Abstract: Self-Regulation has long been seen as a desirable but difficult to achieve instructional aim. This is particularly true of on-line learning, where users have limited instructional support and where attrition rates tend to be greater than in face-to-face teaching. This paper examines the nature of self-regulation, identifying affective and cognitive skills which make for self-regulated learners. The broad psychological states of metacognition and self-concept are identified as well as the motivational and cognitive processes that underpin them. The volitional, learning, and regulatory strategies which learners use are delineated. These are placed within the context of on-line learning. Aspects which characterise learning environments which support self-regulation are identified, and suggestions are made as to how self-regulation can best be enhanced within on-line courses.

A Need for Self Regulation

Universities are moving more and more towards flexible modes of delivering courses; a trend which is impacting on the nature of both teaching and learning. Educators are coming to terms with the challenges of developing courses to be taught remotely and asynchronously, while students, too, are battling with these new modes of delivery. While high school has traditionally been a face-to-face experience, post secondary and tertiary education is limited in its contact time and is being increasingly channelled through Multimedia and Internet resources. This lack of close social interaction significantly diminishes the regulatory mechanisms that ensure students' smooth progression through their course.

This is not necessarily a bad thing. In the end, students must be responsible for their own learning. After all, "learning is not something that happens to students; it is something that happens by students," (Zimmerman 1989, p 21). However, it is unreasonable to assume that students will be coming into a course with the skills to regulate their own learning. (Boekaerts 1997) describes formal schooling as 'outcome based practice sessions' with teachers as experts and students as novices. In more flexible approaches, as in on-line tertiary education, this paradigm is no longer appropriate. Students need to become protagonists in their learning process, using the Internet as a resource for their own learning goals.

It is hardly surprising that there is a high drop-out rate for students with poor study skills when they venture on-line (Loomis 2000). Brooks (1997, p. 135) goes so far as to claim that students "who are poor at self regulation easily can be slaughtered in www-based courses". This does not however acknowledge some of the main benefits of on-line learning – that it is an efficient and flexible environment for users to meet their own learning goals. Attempting to remodel on-line learning on a face-to-face paradigm would dilute these benefits. Perhaps most importantly, there is also a need to acknowledge that self-regulated learning is a desirable thing that is important to life as much as school (Boekaerts 1997). If an educator's role is to assist students in becoming better learners, then courses need to be designed not just to meet specific unit outcomes but to scaffold the development of learner's self-regulatory skills. This is particularly true of on-line learning. Rather than throw students 'in at the deep end' mechanisms must be in place which bridge the nexus between supported and self-regulated learning. In order for this to happen, however, a sound understanding of what self-regulation is, and how it can be inculcated within in students, must be developed.

A definition of Self Regulation

Self-regulation is somewhat easier to define than understand. It has been described as 'the process whereby students activate and sustain cognitions, behaviours, and affects, which are systematically oriented toward attainment of their goals' (Schunk & Zimmerman, 1994). This definition is reinforced by (Brooks 1997), who argues that that it is active and goal directed, resulting from self control of behaviour motivation and cognition. This emphasis on multiple constructs places Self-regulated Learning at the junction of several fields of research (Boekaerts 1997). It emphasises students' reliance on their own internal resources to govern their learning, but these resources are not easy to delineate. Self regulated behaviour is an end process, dependent upon the affects and cognitions that precede it. These are to a certain extent inaccessible, since they are internally constructed and not always explicitly articulated by individuals. Also, the notion of self-regulation is prone to multiple interpretations based upon educational philosophy. (Zimmerman 1989) identifies it in terms of Phenomenological, Social Cognitive, Volitional, Vygotskian and Cognitive Constructivist Theories. All of these approaches bring a unique framework to the concept. Behaviourist approaches emphasise self-monitoring, self-instruction and self-reinforcement, while a phenomenological approach defines it in dimensions such as self worth, planning, and goal setting. Common to most of these however, is an acknowledgment of the interaction of affective and cognitive processes at a level of abstraction. Self awareness at a cognitive and emotional level would appear to be the key enabling process in the development of self-regulatory strategies.

A model of Self Regulation

A number of models have been developed to explain the processes that underpin Self-Regulated Learning. (Boekaerts 1997) provides a six component model based upon the following notions:

- Content domain
- Cognitive strategies
- Cognitive regulatory strategies
- Metacognitive knowledge and motivational beliefs
- Motivational strategy use
- Motivational regulatory strategies

These elements are co-dependent and interact with each other in the application and development of goals, strategies and domain-specific knowledge.

(Garcia 1994) articulates self-regulation in terms of knowledge and beliefs, strategies used, and outcomes. Each of these is moderated by motivational and cognitive components such as personal beliefs and conceptual knowledge, motivational and cognitive strategies, and quantity and quality of effort.

Common to both models is an integration of both affective and cognitive issues:

> "Neither motivational nor cognitive models alone can fully describe the various aspects of student academic learning, yet the two types of models are complementary due to the respective strengths and weaknesses of motivational and cognitive models." (Garcia 1994)

Figure 1 represents a synthesis of the above frameworks. It accommodates the role of both affective and cognitive aspects of self regulation, but also acknowledges the effects of external environmental factors upon an individual's ability to regulate their learning. Self regulation is viewed here as the intersection of self awareness at both a rational and emotional level. Metacognition and self concept are seen as the primary enabling process in this model, with self monitoring and motivation as subordinate processes which are involved in the development of cognitive and motivational strategies. Each will be discussed in turn.

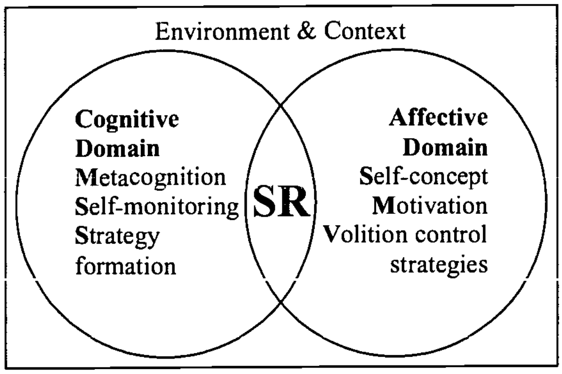

Figure 1 - Model of Self-Regulation

Metacognition and Self-concept

Self awareness has always been an important educational construct. Metacognition can be defined as "knowledge and beliefs about thinking and the factors affecting thinking" which regulate "the articulation of strategy and knowledge" (Pressley 1998). As such it is a necessary precursor to self regulation. Flavell (1987) identifies three types of metacognition: knowledge of self, knowledge about various cognitive tasks and strategy knowledge (Boekaerts 1997).

The first of these should not be confused with self-concept, which appears to be quite a subjective element, although there have been attempts to delineate it in a more hierarchical way (Zimmerman 1989). While metacognition is often associated with issues such as self-efficacy, which involves "personal judgements of one's capabilities to execute courses of action to attain academic achievement" (Bandura, 1977), self concept is more aligned with self-esteem, a personal and less concrete construct. When one considers that students who don't see themselves as 'smart' or able enough often adopt self -handicapping strategies or overcompensate with effort (Brooks 1997), the centrality of self-concept to self regulation is immediately apparent.

Markus and Nurius, 1986 cited by (Garcia 1994) introduce the notion of self-schemas, which combine the cognitive and affective elements of self awareness as "the cognitive manifestation of enduring goals, aspirations, motives, fears and threats." This overarching notion highlights both the similarities and differences between self concept and metacognition. At the heart of each is an awareness of self, and while high self-consciousness is associated with a desire for self-knowledge, low self-consciousness breeds intellectual defensiveness.

Self-monitoring and Motivation

(Weinstein 1986) see all metacognitive activities as partly the monitoring of comprehension, and it would appear that this ability to monitor oneself is what distinguishes metacognitive activity from domain specific cognition. Self-monitoring is an initial step towards the development of cognitive strategies, but as will be shown later, continuous self monitoring is also a strategy in itself. Depending on ones theoretical orientation, this component can manifest itself as social cognitive self-observation, Vygotskian inner speech, or behaviourist self-recording (Zimmerman 1989). Regardless of whether one views cognition itself as an important construct, however, self-monitoring is a pervasive key process to self-regulation.

Motivation results from the actualisation of self-concept. Anxiety, for example leads to a low level of motivation (Zimmerman 1989). While it has been argued that all people are inherently motivated to learn, most of us have experienced difficulties in maintaining motivation, and research has shown that in education, intervention that impinges on self-concept such as unfavourable appraisals by teachers can result in drawing learners' attention away from the learning process (Boekaerts 1997). The ability to maintain motivation is one of the main tenets of self-regulation (Zimmerman 1994).

Self-monitoring and motivation are the primary internal sources of self-regulated strategies. However, there are also factors which are external to the learner which directly affect self regulation.

Environment and Context

Social cognitive approaches have long asserted a bidirectional relationship between external and internal states - role models who overcome adversity might encourage observers to try a task for themselves, for example (Zimmerman 1989).Not only the quality of teaching, but other factors beyond the learning situation have a direct effect on self regulation. (Ertmer 1996, p 747) claims, "outside pressures in students lives may increase their vulnerability to other instructional factors (type of case, time of day, length of lab) that impede [students'] use of self-regulation skills." Ertmer's study relates to the use of case studies for self regulated learning and this highlights another important issue.

The nature of a discipline itself is a unique context, with differences in both teachers' and students beliefs about learning. (VanderStoep 1996) observes different levels of regulation across multiple disciplines, and this has a profound significance for self-regulation, because while self-regulation itself may be veiwed as a generic skill, some of the strategies employed may be pertinent only to speicific domains.

Volitional and Cognitive Strategy formation

As the end product of self regulation, a student is able to activate strategies which enhance their learning. These take the form of volitional strategies, as well as congnitively based learning and regulatory strategies. It has been argued that Self-Regulated learning is "a fusion of skill and will" (Garcia, 1995, cited in Brooks 1997), and certainly effort, stemming directly from motivation, is a concept that most students are able to recognise as a controllable aspect, using it to explain their performance to themselves rather than other explanatory mechanisms (Pressley 1998).

Volition differs from motivation in that motivational processes mediate the formation of and promote decisions, while volitional processes enact and protect them (Corno 1994) Therefore motivational self regulation is dependent upon strategies that activate effort to achieve learning goals. (Garcia 1994). There are several strategies that students use to control effort.

Self handicapping is the withholding of effort or putting obstacles in the way to maintain self concept, while self affirmation maintains self concept through reassessing the value of different domains (Garcia 1994). Defensive pessimism is a coping process which enacts effort through the fear of failure (Boekaerts 1997). Motivational attributions refers to the causality students use to explain performance both retrospectively and prospectively, but regardless of the strategy used, they are all "affectively laden processes" that are related to an individual's self concept.

At a more objective level, students use self-monitoring techniques to support their learning as well as to regulate external factors. Cognitive learning strategies include rehearsal, elaboration, and organisational strategies, as well as memorization through clustering, imagery, use of mnemonics and so on (Weinstein 1986). Typically, deeper cognitive processes (such as transformation - the creation of something new out of existing information) are more successful than ones which engage in knowledge as a static entity, such as rehearsal (Risemberg 1996). It is important to note, however, that knowledge of these learning strategies is not enough to ensure that they take place. Regulation strategies must be implemented to co-ordinate effort and task.

(Garcia 1994) identifies three regulatory strategies that are highly correlated but do have some differences. These are planning, monitoring and regulation. While learning strategies are usually internally developed, regulation strategies have a role in accomodating the environmental and contexutal factors discussed above.

One central concept to planning is that of goal formation. Typically, teacher goals are more distant and abstract than students', and those students who set more proximal goals tend to perform better academically (Boekaerts 1997). Goals are best when they are developed by the student rather than imposed by the teacher, in which case they tend to be viewed as obligations (Brooks 1997). While achieving good grades is a frequently stated goal for students (Pressley 1998), process rather than product goals are more closely correlated with self-regulation (Ertmer 1996).

Monitoring strategies can include tracking of attention, self-testing and self-questioning, as well as monitoring comprehension during learning activities These are closely linked to regulation which manifests itself as a controlling process that results from monitoring (Garcia 1994). An example of this might be a student who reads a passage in a text slower upon arriving at a section which he or she finds conceptually challenging. A final cognitive strategy is resource management. Tied in directly with environmental factors, these involve the regulation of external aspects such as time, study environment, and help-seeking, as well as teacher and peer interaction (Garcia 1994)

Enhancing Self-Regulated Learning

The above framework can provide a useful heuristic in the development of Web based courses. A well designed learning environment should be able to operate on both affective and cognitive processes to activate self-regulated learning. However, while the above model articulates the dimensions of self-regulation, it does provide prescriptive information on how to enhance it.

In the broadest psychological terms, the self-regulated learner operates at a high level of self awareness and self concept. The learner activates self-monitoring and motivational processes, which are enabled through the use of volitional, cognitive and regulatory strategies. As teachers, however, the need is to work at the process level. The learning environment needs to activate motivational and self-monitoring processes, through the implementation of strategies that involve volitional, cognitive and regulatory mechanisms, with the end result being a confident self-aware learner.

It would seem, therefore, that design for self-regulation should treat metacognition and self-concept as an end product. The key processes of self-monitoring and motivation can be enhanced through the integration of the strategies which self-regulating learners typically access to facilitate these processes within themselves. It needs to be acknowledged that the implementation of such strategies is not going to automatically create self-regulation. In fact, it could be argued that self-regulation is contradictory to teaching actual strategies since it is something that comes from the student rather than being externally imposed (Brooks 1997). This paradox is obviously untenable. For students to develop self-regulatory strategies, they need to be made made aware of them and use them in an initially guided and structured manner. (Oliver 1999) identifies three components which are integral to the learning process: Learning Supports; Activities; and Resources. Typically, on-line learning includes a high level of resources and incorporates activities, but is often designed to be 'teacher free', and thus impoverished in learning support.

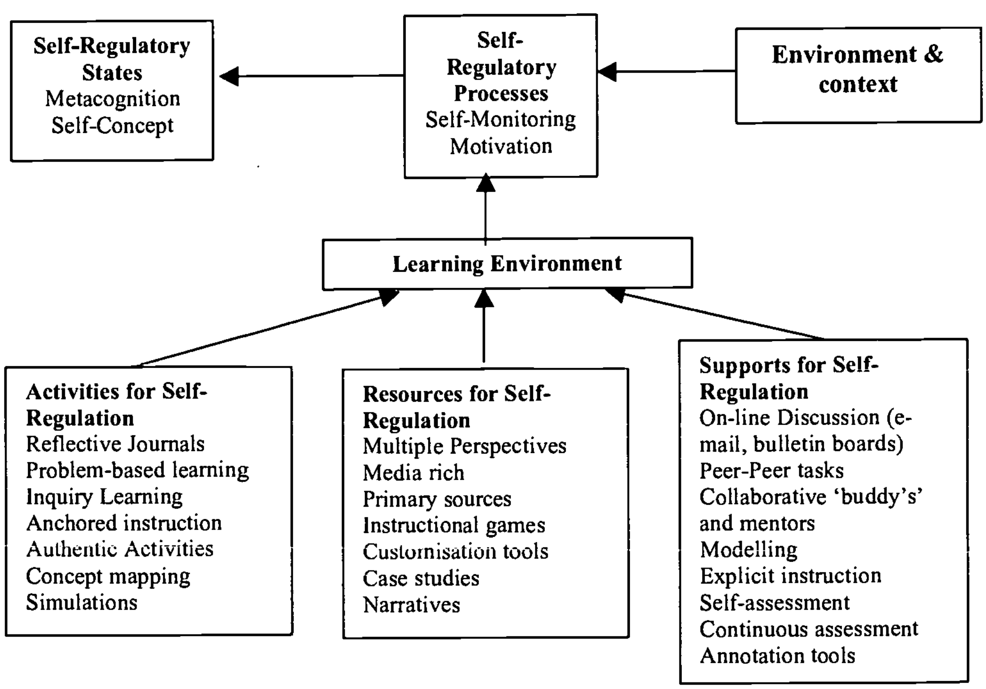

Figure 2 - Self-Regulatory Processes

While this is not usually an issue for students who have a high level of self-regulation, the lack of support is problematic for students whithout this skills. Therefore this paper advocates a process of scaffolding and fading. A high initial level of support for learners is faded over time as they develop their own regulatory and learning strategies (Winnips 2000).

Figure 2 indicates how the self-regulatory processes of motivation and self-monitoring may be enhanced through the integration of learner activities, learner supports and learning resources in an on-line environment. The contention is that the strategies inherent in these elements can provide the necessary learning, regulatory and volitional tools to activate the processes that give birth to self-regulation. Students engage in the resources and activities in the context of support which both models them and makes their role in Self-Regulated Learning explicit for them. As the level of support is reduced, learners may then initiate the strategies themselves in their own ways.

Discussion of Enabling Strategies

The strategies presented above represent, while not intended as a complete or authoritative list, can assist designers of on-line learning environments when considering how best to activate regulatory processes. Activities which stimulate reflection such as journals have been promoted as effective prompts for students own initiated approaches, integrating techniques such as progress worksheets and behavioural graphs (Zimmerman 1989). Also, encouraging students to solve problems while simultaneously reflecting on their own problem solution process can improve their metacognitive knowledge & skills as well as performance (Boekaerts 1997). Activities can also be grounded in authentic and relevant situations to enhance their level of motivation (Keller 1983), and it has been argued that "challenging tasks stimulate self-regulation better than do routine or boring tasks" (Brooks 1997) p. 141.

At the resources level, techniques such as instructional games can provide the impetus to assist in volitional control while narratives can engage the curiosity inherent in motivation (Malone 1981). Keeping resources, complex and real, providing multiple rather than single perspectives can enhance both their relevance and challenge, as well as stimulate the depth of processing required for self-regulation.

This is not to say that the learning environment should be excessively ill-structured. Indeed, having a narrow focus for self –monitoring gives better results than having a broad focus (Brooks 1997), However, "the most strongly advocated approach to including opportunities for student self-regulation is to give students choices" (Brooks 1997). Offering them different ways of learning material and have them compare them, for example, can be an excellent way of allowing users to customise their own relationship with the environment and help their metacognitive processes. Thus, environments that can be customised can assist users in setting their own learning goals.

Learner support can be provided in many forms – through techniques which are automatic such as self-assessment, as well as through peer and tutor interaction. Above all, it is important that users receive encouragement in order promote their self confidence in learning. (Zimmerman 1989). They need to be made aware that learning is hard, even for good students. This allows them to elaborate their motivational beliefs and relate them directly to strategy and capacity beliefs (Boekaerts 1997). A flexible non-threatening approach to feedback and remediation can go some way to achieving this. It doesn't mean that the teachers' role is reduced to that of security blanket or background facilitator – there is still a role for direct instruction, particularly in making explicit the implicit conventions of discipline specific knowledge. In fact teaching students ABOUT self-regulation is important (Brooks 1997). This can involve telling students to find a quiet place to study, planning adequate time etc. Having formal activities in which students consolidate and organize what they have learned combined with more implicit forms of support such as expert modelling, engages the user in self-regulational approaches and makes the strategies purposeful for them.

It appears then, that Self-Regulation is not an easy instructional aim. Those who are poor regulators aren't likely to be changed quickly; even when students know WHAT to do, it doesn't necessarily mean they'll do it. (Brooks 1997). However, research has shown that it IS teachable, and certainly not ineluctably tied in with intangible and unalterable concepts such as intelligence (Symons, 1986). Learners will not always have access to the level of support which they receive in formal education, and this is particularly true of on-line learning, which is currently prone to high levels of attrition. It is important therefore that thought needs to be given to the process involved in users becoming aware of themselves and their own understandings, which in the end will only make them better learners.

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Technology as Text: The Application of Literary Theory to the Use of Interactive Multimedia in Secondary Schools

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Abstract: Definitions of literature are evolving to embody a wider range of cultural practices which can include interactive multimedia (IMM). Also the study of literature is undergoing a philosophical change, where traditional notions of literature as canonical and embodying universal human qualities is giving way to a more relativist epistemology. The act of reading, is not seen now as a passive process, but readers are constructing meanings which are also informed by their own values and cultural milieu. This paper argues that as IMM becomes more integral to the teaching of a wide variety of subjects, students need to be equipped with the skills to analyse IMM as a cultural artefact. As an illustration, a 'reading' will be conducted of the multimedia CD-ROM From Alice to Ocean.

How should we Analyse IMM?

Literature is a broad term encompassing many modes of communication. Traditionally it has been thought of in terms of a 'Canon' focusing on authors such as Joseph Conrad, Jane Austen, and Wordsworth and embodying some kind of universal 'truth', forming part of what Leavis termed 'The Great Tradition' (Leavis, 1946). It was assumed that meaning was inherent in the text and that "the meanings of literary texts could remain the same over long periods of time, even though the 'real' world changed." (Moon, 1992; p 80).

Such tenets are hard to justify, however, since both the American and British critics argue from an explicitly political viewpoint that is representative of the post war and post industrial epoch. Traditional theories have come from a broad range of ontologies and epistemologies that, whether focusing on the relationship between language and meaning, as in a structuralist paradigm, or the cultural politics of Marxist and Feminist approaches, have as a common basis the rejection of the absolutism and perceived elitism of traditional Literary Theory. It is now argued that the study of Literature is neither a neutral, or, as has been claimed, 'common' pursuit (Leavis, 1962) but is mediated by the author, reader, and social milieu; that is, it results from an interaction between "the reader's expectations, projections, conclusions, judgements and assumptions" (Fish, 1980; p 2)

Crucial to a contemporary approach is the idea that the individual will is contaminated by institutional and cultural values (Marxism, Feminism, and other political theories) or even by unconscious impulses (as in a Psychoanalytic approach). In these views the author is as central as ever to the study of Literature, but the notion of the author as an artist with a conscious message will lead to only one limited (albeit dominant) interpretation of meaning since 'to suppose that an author is genuinely unconstrained, that a work could be authentically original is ... nonsense. Texts are cultural products, and say at least as much about the cultures that produce them as the writers that record them" (Saunders, 1993; p 12).

Multimedia and the Study of Literature in Schools

An argument can be made for the study of Multimedia as a literary artefact. While it is a relatively new form of discourse, it is certainly not an alien one. Its non-linear nature offers challenges to traditional narrative, but no more so than many contemporary novels or even older works such as Stern's *Tristram Shandy* which, it has been argued, anticipates many of the techniques of hypertext (Keep & McLaughlin, 1995). In fact, many 'electronic storybooks' such as Broderbund's *Just Grandma and Me* (Broderbund, 1993) are adaptations of already existing Literature and use interactivity and other media to enhance the existing text.

Apart from the narrative elements, IMM, with its integration of sound, graphics, animation and video uses a familiar auditory and visual language combined with interactive control. The concept of readers as protagonists who use "interpretive strategies [to] give texts their shape, making them, rather than, as it is usually assumed, arising from them" (Fish, 1976; p 196), for example, appears to sit comfortably with the nature of learner control in IMM, and how users carve their own path through hypermedia.

Interactive Multimedia, while in not, as yet, a dominant form of discourse, is one to which students are becoming increasingly exposed. However, the idea that IMM products are socially constructed and embody specific cultural value systems, is never explicitly stated. This paper argues that IMM is as accessible as the above genres to a contemporary critical approach, and will conduct a critical analysis of the Multimedia text *From Alice to Ocean* (Against All Odds Productions, 1992) to illustrate this.

Analysis - From Alice to Ocean

The analysis will be conducted from a broad critical orientation as a point of discussion rather than an end in itself. However, as a constructed narrative of a person's journey by camel through outback Australia, it clearly demonstrates the role of Multimedia as a cultural artefact, with meaning being developed through the interaction between the narrator's values, the interpretative assumptions of the reader, and the socio-cultural context in which it was created.

Character - Robyn Davis as Protagonist

As an account of a real journey, it is tempting to think of *From Alice to Ocean* as a 'true' representation of events. Of course, such objectivity is not possible since the very act of writing involves the interpretation and selection of detail. Robyn Davidson is both author and character in her own story. She narrates and mediates the events, privileging an interpretation which the reader finds difficult to resist. Her centrality is reinforced by the very structure of the narrative and its nature as a 'bildungsroman'. This is achieved both through her 'obviousness' and her interplay with other characters.

Robyn Davis is 'obvious' both in that much of her monologue does not conflict with our preconceived notions (Althusser, 1971), and the directness of the voiceover, which naturalises her commentary and makes her more credible. Her authority, however, is rendered absolute by the juxtaposition between her and her photographer colleague, Rick Smolan, whom she describes as "one of those amoral immature photojournalists who hop from troublespot to troublespot without ever having time to see where they are or be affected by it" and the "droves" of "bad mannered, loud, insensitive, litterbugging oafs" who are the tourists she encounters on her journey. Against these characters, and the news reporters ("pariahs") who hound her, Davidson allies herself more with the aboriginal people whom she encounters, suggesting that, despite her 'etic' perspective, she has an insight into her subject matter denied to other observers.

Landscape - 'The Dead Heart'

Despite this, her commentary is very representative of her class and culture. She views the landscape through which she travels with Caucasian eyes. An examination of Australian art shows that she is not alone in her interpretations. Her descriptions are self consciously alienating. At times the land is described in cliched new age mystical terms; Davidson emphasises the 'haunting hallucinatory quality' of the desert. Yet she is at odds with it. The path she follows is 'wide and dry and desolate with one dead bird and two empty holes.' In this way she disenfranchises herself from the environment. Her exploration is a parallel to the early settlers' eurocentricity. In the acknowledgement of a land that is different, this difference is described not only in terms of desolate beauty, but also hostility. After all, many of the early explorers died in their attempts to map the continent – this despite the fact that they were travelling alongside aborigines who have survived on the land for thousands of years.

Race - the Writing of the Other

Davidson's 'Mr Eddie' is cast as a a 'dingo dreaming man', his character being highly romanticised; he never rises above these pixie-like qualities to the reader. Davidson's depiction of the aboriginal children is little better; they are framed in terms of their difference to 'regular' children and drawn with sweeping generalisations, focusing on their directness and 'joie de vivre'. Davidson personifies the sense of belonging she is seeking in her depiction of the aborigines, but she is so bound by her own culture that she can not achieve this goal. She criticises Smolen for taking photographs of a people who do not wish it, yet as both author and subject matter of the CD-ROM, she is complicit in this exploitation. Smolen's claim that he has a job to do and willingness to photograph the less savoury side of life is perhaps more honest than the pretence of the romantic 'lone voyage' in which she engages.

The epilogue is particularly intriguing. The self discovery she describes is not one of union or harmony with the place or people, but is depicted in of self-determination and the imposition of will, with reference made to mundane issues such as changing a job and even divorcing a husband. In the end, the terms she uses say more about her than her voyage. She speaks in the language of a white middle class woman, her values essentially defined by her status, and far removed from the land and the people with whom she claims a link.

Conclusion

Despite the best intentions of many, the study of Literature still carries the cultural baggage of its Leavisite beginnings. It is unlikely that texts like *From Alice to Ocean* will ever find a place on a the Senior High School recommended reading list, and it is not claimed that the CD-ROM has the depth and rich ambiguity in verbal language of a traditional literary text. However, it may be that perhaps the concise and somewhat reductive nature of Multimedia content may not always be a disadvantage. In this case, the product is the distillation of a larger work, and the process of selection of detail has made it particularly accessible to the study of its values.
It has been suggested that the text would be a suitable resource to be implemented across a range of curricula, including photography and geography (Squires, 1996). If this is to take place, it is important to ensure that students have the critical skills to evaluate the values in this and other Multimedia products.

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Developing a Typology of Students in a Web-based Instruction Course

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Abstract: This paper argues that individual differences among undergraduate students is an important factor to the effectiveness of asynchronous learning and that students' needs and perceptions must be taken into account in the design of Web-based instruction (WBI). A student typology is presented based on evidence from an ethnographic study of a WBI undergraduate course.

Introduction

The Faculty of Education at the University of Alberta requires that all undergraduate students be prepared to integrate the use of technology into the curriculum. In 1997 we began to redesign *EDPY202: Technology Tools for Teaching and Learning* (http://www.quasar.ualberta.ca/edpy202) to provide undergraduate education students with the basic skills they will need to apply information technology in Kindergarten - Grade 12 schools. At the same time we were designing this course, the Government of Alberta published *Information and Communication Technology, Kindergarten to Grade 12: An Interim Program of Studies* (Alberta Education, 1998), which formed the basis for the provincial program of studies that was implemented in September 2000.

This technology curriculum provides a broad perspective on the nature of technology and its impact on society. Students are encouraged to grapple with the complexities, as well as the advantages and disadvantages, of technologies in our lives and workplaces. It is not intended to be taught as a stand-alone course but rather to be infused within existing courses. Activities, projects, and problems that replicate real-life situations are effective resources for learning technology. (Alberta Education, 1998).

Since our graduates need to implement this curriculum, the expectations and philosophy provided in this document helped to guide development of our course. Although EDPY202 is primarily a software tools literacy course, it does provide the students with some exposure to curriculum integration. Thus, we hope that these soon-to-be teachers will be in a position to assist their students in using the information technology tools that are commonplace in modern society.

This paper reports some of the results of an ethnographic study of EDPY202 and proposes a student typology that can be relevant for designing and developing WBI courses and increasing students' satisfaction and performance.

The Course

EDPY202 is philosophically based on the perspective that learning is a process of constructing knowledge rather than a process of recording knowledge (Harel & Papert, 1991). From this perspective students are required to be "active participants" in their own learning, which implies substantial learner freedom to select learning strategies. To support this perspective we have designed the course to be self-paced with varying degrees of individualization, allowing students a higher level of flexibility with respect to course time commitments and the level of skills and knowledge they wish to achieve. Course materials can be studied individually, in collaboration with peers, or in collaboration with a more knowledgeable assistant. Further, we have focused learning activities on software tools used for problem-solving: Jonassen's (1996) "Mindtools." This emphasizes students learning "with" the computer as opposed to "from" the computer enabling students to enter an intellectual partnership with the computer in order to access and interpret information, and organize personal knowledge.

The objectives for EDPY202 are directly related to the Alberta Education Program of Studies and students are required to complete either an introductory or an advanced module in each of five topic areas:

- Internet Tools (Email, Web-based conferencing, Internet searching, FTP, Telnet, Simple WWW page creation),
- Digital Media Processing (clip art, drawing, painting, scanning, digital photography, digital audio/video),
- Multimedia/Hypermedia Presentations: (PowerPoint or HyperStudio),
- Spreadsheets (e.g. Excel), and
- Databases (e.g. FileMaker Pro, Access).

While EPY202 has been designed to be self-paced and modularized with a focus on independent study, three optional face-to-face lectures are given to familiarize students. The material covered in the lectures is also available on the course Web page.

Although students are encouraged to work at home, a 3-hour/week laboratory period is assigned where each student has access to equipment (computers, scanners, digital cameras, etc.), software and face-to-face help from an instructor or a teaching assistant. This has two major results: firstly, many students appreciate the opportunity to take the course wherever and whenever they wish, and secondly, the teaching assistants in the lab can concentrate on helping those students who really need help. A comprehensive description of the course is covered in Montgomerie, Carbonaro, Davies and Medici (1999).

The Ethnographic Approach

Anthropologists originally used ethnographic research to study primitive cultures. The technique has been adapted to study organizational culture, which is defined as patterns of shared values, and beliefs that, over time, produce behavioral norms adopted in solving problems (Hofstede, 1990; Owens, 1987). Similarly, Schein (1990) noted that culture is a body of solutions to problems that have worked consistently and are taught to new members as the correct way to perceive, think about, and feel in relation to those problems. The sum of these shared philosophies, assumptions, values, expectations, attitudes, and norms bind the organization together. Organizational culture, therefore, may be thought of as the manner in which an organization solves problems to achieve its specific goals and to maintain itself over time (Hofstede, 1990). In this study we examine the alternative delivery class as organizational culture.

Method

Qualitative data were collected from an EDPY202 class with an enrollment of 700 students between September 1998 and June1999. A total of one hundred and sixteen students volunteered to be interviewed. The group of students was composed of 62 females and 54 males. The great majority of the students, 72, were 19 to 24 years old, 28 students 25 to 35 years old and 16 students were over 35 years old. A subsequent analysis showed that students with lower final course marks were over represented in this sample. The course the following sources of information and insight were drawn upon:

- Knowledge of the course and the students stemming from researchers' participant observations and as instructors.
- On-line discussion on the Web-board conferences and evaluation issues both as an integral part of the course.
- Students' e-mail messages to the researchers.
- Students' responses to open ended taped interview.
- Instructors' responses to open ended taped interview
- Teaching Assistants' (TA) responses to open ended taped interview

The method used to investigate the course relied in part on participant observation and in-depth interviews in order to construct the categories through which the participants themselves interpreted their experience. This paper concentrates on students' point of view. Summaries of the students' comments on the course proved a valuable source of insight to develop a student typology and improve the course design.

Findings

The majority of students interviewed liked the course and spoke positively about the self-directed, active learning experience. One younger student who was quite adept at using computers before entering the course summarized the experience: *"I think this course is fun. It's a breeze. The [Web] site is cool. I am pretty comfortable with all software. The TAs are great. I can do all these things – no problems."* A mature, single parent identified a specific benefit: *"I like this course. I don't need to be on campus; I can be at home with my two year old boy and work on the modules at the same time. It saves me time and money – I don't need to find a baby-sitter."*

About 30% of the students who were interviewed found difficulty with the course. An initial question probed the participants' experiences in the course up to that point. The students' reaction varied great deal. Some reactions were very apathetic, some were very positive, and others were very negative. In telling the stories of their learning. Participants reflected upon the nature of their involvement with EDPY202. They detailed their experiences as they received their initial information about the course, and their development thorough the course.

Developing a New Vocabulary

Some students come to EDPY202 course with no computer literacy. The acquisition of a technology vocabulary is a fundamental part this course. The EDPY202 Web site provides an on-line glossary of all computer terminology used in the course. One male student, 24 years old, attending Secondary Education program exemplified this problem: *"It's so overwhelming... I have to learn [how to use] the Web site and there are so many new words, computer terminology... Searching the Internet is so frustrating... I never get the*
er choose the right words."

Written Versus Spoken Communication

Students are encouraged to use e-mail for communicating with instructors, teaching assistants and classmates. Although students did use e-mail many of them still preferred face-to-face interaction. One female student, 22 years old, attending the Elementary education program said: *"I express myself better talking than writing.... In a distance situation I prefer talking on the phone. It saves time. In this course I have to write e-mails when I have problems... I have to wait for answers that usually don't help much."*

We set up a *WebBoard* Web-based conference system (O'Reilly Software, 1999) to allow students to discuss course topics. During the first two weeks of the course they posted about 234 messages. However this volume was not continued throughout the term. Messages dropped dramatically as some of the students said that they did not read other students' postings because they though they were useless. One female student, 20 years old, attending the Secondary Education program said: *"I have difficulty expressing myself. I don't have much knowledge about computers... I don't know how to give smart or relevant contribution to the Web-Board. So, I don't use it...I don't go there...It doesn't help me... I don't waste my time reading it."*

Difficulty with Active Learning

Although students had access to both a lecture and a Web page that explain active learning in detail, some students are unable to accept and internalize the process of searching and constructing their knowledge. One male, 45 years old, attending the Secondary Education program stated: *"I need to be taught. After I can do* *things [by] myself. I don't like classes [where] I never see the instructor. The TAs don't know everything. I just can't stand it. It is not my style... I am to old to change now."* Another showed frustration and lack of understanding: *"In the e-mail the instructor told me I must be responsible for my own learning, but what does it mean? I am a responsible person.* A female student, 20 years old, attending the Elementary Education program: " *I don't understand active learning. I am going to teach in a traditional way. I am in elementary. I* " A male student, 23 years old, attending the Secondary Education program: *I am not an independent type of person. I need help to learn.*"

On the other hand, some of the students had more positive reaction and they were very optimistic about active learning. A female student, 24 years old, a Secondary Education student explains: " *I always have been very independent since school. I take this course from home...I don't think I learned how to be independent. It is just the way I am. I don't know if am practicing active learning in this course, but at least I am trying.*"

Feelings of Isolation and Exclusion

Students who feel any kind of disadvantage may be affected by their perception of the group norms. Inevitably these students compare themselves with the group in terms of achievement. The impact of this mindset may be so strong that some students may drop the course. A female student, 19 years old, attending the Elementary Education program said: *"The others are so smart. They talk differently, they know what is going on...they know that stuff... I just learned how to turn it [the computer] on. It is awful."* A male student, 23 years old, attending the Secondary education program said: *"I feel isolated and in disadvantaged because I am slow... My TA doesn't have the patience to explain things to me. He always says I should know how to do things by now but I forget stuff after a while... I have to graduate... I have to pass."*

Overcoming Technical Problems

The level of anxiety for some students is quite high, mainly at the beginning of the course. One of the most common reasons given is problems encountered with the technology. One male student, 22 years old, attending the Secondary Education program reported: *"I want to drop out but I can't. This is a required course and I Nothing seems to work for me.... The computer doesn't like me. It crashes on me all the time. I lose my work and I have to start all over again.... It is a waste of time."*

One often reported problem is that the laboratory which students use is equipped with Macintosh computers. Some students who use Windows computers say the Macintosh interface confuses them. They feel disadvantaged because the examination takes place on Macintosh computers. A male student, 20 years old, attending the Elementary Education program reported: *"They told us that we can take this course from home... it's not true. I'm an IBM user... I have to come here [university] for the final...they have only Macs... It's not*

Marking Criteria

Some students perceived problems with marking criteria. One female student, 32 years old, attending the Secondary Education program: *"If you don't do the advanced ones [modules] you'll never get a good grade. So, why are the intro modules there? You have to do the advanced [modules] anyway."* Others found the system of submitting their assignments for marking via the File Transfer Protocol (FTP) and the automated system, which kept track of submissions (Montgomerie, Harapnuik & Palmer, 1997) to be very frustrating. A male student, 25 years old, attending the Secondary Education program: *"First my password didn't work... now I never get my marks back on time, I sent messages to my TA but he never answered me."* Another said, *"I always lose something [files] when submitting assignments. How can I prove I did it on time? I lose marks! The TA can't be responsible but I would like to be able re-submit the stuff and get my marks."*

Developing a Student Typology

During the observations and interviews we have had the opportunity to identify individual differences in students' perceptions, behavior, and learning styles. In discussing their expectations of their EDPY202 experiences, students provided large amounts of information about their understanding of themselves as learners. They discussed the ways in which they feel more comfortable learning and presenting assignments. A male student, 22 years old, attending the Secondary Education program said: "*I have been dealing with computers since junior high. It is not a problem. I know all that stuff already. I hope I can get a nine.*" A female student, 32 years old, attending the Elementary Education program said: "*I feel comfortable in the traditional classroom. Computers frighten me a lot. I always think I can do something wrong. I don't have much confidence in me or in what I can do in this course.*" She also indicated that she always feel excluded during the lab sections: "*TAs never look at me.*" She also felt embarrassment at her lack of knowledge in

I just can't explain what is going on because I don't know specific computer terminology

cited the excitement of learning through Internet and WWW and their worries with the completion of the course. A male student, 21 years old, attending the Secondary Education program said: "*This is a good experience. I can stay updated, I can learn faster. It drives me... to go on, eh. Now everything is on the Internet and I have to learn how to use it properly in the classroom. It is a revolution. I like the way this course was set. Even when I am getting tired and I don't feel like working on the course I realize. I'm getting behind and that's the motivation to move on.*" A female student, 42 years old, attending the Elementary Education program said: *I don't know exactly what I am doing in this course but I now the importance of the Internet, so let's see what happens. Well, I have to get credit too.*" Another student, a male, 26 years old, attending the Elementary *I now I need this course. I want to teach using technology. It is difficult sometimes, but not impossible. I am confident using the Internet. I can work on my own pace. I can learn... and I need to graduate, of course!*"

Students come to EDPY202 with very different expectations but with one thing in common they want to be successful. A female student, 21 years old, attending the Secondary Education program explains: "*I want to learn but I also want to pass.*" A male student 21 yeas old, attending the Secondary Education program sees himself as a very independent learner and he was expecting a interesting kind of course. He said: "*Oh gee! This is really interesting stuff, I was expecting something like that, well, what can I say... It is just great, lots of fun, eh!*"

This has led us to begin to develop a typology of students in this course. The first category of student is the Beginners. Beginners have little knowledge of the technology involved and appear to resist it because they are not fully aware of its implications and use. The challenge is to convince these students that technology can benefit their professional lives and their future students. The second category is the Skeptic. Skeptics are aware of the importance of the technology in their professional life but they are concerned about the amount of work required to develop the skills necessary to use the technology effectively. Skeptics often complain about the effort needed to complete the required tasks. The third category of student is the Explorer. Explorers are enthusiastic about the technology, have some previous knowledge and want to learn more. These students have a mixture of dependent and independent learning style and most of the time they are pleased to help others. A fourth category is the Optimist. Optimists have little knowledge but accept the technology at face value and want to learn as much as possible from TAs, instructors and peers. Explorers and Optimists are about 90% of the interactive learning community in the course. The final category is the Self Professed Expert. Self Professed Experts are very independent and never go to the lab sections. They often say they are taking the course only because it is required. Self Professed Experts appear to think they know everything and they don't need help from instructors, TA or classmates. Often, Self Professed Experts obtain the highest final grades in the class, but this is not always the case.

Conclusion

The findings of the study point to many factors that can influence students to have either a successful or a disastrous on-line experience. Looking at the Web course structure and its impact on the students, it is clear the importance of knowing what kind of students instructors have in their courses. Successful or problematic experiences have strong impacts on class relationships and consequently on students' performance and attitudes towards the course. Some of students with limited skills or knowledge feel like outsiders while other students develop a friendly interactive group. Web-based course developers have to take into account students' differences if they want to design truly individual instruction. Without a Web-based course that takes into account students' individuality, students feel isolated and become anxious, defensive, and helpless.

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Design and Implementation of a Mutlimedia Learning Environment for Spelling

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According to the dual coding theory, we perceive and store words and visual images in two systems: one verbal and the other perceptual. We present in this paper the design and implementation of a multimedia spelling-book based on the above theory. The book presents the story of the "beautiful Helen" as Homer records it. The review of the current conventional spelling books for pupils combined with the characteristics of the Homer Epics and the different ways of using images, led us to the formation of a set of parameters, assumptions and aims for the interactive learning environment. The methodology we followed to end up with the design and development of the multimedia spelling-book is given in detail along with implementation issues and the description of the application. The system is expandable (more scenes) and transferable (other stories). The application is currently undergoing user trials in real life situations.According to the dual coding theory, we perceive and store words and visual images in two systems: one verbal and the other perceptual. We present in this paper the design and implementation of a multimedia spelling-book based on the above theory. The book presents the story of the "beautiful Helen" as Homer records it. The review of the current conventional spelling books for pupils combined with the characteristics of the Homer Epics and the different ways of using images, led us to the formation of a set of parameters, assumptions and aims for the interactive learning environment. The methodology we followed to end up with the design and development of the multimedia spelling-book is given in detail along with implementation issues and the description of the application. The system is expandable (more scenes) and transferable (other stories). The application is currently undergoing user trials in real life situations.

A Design Procedure for Creating Training Courses

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Introduction

The training is a key issue in our days. The training, retraining life-long learning are thought to be absolutely necessary for people sharing the labor market in the Information Society.

Ways of building curricula, planning of courses are objects of a very large amount of presentations, papers, good practices. In this work, we present an approach to face the subject on a systematic way.

The training of the employees of an organization is a difficult task, as they have to understand new trends and use the aquired knowledge and skills to improve their position and be more productive. Among the problems arising, during training is the restriction of available time. So, the courses must be well designed and delivered, to be fruitful and achieve their target. Another major problem, which is quite common especially with IT courses, is that they are quite similar for all employees and they are delivered on different levels including awareness. The highly interactive and graphical environment makes the training task more competitive for them.

The approach we present here is suitable for designing courses for trainees (employees, students etc) to achieve knowledge and skills. The approach consists of a good number of parallel phases which can be repeated. By every repetition the design is more detailed. The parallel phases are merged and split, starting a new parallel phase.

The whole procedure resembles the filling of an empty cell. The approach is transferable and the concepts can be used for evaluation and redesigning of the course.

Design Considerations

The procedure starts with the creation of a short list (SLP) of target identification. This short list is constructed by the policy makers. It contains general characteristics and specific ones. It can contain skills, levels etc. Another short list (SLS) is created by a specialist on IT responsible for the course, delivering. The SLS contains means, tools, course material, methods etc.

Each one of the lists is transformed to sets of key-words. Each set presents a target secondary or main. Using partitioning techniques, one can merge and split the sets and form the final sets (FS). Those FS combine means and targets.

In case the FS are poor or problematic, the procedure can be repeated by reviewing the short lists. The repetition of the phase can lead to a quite detailed presentation of the course.

We have applied this procedure starting by global descriptions. Those descriptions were combining the environment of the company. We have proceeded by analyzing further the FS. We needed three phases. We have tested the procedure by organizing a university level course on IT, following the same approach.

Specialists of IT and policy makers worked independently on the parallel phases and they met to merge and split. The descriptions are organized in set and subsets or they are the fields of an operator. The second presentation is more evident.

Discussion

We have used the here presented approach as the basic tool for designing a pilot course for the employees of a company. The company is under a renewal of its information systems and the relevant applications.

The short lists' description is a powerful tool as one can incorporate global characteristics which are usually ignored when designing courses for IT. The approach was applied too on CBT courses and it was extremely powerful.

We are now using this approach to re-design existing courses. We analyze the targets/means and we compare them with the outcomes.

We have some rules for the FS content which can support decisions. An interesting speculation on the $\overline{FS}$ is that, in case the short list of the means is more rich than the one of targets, the partitioning gives multiple sets. This multiplicity can support the delivering of more self-adapted courses. The decisions about open and flexible courses are strongly facilitated without loss of the overview and target.

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A Learning Environment Based On Metaphors, Concepts Maps and Hypermedia : Application To Computer Networks' Training

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Abstract: Metaphors are recognized as an help for learning concepts and are frequently used by teachers. And yet there is no computer-based training tool which fully takes advantage of this strategy. This paper describes an innovative learning environment implementing the metaphor strategy, and set in a constructivist approach. This tool is based on concept mapping and hypermedia as support for learning activities. The paper describes the generic structure of the tool, the prototype implemented for the domain of routing in computer networks and the experimentation carried with a small group of mature students pursuing continuing education.

1. Introduction

Concepts' learning has always been an important issue in education, and has a special importance in current technical programs, as the increasing growth of technologies brings a need to come back to basic points. Metaphors are recognized at a theoretical level for facilitating comprehension and memorization of concepts. According to (Mayer 1983), teaching scientific concepts can benefit from metaphors because they can help to understand the scientific language. At a practical level, metaphors are frequently used by teachers in their lectures.

Computer-based training (CBT) tools use various instructional strategies for learning concepts, like simulation (in simulators) and visualization (in multimedia and simulators). Metaphors can be found in CBT tools, for example multimedia tools can contain metaphor images to illustrate some topics, or a simulation can include a metaphor, like in (Rieber, Noah 1997). But this use of metaphors is quite seldom and uneven, and it is not considered as a primary instructional strategy. On the other hand, metaphors are very frequent in CBT tools' human-computer interface, in fact in all software's interface (Caroll & al. 1988). But those metaphors are at the interface level and not at the educational content level. Actually, there is no real CBT tool that fully takes advantage of metaphors as an instructional strategy. There has been a first research on this subject in (Brna, Duncan 1996): AMPS is a prototype of an intelligent learning environment for electric circuits' domain, using the water analogy. There is a simulation of each domain and the learner can solve problems, edit analogy relations and use multiple analogy from a library.

This is why we are running an exploratory research whose aim is to conceive a new kind of learning environment, based on a specific instructional strategy: metaphors as an help for learning concepts. This tool relies also on concept maps elaborated by the learner and on hypermedia. It is grounded in the constructivist current, which gives importance to the learner as an actor of his own learning, and importance to previous knowledge.

In this paper, we will describe an overview of this on-going research. After introducing metaphors and concept maps in education, we will define the generic framework of the environment and the possible uses for the learner and for the teacher. Then we will describe the prototype we have realized for a particular training domain (computer networks) and the experimentation carried with a small group of students.

2. Metaphors In Education

The principle of using metaphors in education as a teaching strategy is to base the new knowledge (target domain) on prior knowledge in an other known domain (source domain), as illustrated in (Fig. 1).

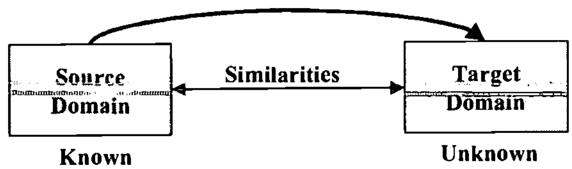


Figure 1: Principle of metaphors for learning

The constructivist approach views learning as an active construction process, only possible if based on previous knowledge. Thus metaphors are an important instructional strategy in this perspective because previous knowledge is the starting point for learning.

The process of analogical reasoning has been widely studied in cognitive psychology producing various theories for how operate this cognitive process. On an other side, some researchers in the field of education like (Duit 1991) and of human-computer interaction like (Caroll & al. 1988), (Madsen 1994), provide pragmatic guidelines for how to use metaphors. For example, Madsen defines three stages for using metaphors in systems design: generate potential metaphors, evaluate the metaphors, and develop metaphors in the design task. Duit gives guidelines for using metaphors in education, like: "metaphors should be familiar", "use multiple metaphors", "guide the learner through the use of metaphors", etc.

In our work, we consider that multiple metaphors should be provided for each topic and that the limits of metaphors have an instructional value.

3. Concept Mapping

Concept maps are used in education for more than twenty years and are originated in Novak and Gowin's work (1984) on learning science. A concept map is a graphical representation of concepts (nodes) and relations between them (links). It is a kind of semantic network but naming of relations is free and, according to Novak, it should be structured from top to bottom, from general concepts to more specific concepts.

Concept maps can have a lot of purposes, in education and also in communication. In the education field, they can be elaborated by learners, teachers or CBT tools designers. When concepts maps are constructed by learners, they are a way of accessing learners' representation like in (Baron, Bruillard 1999), and a powerful cognitive tool allowing learners to organize knowledge in a more and more complex structure (Jonassen & al. 1997).

We had at first considered concept maps (elaborated by learners) as a mean for accessing learners' representations of the domain. But it soon appeared that it was also an important instructional strategy for learning concepts and that it could also be an aid for the reflection on metaphors. This is the reason why the environment we propose relies a lot on concept mapping. So we consider concept maps in the following aspects:

- As a tool for learners to manage their knowledge
- As a mean for accessing learner's representations
- As a tool for teachers or designers to structure the knowledge domain
- As a mean to present metaphors

4. Learning Environment Based On Metaphors, Concept Maps and Hypermedia

Generic framework: We propose a generic framework (Fig. 2) for an innovative learning environment, which makes possible to implement the metaphor instructional strategy. This tool is based on hypermedia representing the source and target domains of metaphors and on concept maps elaborated by the learner. The learner can navigate from one domain of the metaphor to another through hypertext links and can construct his own map of the target domain. This tool is intended mostly for learners but can also be used by teachers to study metaphors in a lecture.

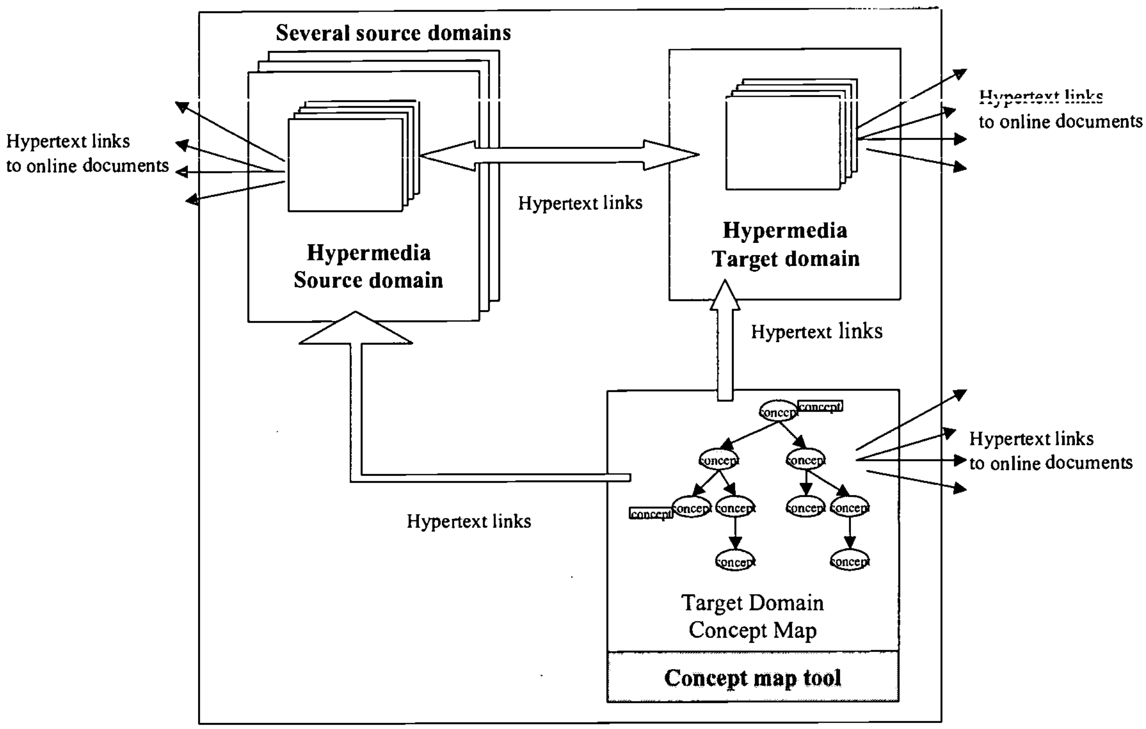
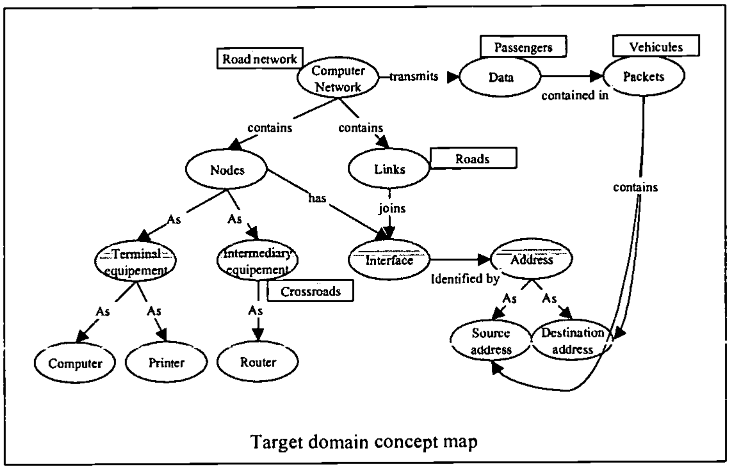


Figure 2: Components of the environment

A hypermedia module represents each domain (several sources and one target). Analog concepts in source module and target module are linked with semantic hypertext links. The concept map can also be linked with documents in the target module or in the source module. Each module can be linked with online documents, like Web pages on Internet.

Activities for the learner: Learning activities can concern concept map elaboration, metaphors study, and hypermedia lecture and authoring. Concerning concept mapping, several different activities, discussed in (Meyer & al. 2000), based on metaphors and concept maps can be considered, depending on which concept map is constructed (source domain or target domain) and by whom. We retained activities involving the construction of a concept map by the learner (because of our constructivist perspective) and for the target domain (because it is the domain to be learned).

For example, the learner can be asked to build a concept map of the target domain and to indicate on it metaphors from source domains of his choice, taken from his reading of hypermedia. (Fig. 3) represents this possible concept map (the target domain is here computer networks). Concepts from source domains (rectangular shape) are set close to analog concepts of the target domain (oval shape). In this concept map, metaphors come from one source domain (road network) but metaphors from several source domains could be indicated. Concepts can be annotated, in order to precise their definition and in order to indicate the adequacy and limits of metaphors.



Target domain concept map

Figure 3: Example of a concept map with metaphors

Activities for the teacher: Concept map elaboration can also be useful for the teacher because it helps him to structure his knowledge. But beyond this, it can be for him a tool to think about metaphors for a lesson's preparation. In effect, for a given target domain, he can indicate on the map what are the metaphors, for different source domains. Then he can visually compare the metaphors' richness of different source domains and choose the most appropriate metaphors for his lesson.

5. Prototype And Evaluation

We have realized a prototype for a specific domain, which is routing in computer networks. This domain is, according to teachers, complex and difficult to teach. It is also a noticeable metaphorical domain, maybe because several metaphors (road, mail) were used at the origin by searchers in computer networks' field. This work has been done in collaboration with teachers of two French "Grande Ecole" engineering school, Ecole Centrale de Lyon and INSA de Lyon.

5.1 Study Of Metaphors

We first have studied the concepts related to routing then we have thought about metaphors, which can be used for teaching routing, within three stages. The first stage was the generation of potential metaphors: we collected them in different ways, with students, teachers, books and Web pages on Internet. It gave us a base of approximately 50 elementary metaphors in 12 source domains. The second stage was to evaluate potential metaphors, their appropriateness, limits and familiarity for the audience. We retained three main metaphors: road network, railway network and post, illustrated by (Tab. 1).

Source domain	Concepts of source domain	Concepts of target domain
Road network	road, highway roadmap traffic jam	link routing table congestion
Railway network	track switch, marshalling yard	link router
Postal communications	envelop, parcel sorting office	packet router

Table 1: Examples of metaphors

Other metaphors could have been kept, like ants routing or water supply, but we found that detailed study of metaphors brings about fundamental questions on the domain knowledge and is therefore time consuming, so we had to limit the number of metaphors.
The third stage was to develop metaphors in the design task, which is here to develop a hypermedia. The tasks involved text writing of the metaphor (explaining similarities and dissimilarities), search for meaningful pictures of source domains and linking analog concepts in the source and target domain.

5.2 Realization Of The Prototype

The prototype is a hypermedia composed of four parts: three source module corresponding to each source domain and one target module. The format is basic HTML pages, stored in an Apache Web server. Because of the limited time we had, we have realized a simplified version compared to the generic environment described above: hypertext links are "one-way" from source to target domain, links from the concept map to the hypermedia documents are not proposed and documents of the target domain come from conversion of PowerPoint slides into HTML pages (60 slides). Each source module contains text and images explaining the source domain, like in (Fig.4) which is a screen shot of the postal metaphor: those compartments, used in a sorting office to sort letters according to various destinations, are similar to a routing table in a computer network router.

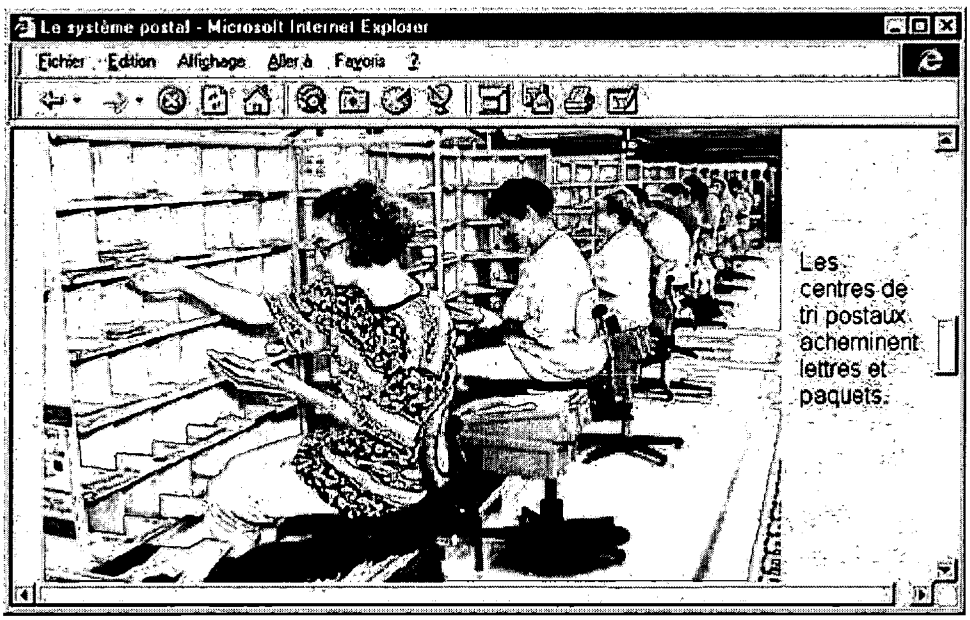


Figure 4: Example of hypermedia page for postal source domain

Concerning the concept map construction, after an evaluation of various concept mapping and diagramming tools, we have choose a professional diagramming software, iGrafx 8.0, because it allows, in addition of diagramming and annotating features, several display levels which are useful to show or hide metaphors from different source domains.

5.3 Experimentation

We have carried an experimentation with a group of mature students pursuing continuing education (master degree specialized in management of computer networks at Ecole Centrale de Lyon). The objectives were to evaluate the features of the prototype, to evaluate the appropriateness of metaphors and to evaluate understanding of learners, trained with and without metaphors. Two training sessions of three hours with the same group of seven students were set up, after a lecture on routing. In the first session, they had to construct a concept map of routing (15

concepts were given and they had to add at least 10 other concepts). In the second session, they could browse the prototype and they had to work again on their concept map and to set metaphors on it. Collected data, for each session and for each student, were a questionnaire and a concept map.
This experiment showed, regarding the prototype's features, that activities and tools for concept maps' construction and metaphors' indication were satisfying, but could be improved. For example, one student suggested that a non-graphical method for concept matching should be more adapted because he had spent too much time to set the metaphors on his concept map. From the metaphors' point of view, all students told that learning with metaphors was interesting, and metaphors in the prototype were appreciated, the most quoted being the road network metaphor. From the learner's understanding point of view, 2 students told that it helped them a lot, 4 that it helped them slightly, and one person that it didn't helped.

6. Conclusion

We have proposed a generic framework for an innovative learning environment implementing the metaphor instructional strategy. This tool is based on hypermedia and concept mapping and fits in the constructivist point of view. We found that it could also be used by teachers for thinking about metaphors. We have realized a prototype for computer networks, which showed that finding and implementing appropriate metaphors is time consuming. This prototype was evaluated with only a small number of students, but it has proved the interest of this metaphorical approach and showed that the features of the tool were convenient but could be improved.

It has also raised a lot of questions like: What are the most interesting instructional activities to propose? How to design the hypermedia source and target module? How can limits of metaphors be better taken into account in the tool? What are all the uses for the learner, the teacher and also the CBT designer? What his the best period for the use of this environment by students? How could this approach be integrated with other instructional strategies? A more elaborated prototype and other experiments should be set up in order to give some answers, and to finally develop a design method.

Beyond the fact that this environment should provide a more efficient learning, it may help the learner to develop his/her autonomy and reflection on the domain knowledge, especially in thinking about the relations between different domains. In this sense, this tool may also be useful to develop the sense of abstraction.

7. References

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Teaching Science through Web Adventures

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Abstract: This demonstration presents an interactive web adventure designed using Flash 4.0. The adventure series entitled, *The Reconstructors*, is funded by the National Institute on Drug Abuse with a focus on the history and science of opiates. It was created for middle school students to cover topics such as neurotransmission and involves virtual experiments. Students enter a futuristic world in which they become "reconstructors," members of an elite scientific unit charged with recovering lost medical knowledge. Episodes have been evaluated through a comprehensive process involving students, teachers, and scientists. Analysis of the pre- and post-test scores demonstrated significant knowledge gain that can be attributed to use of the game. Qualitative comments from students revealed that the key factors that kept students interested and motivated in using the game included an engaging problem, interesting characters, sound, and a contemporary appearance. The front-end research, development process, and outcomes will be discussed.

PEDAGOGICAL ISSUES ON THE USE OFWEB BASED RESOURCES

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Abstract: Universal secondary education was introduced into Trinidad and Tobago in 2000. The immediate consequence is the placement in secondary students of students whose literacy and numeracy skills are inadequate for the successful access of secondary education. This has provided a challenge for ensuring adequate learning outcomes and appropriate instruction. It has been proposed to employ web-based resources and distance learning strategies to assist these students and their teachers. However, several pedagogical concerns have to be addressed:

i. the nature of the insertion of web-based resources into the instructional context;
ii. the choice of instructional objectives – imitative or creative;
iii. adequacy of teacher training; and
iv. students' perception of the instructional milieu.

Universal secondary education was introduced in Trinidad and Tobago in 2000. For the first time in our history, every child who sat the Common Entrance examination in Trinidad & Tobago was placed in an institution for the purpose of secondary education. There is a lack of places in the secondary school system and other post-primary were asked to accept students from the primary schools. Students have therefore been placed in a variety of institutions: state-funded secondary schools managed by denominational boards; secondary schools managed by the state; private secondary schools; vocational centres managed by NGOs; primary schools which are under-populated.

The placement of all students has provided a challenge for ensuring adequate learning outcomes and appropriate instruction. The immediate consequence is the placement in secondary institutions of students whose literacy and numeracy skills are inadequate for them to successfully access secondary education. The challenge is two-fold*: to provide appropriate instruction to meet their needs of those whose skills are poor;* and *to provide adequate instruction to students in large mixed ability groupings* Remedial tutors have been hired and assigned to assist these students and their secondary teachers in the areas of Mathematics and Language. It has been proposed to employ web-based resources and distance learning strategies to assist these students and their teachers. The intent is that instructional resources and ideas and information will be communicated to tutors and teachers; and exercises and activities for students will be provided via the Internet. The classroom teacher would therefore be able to provide tasks for different attainment levels while having time to devote to those who need the most assistance.

A brief review of modern educational trends shows that every new technology is embraced as a panacea for educational ills. The proposal recognises that the Web will produce a change in the delivery of instruction. The instructor will be a facilitator assisting each individual as he/she tries to complete the tasks. Study will become more task oriented and allow for grouping according to interests. It is conceivable that while studying a specific region in Social Studies, one group would be chatting with students in another country or sending e-mailing, another would be scanning the fact sheet put out by international agencies or reading an on-line newspaper from the region or working on exercises or tests put on the Student Website. However, several pedagogical concerns need to be addressed before the project can be implemented

The design of instructional media is determined by its insertion into the instructional context. Its role must be agreed if intended benefits are to be derived. Will the use of web-based resources be core or peripheral? Media can be used in at least nine ways in the instructional context: *to gain attention; inform the learner* *of objectives; stimulate recall of prerequisites; present stimulus material; provide learner guidance; elicit a response; provide feedback; assess performance; enhance retention and transfer* (Gagne et al, 1988). The Web has the capacity for multi-media presentation but the use of various media must be informed by its purpose. Will its use be passive, active or interactive? Passive use should necessarily be brief. Interactivity demands particular sensitivity to the needs of individual learners. Where interaction with the instructional content is essential then design must facilitate control and repetition.

Is the learner to be shaped or is he an important actor in prescribing instructional outcomes.? Feedback is adaptive and imitative and so the design of instructional resources or courseware will seek to shape learning outcomes. However, creativity assumes assimilation and so the pace of delivery must be controlled by the student. Non-sequential presentation of material or 'branching' is more suited to such learning. The provision of remedial tutors underscores an assumption that the needs of students is remediation. Remediation presupposes that students need to be shaped to a norm and so instruction tends to be imitative. Material developed for this mode will not yield control to the student. Yet lack of opportunity for mastery reduces the motivation to learn.

The issue of teacher education is of paramount importance in this context as an understanding of theoretical underpinnings influence the role of the teachers, their perception of learner needs and consequent use of instructional resources. While media may be used as passive, active or interactive, each medium has its strengths. Gratuitous use of multi-media because it is available does not enhance the instructional context. One medium may distract attention from the other. If the resources provided are seen as teaching aids then the instructional mode is teacher centred. Media, adequately used, can facilitate student centred learning and promote mastery learning. Any use of Web-based resources must be appropriate to the culture, and the ability and experiences of students.

The capabilities of students limit the effectiveness of a medium. Language skills also determine the structure of the content. Content depth, length of passage, layout styles should be based on the need to sustain interest and motivation. Variety and diversity are watchwords but the ease of processing is the bedrock on which successful design is built. Whatever the medium or media used the instructional environment must ensure that students possess the skills necessary for successful learning outcomes. Mere exposure to various media does not guarantee successful manipulation of them or appropriate processing of information.

The novelty of the Internet and computers needs to be considered. Duby (1991) found that students' perception of tasks influence their approach and motivation. If the medium is seen as entertainment little mental effort is invested and learning is minimal. Design should be culturally sensitive, taking into consideration the pace of life, colours and images. While motion may draw attention, excessive use may be distracting. The use of computers for higher order learning through simulations and animations is far more effective than 'drills and practice'(Castro, 1998).

There may be no correct use of Web-based resources. Nonetheless, the use of media should change the form of educational structures as instructional objectives shape the nature of the instructional milieu. Given its capacity for multi-media representation and its non-sequential structure, it offers anopportunity for enhance learning. *It also presents a challenge for informed planning if the potential is to realised.* In the context of this project consideration must be given to whether the medium - the Web – will carry supplemental or core material. On this decision hinges the objectives and the design of resources.

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Developing a questionnaire to measure the effectiveness of computers in teaching

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Abstract: This paper uses the data from a longitudinal study to conduct a series of factor analysis to test the reliability of a set of items to measure the effectiveness of the use of computers in higher education. The results suggest that there are specific clusters of items that can be used to measure the effectiveness by using the surrogate measure of attitudes towards the use of computers in teaching.

Introduction

One of the thorniest problems following the introduction of computers in education has been assessing the efficacy of technology in improving the quality of education. There is little doubt that technology and education are now intimately associated and there is a growing application of technological tools in the educational process (see, e.g., Brown, 2000; Oblinger and Rush, 1997). This increased application of technology is constantly calling for the need for better assessment of the effects of technology and there are relatively few good methods of evaluating this efficacy (Reeves, 1998; Woodrow, 1994; Woodrow, 1996). There are several problems related to the process of evaluation with the primary being the lack of a good measurement tool to track changes in the educational outcome. This problem is also related to the fact that "learning" itself is a slippery term and defies universal definition, making the quantification and measurement of learning a tricky process. Indeed, without a robust definition it becomes particularly difficult to measure it.

It has been suggested that learning can be measured using other "surrogate" measuring techniques such as the evaluation of the changes in the *attitudes towards* learning and the changes in the learning *process*. Based on the examination of a series of assessment projects, Mitra and Hullett (1997) has suggested that attitudes towards technology can perform as an alternative way to measure the effectiveness of the introduction of technology in the learning place. This approach has been applied to various academic scenarios to report on the ways in which technology continues to impact the process of teaching and learning (see, e.g., Lawson and Pelzer, 1999; McQueen and Fleck, 1999; Merisotis and Phipps, 1999; Mitra, et. al., in press; Mitra, et. al., 2000; Mitra, et. al., 1999; Mitra and Hazen, 1999; Mitra, 1998; Phipps and Merisotis, 1999). However, what has still remained a challenge is trying to find a particularly robust set of measures that would address all the different aspects of the effects of technology in teaching. Woodrow (1991) reported on the analysis of four different attitude scales and all of them tended to measure different attributes of the outcome of the application of technology in teaching. Furthermore, with the changes in technology some of the specific aspects of the measurement continue to change as well, thus making some of the scales inappropriate for the current mode of technology intervention.

In this paper it is suggested that it is possible to identify some specific aspects of the outcome of the technology use in teaching where the factors being measured are not necessarily technologically determined. In stead, the factors being measured are more fundamental constructs of the human-technology interaction in the educational setting and thus can be applied more broadly to several different assessment situations and can be more universally applied. Using the data from an ongoing longitudinal study of the application of technology in an American private liberal arts institution, it is possible to show that there are certain fundamental aspects of the effects of the application of technology that can be measured using reliable attitude items.

Methodology and Data

This paper utilizes the data from a longitudinal study to assess the impact of technology introduction in liberal arts education at a non-technical small private university in the United States. The data was collected over four academic years and this *post hoc* analysis uses the data collected in the spring of 1999 from a sample of students who responded to a questionnaire mailed to them. The questionnaire was developed by conducting a series of focus group meetings that explored the various technology-related issues that the students were facing with the universal and standardized introduction of technology in teaching. The questionnaire included nearly fifty attitude items measured on a five-point Lickert-type scale. Of these fifty, there were several items that were specific to the local conditions of the university. The remaining items have been analyzed here. The entire questionnaire also consisted of usage questions and demographic questions.

Analysis and Results

The analysis included two components: first, a factor analysis that elicited four factors on the basis of twenty-five items that were selected as the general attitude items in the questionnaire and second, the items that loaded on the same factor were subject to reliability tests (Cronbach's alpha) to explore the levels of reliability of the similar items.

The 25 items were analyzed using a varimax rotation and this resulted in four major factor loadings. These are reported in the next table.

Table 1: Factor loadings

Factor 1	Loading
1. Talking face-to-face with professors is generally gratifying	.984
2. Computers enable me to interact more with professors	.488
3. The use of computers positively impacts the social life	.976
4. The use of computers makes the academic climate of Wake Forest intellectually exciting	.984
5. The use of computers is increasing cooperative learning at WFU	.749
6. Computer mediated communication makes it easy to maintain relationships	.982
7. Computers provide a non-threatening way to communicate	.628
8. Computers allow me to communicate with people I would not normally be able to communicate with	.921
9. When communicating using a computer one does not need to be formal	.976
10. The use of computers is strengthening the academic climate	.983
Factor 2	
11. Computers are effective for communicating with other students about class related work	.824
12. Computers are effective for communicating with faculty about class related work	.888
13. Computers are effective for communicating with other students about non-course related subjects	.802
14. Computers are effective for communicating with faculty about non-course related topics	.691
15. Communicating with professors by e-mail is generally gratifying	.628
Factor 3	
16. I would stay away from classes that do not use computers	.920
17. The computerization process poses a threat to my privacy	.810
18. The adoption of computers will give more power to the instructors	.922
19. Computer use increases the usual college work load	.293
Factor 4	
20. There is a need for classes which teach "how to" use a computer	.142
21. I prefer classes in which I get to use computers	.502
22. Computer use helps me better understand the course material	.571
23. I prefer classes with "hands-on" computer experiences	.610

24. I expect that I will be required to use the computer	.616
25. I expect ALL instructors at Wake Forest will use the computer in teaching	.687

The factor analysis was followed by the computation of the inter-item reliability for the items within each of the factors. This correlation was high, with the Chronbach's alphas for the four factors reported in the next table.

Table 2: Alpha value for each factor

Factor Number	Alpha
1	.93
2	.81
3	.75
4	.36

While the alpha values reported in Table 2 are relatively high, a second set of alpha values were computed after dropping from the set the item with the lowest factor weight from each of the factors reported in Table 1. This resulted in higher alpha values and thus a more robust set of items. These adjusted alpha values are reported in the next table.

Table 3: Alpha values after dropping item with least weight

Factor Number	Alpha
1 (drop Item 2)	.96
2 (drop Item 15)	.81
3 (drop Item 19)	.81
4 (drop Item 20)	.51

These results suggest that it is possible to propose a computer attitude scale with 21 items which could serve as a surrogate measure for learning outcomes by providing an evaluation of the attitudes of students towards the use of computers in teaching. The items all could use a five-point Lickert type scale with '5' being 'strongly agree,' '4' being 'agree,' '3' being 'no opinion,' '2' being 'disagree,' and '1' being strongly disagree.' The items are now presented with slight alterations in the reference to a specific university so that the items can be used at any place of higher education.

Table 4: Attitude items

Talking face-to-face with professors is generally gratifying
The use of computers positively impacts the social life
The use of computers makes the academic climate of the university intellectually exciting
The use of computers is increasing cooperative learning at the university
Computer mediated communication makes it easy to maintain relationships
Computers provide a non-threatening way to communicate
Computers allow me to communicate with people I would not normally be able to communicate with
When communicating using a computer one does not need to be formal
The use of computers is strengthening the academic climate
Computers are effective for communicating with other students about class related work
Computers are effective for communicating with faculty about class related work
Computers are effective for communicating with other students about non-course related subjects
Computers are effective for communicating with faculty about non-course related topics
I would stay away from classes that do not use computers
The computerization process poses a threat to my privacy
The adoption of computers will give more power to the instructors
I prefer classes in which I get to use computers
Computer use helps me better understand the course material
I prefer classes with "hands-on" computer experiences

I expect that I will be required to use the computer	
I expect ALL instructors will use the computer in teaching	

Discussion

The analysis presented here first suggests that it is possible to develop standardized items that can be used to measure the attitude of students towards the introduction of computers in teaching. The items, by clustering around four factors, also represent specific attributes of the effects of computerization that can become yardsticks for the more urgent question of measuring the effectiveness of computers in enhancing learning. In presenting the findings from several different studies, Mitra and Hullett (1997) have indicated that "predsipositions" play an important role in the perception of the effectiveness of computer aided instruction. Within the notion of predisposition, the authors included issues such as comfort with computers, the rapidity of the introduction of computers and other such perceptual ideas. Additionally, the authors noted that technographics, context and technological sophistication could also play roles in the determination of effectiveness of computers in instruction.

The results of this study help to support the findings of Mitra and Hullet (1997), but also suggest that the idea of measuring predsipositions need to be made more elaborate and must include a large array of perceptual parameters. Indeed, some of these parameters are no longer only predsipositions but also include perceptions that develop as computer aided instruction becomes more prevalent on college campuses. In other words, the perceptions that can determine the effectiveness are not only the ones that the students possess as they are initiated to computer aided instruction, but the effectiveness could also depend on perceptions that develop with continued exposure to computer aided instruction. Indeed, the four factors identified here represent four major perceptual categories all of which arguably can have an impact on the perceived effectiveness of the computerization process. This is supported also by arguments made by authors such as Pacey (1983) and Negroponte (1995) who have suggested that the effectiveness of computers often depends on the way in which the users might perceive the values associated with the "practice" of using computers. Thus, by measuring the values and expectations related to computers in teaching, it might be possible to arrive at a more reliable measure of the effectiveness. The data from this study suggests that there are four kéy values that can be measured as represented in the four factors identified in the analysis.

The first parameter that needs to be measured can be called "climate of interaction." Clearly, the computer has become a key form of an interaction device for the students and the effectiveness of the computer as an interactive tool can have a large impact on the way in which the computer becomes effective in instruction. Consequently, by knowing how well the environment supports the interactive applications of the computer could have a lot to do with how students evaluate the effectiveness of the computer in education. Extrapolating from there, it is also possible to argue that if indeed the computer enhances interaction then it could begin to play a critical role in transforming the instructional environment. Thus it is important to measure the way in which students perceive the enhancements in interaction with the introduction of computers. Interestingly, this enhancement is not only with the use of computer mediated communication, but the very presence of the computer and the accompanying shifts in the climate of the institution can also affect the more traditional forms of communication such as "face-to-face" interactions. The data suggests that such attributes should also be measured to get a sense of the changes in the climate of interaction that follows the introduction of technology. Thus the following items could be used to measure the climate of interaction.

- Talking face-to-face with professors is generally gratifying
- The use of computers positively impacts the social life
- The use of computers makes the academic climate of the university intellectually exciting
- The use of computers is increasing cooperative learning at the university
- Computer mediated communication makes it easy to maintain relationships
- Computers provide a non-threatening way to communicate
- Computers allow me to communicate with people I would not normally be able to communicate with
- When communicating using a computer one does not need to be formal
- The use of computers is strengthening the academic climate

The second parameter that emerges as important is also related to communication and can be labeled, "communicative effectiveness." Unlike the earlier item which is broad-based and addresses issues related to the overall climate of an academic institution, this second factor includes attributes that focus primarily on the role of the computer in the pragmatic act of communicating. It can be argued that a change in the perception of the effectiveness of the computer in facilitating communication could have an impact on the learning outcome. Consequently, it is important to be able to measure how effective the computer is considered to be in communicating with various groups with whom students typically have to communicate in the course of their academic activities in college. The following items refer to the communicative effectiveness of the computer in education.

- Computers are effective for communicating with other students about class related work
- Computers are effective for communicating with faculty about class related work
- Computers are effective for communicating with other students about non-course related subjects
- Computers are effective for communicating with faculty about non-course related topics

The third parameter that is important to measure to obtain an evaluation of the computer in instruction can be called the "abstract expectations" of the students as they are placed in a computer aided instruction situation. It is clear that the promises of technology tend to alter what students can expect from the computer and the instructional situation that they are placed in. These expectations, and how well they are met, can have a direct impact on the way in which students react to the overall use of technology in instruction. There are many facets of these abstract expectation and they include expectations about the level of use of computers in learning; apprehensions about the loss of privacy and concerns about the increases in the power inequity between the teacher and the student. In many cases these might strictly be perceptions and the changes are not as dramatic as the students might think they are, but it is still important to measure these expectations because people with different expectations could easily have different assessments of the effectiveness of the computer in teaching (see, e.g., Mitra, et. al., 1999). Therefore, the following items can be used to measure the abstract expectations related to the introduction of computers in teaching.

- I would stay away from classes that do not use computers
- The computerization process poses a threat to my privacy
- The adoption of computers will give more power to the instructors
- I prefer classes in which I get to use computers

Following from the notion of abstract expectations, there is a fourth parameter that should also be measured to develop an assessment of the effectiveness of the computer in teaching. The fourth parameter can be called, "pragmatic expectations." These items also deal with the notion of the benefits and burdens of technology, but focus more on the specific ways in which students anticipate using the computer in the process of learning. Students entering a computer-enriched environment often come with specific expectations about what the computer could do to transform the learning process. If they perceive that there will be a positive transformation it is possible that their learning will be enhanced as well. Thus, it is important to measure what the students expect in terms of what the computer can do to transform their comprehension of the material being taught. This change is in turn related to the ways in which the students feel about the extent of their computer use with "hands on" application as well as the breadth of the computer use in terms of the number of classes in which they might be asked to use the computer. As pointed out in earlier research, these issues can impact the students' general assessment of the role and effectiveness of the computer in the practice of teaching. These items take the focus of attention away from a technologically determined, technology-centric view to a more sociologically determined focus on the practice of technology (Pacey, 1983). The following items attempt to measure this aspect of the pragmatic exceptions arising from the practice of using computers in teaching.

- Computer use helps me better understand the course material
- I prefer classes with "hands-on" computer experiences
- I expect that I will be required to use the computer
- I expect ALL instructors will use the computer in teaching

In summary, this paper and the data offers a valid and reliable measurement of four key parameters that can serve as indicators for the assessment of the effectiveness of computers in teaching. While these measurements offer an initial glimpse on the thorny question of measuring the effectiveness of computer assisted teaching, they do not, however, claim to be direct measurements of the teaching effectiveness. These items only offer alternative and surrogate measurements which, however, can be coupled with more direct measurements.

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ITMS: Individualized Teaching Material System

-Adaptive Integration of Web Pages Distributed in Some Servers-

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Abstract: Web-based Adaptive Educational System (Web-based AES) has actively been developed. However, it is doubtful whether the system is useful to learners, since the system mainly deals with Web pages fixed in one server. Web-based AES should deal with various Web pages distributed in some servers in order to fulfill the learners' diversity. We developed a Web-based AES named ITMS (Individualized Teaching Material System). ITMS adaptively integrates knowledge on the distributed Web pages and generates individualized teaching material that has various contents. ITMS also presumes the learners' knowledge levels from the states of their knowledge reference instead of tests or questionnaires. This paper describes the framework of adaptive knowledge integration, the method of the presumption, and the overview of ITMS.

Introduction

In the past Adaptive Educational System (AES) was developed as a stand-alone system. Web-based AES has recently come to be developed by the rapid increase of the Web (Brusilovsky 2000). Nowadays Web pages are expected to be teaching material for life-long learning. This expectation will strongly increase the development of Web-based AES. However, it is doubtful whether the current Web-based AES is useful to learners. This is because the Web-based AES mainly deals with Web pages fixed in one server regardless of the learners' diversity, namely it does not provide the learners with useful contents created by various authors all of the world. If learners only utilize search engines, they will be able to receive piles of various Web pages. However, the piles consequently will bother them, which is what is called disorientation (getting lost) and information overload. This indicates that the accuracy and the usability of search engines are not enough for educational usage. There are a few Web-based AESs partially deal with the distributed Web pages. For example, AHA adapts hyperlinks that connect with the distributed Web pages to learners' knowledge levels (De Bra & Calvi 1998). However, these systems do not seem to solve the disorientation and the information overload on the distributed Web pages, not restricting the learners' movement among the distributed Web pages completely.

Our research goal is to adaptively provide learners with useful teaching material created by various authors and furthermore is to avoid the disorientation and the information overload in the teaching material. We developed a Web-based AES named ITMS (Individualized Teaching Material System). ITMS adaptively integrates knowledge on Web pages distributed in some servers and generates individualized teaching material that has various contents. An adaptive aspect of ITMS is to inform the learners of knowledge they should/must refer to on the basis of their knowledge levels. ITMS additionally avoid the disorientation and the information overload by contriving knowledge presentation. Here, there is a problem how ITMS assesses the learners' knowledge levels. AES needs to assess the levels frequently for proper adaptation. However, frequent tests/questionnaires will cause the learners loads. We are trying to presume the levels from the states of the learners' knowledge reference.

Framework of Adaptive Knowledge Integration

Educational Web pages need to contain a lot of the related knowledge, taking into consideration diverse kinds of learners' readiness. Especially prerequisite knowledge is essential in order to prevent novice learners from having a learning impasse caused by the contents of Web pages. However, it is hard for authors to create these Web pages by themselves. Even if they can do it, the Web pages will not have the contents organized with various viewpoints.

Hence we propose the framework that adaptively integrates a lot of the related knowledge and generates individualized teaching material. This knowledge, needless to say, is created by various authors and can be stored in distributed servers. We developed ITMS according to this framework.

Knowledge Creation

The authors create knowledge for integrating in the following order.

(i) They create educational Web pages.
(ii) They divide the Web pages into small fragments (For example, fragments on a certain formula in mathematics are "the formula", "the explanations", "the demonstration", and "the exercises").
(iii) They make an index of each fragment using HTML comments designated by ITMS (The fragments do not have semantic attributes).

The fragments can contain fragments created by various authors inside them, namely various kinds of knowledge can be structured hierarchically. The authors only describe the pointers (URLs) to the distributed Web pages containing the indexed fragments in order to structure the fragments. ITMS provides the authors with creating large-scale teaching material easily.

Integration Method

ITMS generates individualized teaching material in the following order.

(i) It receives the request of a Web page from a learner.
(ii) It analyzes the hierarchical knowledge structure through the pointers, regarding the requested page as the root.
(iii) It acquires sequentially the knowledge on the distributed Web pages on the basis of the analyzed structure.
(iv) It integrates the acquired knowledge into the requested page.

ITMS adopts hierarchical stretch-text as a method of knowledge presentation in order to facilitate the learners' knowledge reference. Hierarchical stretch-text, which contains knowledge hierarchically inside it, is expanded and collapsed by the learners' preference. When the learners need to refer to knowledge inside it, they click the title of the knowledge (the trigger of the stretch-text) and the knowledge is expanded beside the title. It is indicated that stretch-text (hierarchical stretch-text) is effective in the decrease of getting lost and information overload (Boyle & Encarnacion 1994)(Höök et al. 1996)(Murray et al. 2000). Although conventional stretch-text mainly deals with text data, hierarchical stretch-text in ITMS deals with various data such as images, movies and Java applet.

Adaptation

ITMS adapts the contents of the individualized teaching material to the learners' knowledge levels by embedding visual annotation (Brusilovsky 1995) and knowledge hierarchy alteration. The two methods, which inform the learners of knowledge they should/must refer to, not only prevent the decline of their knowledge levels but also are useful in presuming the levels.

Taking into consideration the fine-grained knowledge for integrating, we simply classify the knowledge levels as follows: "understanding", "unstable understanding", and "no understanding". The next section describes the presuming method. Table 1 shows the relation between the knowledge level and the adaptation. Figure 1 shows the overview of the adaptive knowledge integration.

Knowledge Level	Adaptation
understanding	A circular blue icon, which means knowledge that a learner does not have to refer to, is embedded beside the title of the knowledge.
unstable understanding	A circular yellow icon, which means knowledge that a learner should refer to, is embedded beside the title of the knowledge.
no understanding	Knowledge, which a learner must refer to, is transferred to the top layer of a new Web page and a circular red icon is embedded beside the title of the knowledge. Additionally, a star-shaped red icon, which means the transfer of the knowledge, is embedded in the original location of the knowledge.

Table 1. The relation between the knowledge level and the adaptation

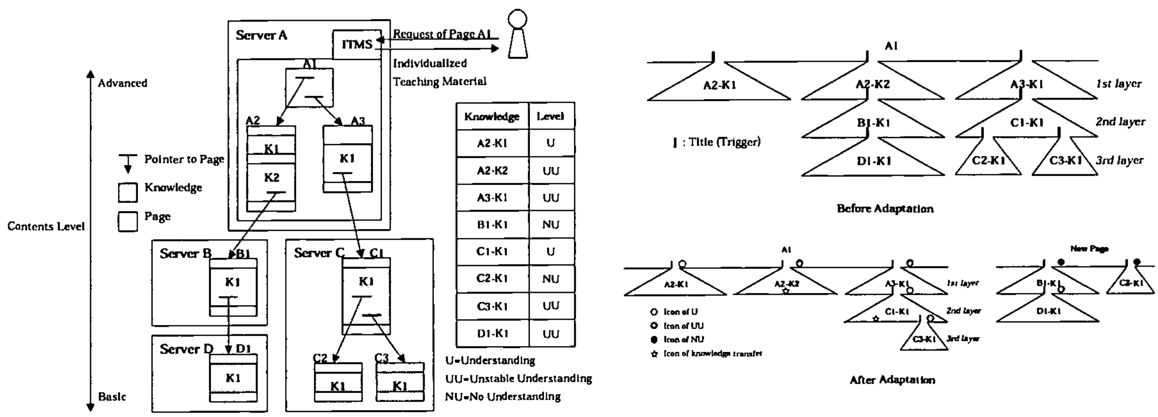

Figure 1. The overview of the adaptive knowledge integration

Method for Presuming Learners' Knowledge Levels

Fundamental Idea

Tests and questionnaires are methods for assessing learners' knowledge levels correctly. Frequent tests/questionnaires are necessary for AES to assess their latest knowledge levels, whereas the frequent test/questionnaires will cause the learners loads.

ITMS needs to assess their latest knowledge levels in order to provide proper adaptation. Accordingly it utilizes the states of their knowledge reference as elements for presuming the levels. Activities of their knowledge reference do not cause them loads basically, based on their intention.

Related Works

It is indicated that data on learners' activities in hypermedia is so insufficient that AES should not independently use the data to presume their knowledge levels (Brusilovsky 1996). Especially data from a Web browser such as browsing history may be unreliable.

There are some AESs that presume their knowledge levels from such activities (Hohl et al. 1996) (Wu et al. 2000). These systems, which mainly utilize data on the activities and data on knowledge structure of a domain (domain model) for the presumption, do not take into consideration the decline of the levels, namely it is difficult for these systems to assess their latest knowledge levels. Although some of these systems allow the learners to modify their own levels (user model), their modifications are not always correct and might be loads.

Method

We hypothesize that learners autonomously refer to knowledge if they do not understand the knowledge. Accordingly, this hypothesis indicates that the states of their knowledge reference are strongly related to their knowledge levels. Specific hypotheses are as follows:

(a) Learners do not refer to knowledge they understand.
(b) Learners refer to knowledge they do not understand.
(c) Learners understand knowledge just after referring to the knowledge.
(d) As the time passes, learners' knowledge levels decline.

On the basis of the above hypotheses, ITMS assesses the level of the knowledge that the learners can directly refer to at "understanding" regardless of the sates of the reference. In other words, the level of the stretch-text that the learners can directly expand is assessed at "understanding". Hence it is important how ITMS presumes the level of the knowledge that the learners cannot directly refer to, namely hidden knowledge. To take an example in "Before Adaptation" in Figure1, ITMS assesses all the level of A2-K1, A2-K2 and A3-K1 at "understanding" and cannot assess the level of the others in the case that a learner refers to A1, since it is unknown whether the learner is aware of the others.

ITMS presumes the level of the hidden knowledge from the frequency of sequential presence of the hidden knowledge. In the case that the frequency reaches thresholds that are related to the knowledge levels, ITMS adapts the knowledge presentation in order to make the learners be aware of the hidden knowledge. The knowledge hierarchy alteration presents the hidden knowledge that was presumed to be in "no understanding" on the front Web browser as a new Web page. By this alteration, the learners will surely be aware of the hidden knowledge of importance and ITMS assesses their latest knowledge levels. Table 2 shows the relation between the knowledge level and the threshold.

Knowledge Level	Threshold (Initial value)
understanding	--
unstable understanding	2
no understanding	5

Table 2. The relation between the knowledge level and the threshold

ITMS modifies the thresholds from hypothesis (a) and (b) and realizes fine-grained adaptation. The rules for modifying the thresholds are shown below.

```
if (Level of Knowledge X == "unstable understanding"){
        if (Learners referred to Knowledge X){
                Threshold of "unstable understanding" of Knowledge X --   (>2)
        }
        elseif (Learners did not refer to Knowledge X){
                Threshold of "unstable understanding" of Knowledge X ++
        }
}
elseif (Level of Knowledge X == "no understanding"){
        if (Learners referred to Knowledge X){
                Threshold of "no understanding" of Knowledge X --   (>5)
        }
        elseif (Learners did not refer to Knowledge X){
                Threshold of "no understanding" of Knowledge X ++
        }
}
```

ITMS

System Architecture

ITMS may be popularized from the reason of a client/server system with simple architecture, which does not need additional devices such as a proxy server. The authors can easily do setup of ITMS. All the learners have to do is prepare a Web browser interprets Dynamic HTML and JavaScript. Figure 2 shows the architecture of ITMS. ITMS, which is implemented using Perl, consists of the following modules and databases.

Data Receiving Module (DRM): This module receives all of the data from the learners (login name, page request and the states of knowledge reference).
Knowledge Level Presumption Module (KLPM): This module presumes their knowledge levels from the data of their knowledge reference and the thresholds.
Knowledge Integration Module (KIM): This module adaptively integrates the related knowledge and generates individualized teaching material. It additionally attaches JavaScript that observes the states of their knowledge reference to the individualized teaching material.
Knowledge Reference DB (KRDB): This database has the data of the states of their knowledge reference.
Knowledge Level DB (KLDB): This database has the data of their knowledge levels (the thresholds of each knowledge).
Knowledge Metadata DB (KMDB): This database has the metadata (index and location) on the integrating knowledge.
Teaching Material DB (TMDB): This database has educational Web pages containing the integrating knowledge.

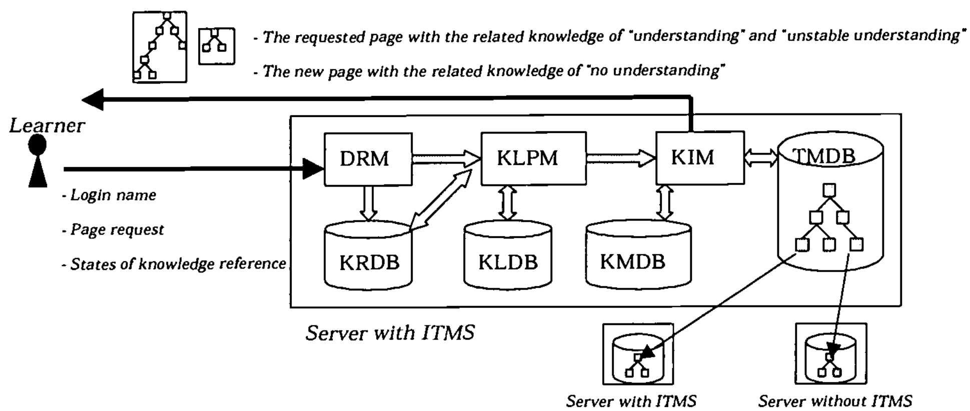

Figure 2. The architecture of ITMS

An Example of Adaptive Knowledge Integration

We created educational Web pages on CG (Computer Graphics), which contain the prerequisite knowledge of linear algebra and programming language. The prerequisite knowledge is created by two authors and is stored in two servers. Figure 3 shows a learning example in ITMS. The left Web browser shows one of the educational Web pages that a learner requested. The right Web browser shows a Web page that contains the related knowledge (the prerequisite knowledge) of "no understanding". Hierarchical stretch-text in this example has images and a Java applet. The learner acquires various kinds of knowledge of CG in accordance with the adaptation of ITMS.

Conclusion

This paper described ITMS that has the framework of adaptive knowledge integration. This framework adaptively provides learners with useful teaching material created by various authors. A key feature of ITMS is to deal with Web pages distributed in some servers for the adaptive knowledge integration. ITMS additionally presumes the learners' knowledge levels from the states of their knowledge reference in order to decrease their loads.

The current ITMS has two apparent problems to be solved. One is to prune knowledge unnecessary for the learners. As the integrating knowledge increases, overload to ITMS increases beyond doubt. The other is to manage the knowledge distributed in many servers. The solution of the former may need analyzing the learners' knowledge levels in detail. The introduction of XML for solving the latter is now under consideration.

We are evaluating ITMS by experiments and planning to improve ITMS on the basis of the evaluation. In addition, we are currently applying the framework to exploratory learning in vast Web space.

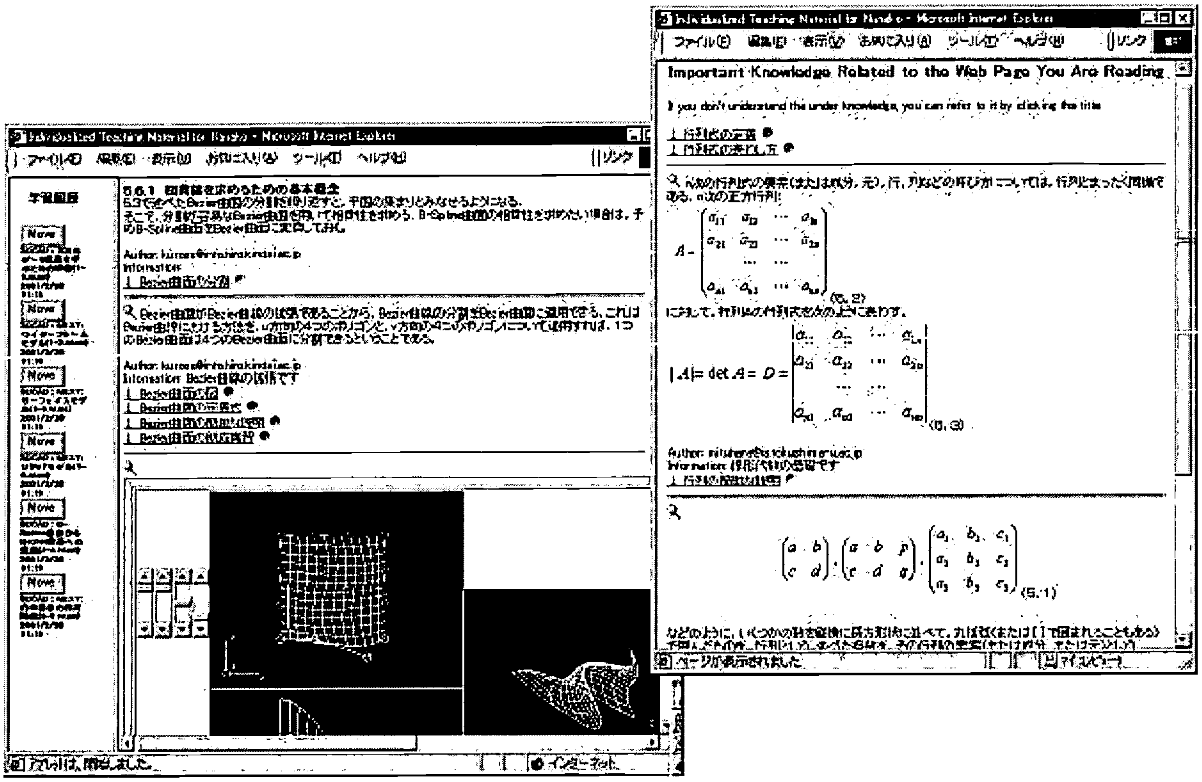

Figure 3. A learning example in ITMS

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SPicE Project: Web-based Instruction in Acquiring Science Process Skills

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Abstract: The evolution of Web-based Instruction (WBI) has created an alternative approach in the learning of science. SPicE project attempts to explore the potentials of WBI in the acquisition of science process skills among elementary children. It provides the necessary elements for children to acquire process skills. This paper describes the rationale of developing the Web-site and the SPicE project itself.

Background

Since the mid-1800's, science educators have argued that the processes of science should be taught as a part of school curriculum. Gagne (1965) views science process skills as the foundation for scientific inquiry and sees knowledge develops inductively from sensory experience. According to him, the skills comprise of basic science process skills and integrated science process skills. Although emphasis on the process approach has been given for the past 50 years, there is no evidence that science courses have been successful in enhancing students' mastery of the science process skills (Yager & Lutz, 1994). The question arise now is to why it has not been successful in enhancing students' mastery of these skills. The answer probably lies in the approach being used in teaching of such skills. Alternative approaches and modes need to be explored. Several studies (eg. Santos & Oliveira, 1999) explored the use of Web in fostering skills such as thinking, problem solving and communication skills, and they found that Web technology can play a vital role in fostering the development of these skills. With the emerging of Web technology in the Malaysian education setting, probably this technology can be one of the approaches to foster the acquisition of science process skills among students.

The SPicE Project

Science Process Skills in Scientific Exploration or in short SPicE Project is part of my on-going doctoral work and it is an instruction in a Web-based environment. SpicE is developed specifically for children of Grade 4 to 6, dedicated particularly to the acquisition of science process skills and is written in the Malay language. Since this is a prototype of SPicE, the project will only focus on one of the 12 skills outlined in the Malaysian Primary Science Syllabus. Using computer in science teaching is not a common phenomenon in Malaysia. However, by 2010 most schools will adopt the Smart School Concept (Ministry of Education, 1997), where technology will be used as an enabler in the teaching and learning. After browsing the net for about three years, it was found that most science sites were dedicated to the acquisition of scientific knowledge and only a few gave focus to the acquisition of science process skills. Moreover, all the sites that emphasized on process skills were in English.

SPicE can be viewed at http://202.190.17.140/~spice/index.html and it is best viewed using Internet Explorer. Since the animation was programmed using Macromedia Flash v. 4.0, Shockwave Plug-in is needed to run SPicE. SpicE requires learner to login. SpicE will then take the learner to the Homepage and later to the main page. Learner needs to 'click' on Integrated Science Process Skills and then on Controlling Variables. On this page, SPicE is indexed into four sections: Aktiviti (Activities), Cabaran SPicE (SPicE Challenge), Forum (on-line discussion) and Hubungan (links to other related sites).

Activities

The main concern of this project is to give ample opportunities for the children to practice the skill. In this section, learner is given two choices of activities; namely the 'Hands-on' activity and 'Simulated Activities'. The

'Hands-on' activity requires learner to perform a pendulum experiment, where washer is used as the weight. Children investigate the effect of the pendulum swing when various length and types of strings being used. Upon completion, children click on 'Log Pemerhatian' (Worksheet) and another window appears where learner fills in the values of different swings and answer some questions related to the activity. Learner then sends the worksheet electronically to a database.

There are three types of 'Simulated Activities' in this program. These activities adopted the direct manipulation approach where students vary the variables by clicking the mouse and immediate feedback is obtained. Each activity is presented at different difficulty levels. Learner completes an electronic worksheet and sends electronically to a database. One of the features of the worksheet is the computer-generated graph.

SPicE Challenge

Besides having the various activities, SPicE also provides the learner with a 12-items quiz, aimed to reinforce the children's understanding on variables, controlling variables and the idea of fair testing. Each item need to be answered before the learner can proceed to the next question. The items are in the form of multiple choice questions and learner chooses the answer by clicking on the radio button.

Forum

Forum is a discussion platform. Learner poses questions, share their experiences and seek help from their teacher and fellow friends. The teacher can serve as an expert in responding to students' problem. This platform allows the children to communicate asynchronously since some students are shy to participate in any classroom discussion.

Linkages

Linkages are links to other local and foreign sites related to elementary science learning. These linkages allow children to explore other sites and interact with the activities available in the sites. This will certainly enrich the children's understanding.

Conclusion

SpicE provides the resources necessary for the acquisition of science process skills among elementary children. It provides a variety of activities for children to choose from, since SPicE's main goal is to provide ample opportunity for learners to acquire skills. SPicE provides an alternative approach for teachers and students to develop a community for exchange of ideas and for solving problem collaboratively. It provides self-assess evaluation to determine the one's own understanding of the intended learning outcomes. It also provides links to other related sources that will assist the children to further enhance their acquisition of the skills.

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The Implications of Well-formedness on Web-based Educational Resources

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Abstract: Within all institutions, web developers are beginning to utilize technologies that make sites more than static information resources. Databases, XML and XSL are key technologies that promise to extend the web beyond the "information storehouse" paradigm and provide additional functionalities. Thus, the purpose of this contribution is twofold. This paper begins by providing background information and an overview to the issues surrounding the transition from HTML to XML occurring on the web today. It must be noted that the implementation of these technologies is not limited to research and development arms of business and industry. Educators can use them to create knowledge warehouses where students can search, examine and consume educational materials more quickly and easily. The second half of this contribution examines a database-driven, education resource used at Purdue University and the efforts to migrate it toward an XML and XSL-based implementation.

Introduction

A web convergence is beginning to dawn upon the horizon of this new millennium. It is a shift from the "immediacy reaction" that spawned the millions of pages in the later half of the 90's to "intelligent proaction" where information, communication, and applications are singular and are guided by a process-based backbone.

In the middle to late 1990's the major concern in education, business and industry was establishing a web presence, using it as a real-time but static information resource. Many institutions frantically invested, web-enabling massive amounts of their data. From the syllabi and supplementary content of educators to the marketing content and the snapshots of corporate entities, most of the attention was spent on just getting information onto the web, with little concern for how it looked, how it was accessed or how it was found. Today, however, the concern has shifted. The motivation is not just about producing pages and pages of static information floating in ethereal global and local domains. It is about managing the converging *processes*, *information*, *communication* and *applications*, making them readily accessible and intelligently presented when and where they are needed. With the multitude of data that exist on the web, managing, finding and quickly interpreting data while at the same time merging processes, communication and applications is critical.

Regardless of content domain, several features and technologies are integral in any effort to make web-enabled data more efficient, intelligent, and effective. Key to this is the understanding that no single technology fulfills all aspects or needed features. Convergence and integration are crucial to generating intelligent web sites. Features of the web-enabled, intelligent enterprise include:

- Dynamic content that changes to meet the needs of the user in a just-in-time fashion.
- Technology implementations that utilize database systems but also allow real-time information updates and customized queries with little management overhead.
- Global data classification and local labeling systems that provide a means for the user to quickly find and access information in a culturally and environmentally independent way.
- Effectively designed media assets that clearly and logically communicate content while considering bandwidth limitations of end users.
- Use of human-computer interface design principles and theory to provide adequate communication channels that are non-interfering, unimposing and transparent to the user.

- Integration of systems and software that link information, communication, applications with a process-based backbone.
- Software that assists, automates and initiates standard processes and provides ready access to the information on which decisions are made.

Databases, XML and XSL

Current literature reveals the significant research and development effort that has been invested in creating web technologies that make managing, searching and finding data and data nodes easier. Much of the literature focuses on the Extensible Markup Language (XML) (Cadinaels, Duval, Olivie, 1998; Fowler, Fowler, Williams, 1996; Harold, 1999). Although most browsers are only beginning to support XML, the implications of future XML and Extensible Stylesheet Language (XSL) solutions are quite significant. XML is not intended to be coded by-hand, as is the case with HTML. Similarly it is not about the aesthetic appearance or layout and design of pages. Rather, XML is much more complex and diverse. XML is a markup language that can be used to not only describe and classify the contents of a page, but also the tagging scheme itself. In this aspect it is considered a meta-markup language because XML classifies content but also includes a self-contained description of the tags used.

The implied result of XML and XSL is that the complete language and technologies used for web site development could turnover completely within the next five years. Also fundamental to this initiative are the integration of open databases or database-type technology structures that are diverse in their content support, easily extensible and web-enabled in all aspects (Hendrikx, Duval, & Olivie, 1999). The combination of these technologies promises greater flexibility and extensibility for web pages and easier development, maintenance and management for the developer. For the end user, searches are more accurate and labeling systems tend to be more logically named and structured. They also enable advanced technologies such as alternative browsing capabilities, voice-based services, and intelligent search and retrieval agents.

Aside from the aforementioned advantages of XML, it allows several unique benefits for the developer. The most insightful is the ability to create domain-specific markup languages. In fields such as chemistry, mathematics and music studies, representing domain specific content, such as chemical bonds, mathematical equations or musical scores on the web, is very difficult. HTML is far too limiting to represent these domain specific symbols and materials, not to mention the limits of computer-based fonts and their inconsistencies across platforms. XML enables the developer to create his own markup language. Because XML both classifies and describes itself, specialized symbol systems can be used on the web with less concern over end-user technology. Examples of XML implementations already exist for chemistry via the Chemical Markup Language – CML (XML-CML.ORG, 2000), mathematics via the Mathematical Markup Language – MathML (Kamthan, 2000), and music via the Music Markup Language – MusicML. Many other general markup languages are also under development, including those for the delivery of multimedia and vector graphics (World Wide Web Consortium, 2000).

As the convergence of technologies continues, in the public sector the transmission, interpretation and creation of data does not go unaffected by developments on the web. Here, too, XML has application and provides significant potential. One of the difficulties in the financial world is the data tracked on consumers. From personal data to financial records, exchanging data about a consumer from one institution to another is difficult due to the variety of software applications and data formats that exist. Another initiative for XML is to use it as an intermediate data format, that is a neutral file format, for storing consumer data so that information exchange can occur more readily.

Migration to XML

The migration path to the implementation of full-scale XML (and eventually XSL) solutions requires careful observation of established rules that make the migration more easily implemented. Additionally, it requires a different approach to development. Except in the case of database-driven sites, most pages today begin as a formatting exercise, establishing the design and visual aspects of the page and then adding content with little or no attention to what the content is (classification). Future implementations based upon XML and XSL reverse this process. With XML, document content is classified and then rules for formatting, based upon the content classifications, are applied. Most of the developmental sites that implement XML use HTML or CSS for formatting. However, future pages will use XML for classification and XSL for formatting, style and visual attributes.

Additionally, future browsers will be based upon XML standards and will be very restrictive of the content they will render.

The rules for enabling the XML and XSL transition, called rules of *well-formedness*, are style and coding modifications that have little adverse effect on the display of pages in today' s browsers. However, the adherence and application of these rules to today' s HTML-based pages is vital to the eventual evolution of pages implemented entirely in XML and XSL, as well as being able to correctly view pages in XML browsers. This is also true when content is pulled from databases, which tend house exponential amounts of data.

In general, the rules of well-formed HTML documents, usually identified by the extension .xhtml, are a means of providing "clean code" and "code mechanisms" on the web. It is given that the majority of pages available on the web are written poorly at best and inconsistencies reign supreme, particularly of those pages created by generators or site management applications. The rules for well-formed HTML documents are in most cases a standardization of features that are inconsistent within the HTML Document Type Definition (DTD). Following the rules of well-formedness when creating HTML documents ensures an easier transition to XML as well as compatibility with future browsers. However, since most of today' s page editors and site management tools do not understand or utilize XML, implementing rules of well-formedness must, in most cases, be performed by hand. The following partial list presents the main rules of well-formedness as they apply to the creation of .xhtml documents:

Close all tags. Within HTML documents, there are many tags that do not require a closing tag, such as <P>, <LI>, and <DT>, when interpreted by the browser. However, within the HTML DTD, it is specified that these tags have closure. Yet, these tags when left unclosed in a page cause problems for XML interpreters and readers. Consequently, adding the closing tags causes no ill effects when rendered in an HTML browser because they are specified within the HTML DTD.

Avoid orphaned tags or overlapped tags. When generating HTML by hand with a text editor, commonly developers will overlap sets of tags. Many page editors and site management tools also allow overlapping tags. For example, a text segment that is to be italic and bold would include both the <B> and<I> tags, one inside the other. When creating composites such as this, it is imperative that the order of the tags be correctly written. If the <B> tag is identified and then <I> tag, the closing order should be </I> and then </B>. If the opening sequence does not match the closing sequence, an orphaned tag exists. Rules of well-formedness require that composite tags be used in logical groupings without orphaning tags.

All attribute values should be encased in quotes. As is common practice, some developers enclose all values in quotes and others do not. Consistency is what is usually stressed. Additionally, there are times when double quotations or apostrophes around attribute values are required by certain browsers, particularly in pages that utilize various scripting languages. Well-formed HTML documents surround every HTML attribute value with quotes for proper interpretation by XML browser.

Use escape sequences for specific symbols. HTML provides a means for providing special symbols within the text rendered in the browser. These escape sequences permit one to include symbols generally used by the HTML code, such as the less than (<), greater than (>), and ampersand (&) symbols. Often developers mistakenly enter these symbols into their content, without realizing that they may or may not be rendered properly. For example, if the developer wants to have an ampersand (&) in his document, &amp should be entered rather than the symbol itself. For well-formed HTML documents, escape sequence use, as opposed to directly typing in the symbol, is mandatory. Also, the HTML version 4 specification included several additional entity references that can be used in pages. However, these character references are not supported and can cause problems in XML browsers. Developers should only use entity references for ampersand (&), greater than and less than symbols (< >), apostrophes ('), and double quotations (").

Include "required" structural tags. Many of the browsers being used with frequency by the general public will ignore terse errors in HTML code, such as forgetting the structural <HTML> and </HTML> tags. For proper interpretation by XML browsers, developers must strictly adhere to the HTML DTD specification and include all required structural tags.

Observe case sensitivity. Unlike HTML, XML is case sensitive. It is best to enter all tags and attributes in lowercase or uppercase, preferably lowercase.

Close empty tags. As opposed to tags that require no closing tags, HTML includes several tags that are called empty tags, such as <BR>, <HR> and <IMG>. A specified in the HTML DTD, these tags have no official closure. Within .xhtml files, these tags must be closed, using <BR />, <HR />, and <IMG /> respectively. Note that for proper interpretation by legacy HTML brows ers and XML browsers there should be a single space between the tag name and the backslash (/).

Implementing the rules of web-formedness within existing large sites is a daunting task. However, where large data resources are concerned, the transition to XML must occur in steps, as it will undoubtedly happen on the web at large as well. The intermediate step is to implement the rules of well-formedness within today's HTML documents. In the future, the complete overhaul of a site from poorly and loosely written HTML straight to the stringencies involved with XML will be significantly more difficult than the evolution from well-formed HTML to XML. Therefore, it is vital that educational institutions design pages according to the rules of well-formedness if they intend to eventually migrate to XML in the future.

At Purdue University

As the university strives to reach the next level of web integration (fully integrated or true distance education), many are concerned with the evolution of technologies taking place on the web. The most significant concern is the evolution from HTML and existing technologies to future XML and XSL implementations. To test the efficacy of this transformation, one of the major resources being used, the *Computer Graphics Question Repository (CGQR)*, has been targeted for evolution to well-formed HTML, and eventually to full-scale XML and XSL. The CGQR contains over 700 questions that have been answered to date.

The CGQR is a database driven site that provides a means for students to ask questions and find answers to pertinent issues related to computer graphics and the courses they are taking. Several of CGT courses are quite large, some including as many and 150 to 200 people. In the past, one of the difficulties for professors was being able to have one-to-one contact with all of his or her students. The CGQR was created to allow professors to be able to impact all the students in the course while also allowing all students to have direct access to the professor in charge of the course, even if they have another individual within smaller laboratory settings. Even within smaller courses, professors have found that the CGQR strengthens the course and thus the CGQR is used heavily across multiple courses and therefore contains a variety of information.

One of the problems in almost all courses is that students are often disinclined to ask questions. This is sometimes due to fear; often the fear that the question they will ask will be a source of embarrassment when answered. However, if qu estions are not asked, the amount of cognitive processing is questionable. Accordingly, the primary purpose for the CGQR is to increase student inquisitiveness as well as increase the learning that occurs both inside and outside the classroom.

CGT professors can use the CGQR in several ways. Predominantly, content for the CGQR is a direct result of lectures and demonstrations in various courses. At the end of every lecture and demonstration, students are required to submit a note card or small piece of paper for attendance purposes. However, in addition to their name, the submission can also include any questions the student may have in regards to the lecture material, particularly those things that might have been confusing or things for which more information is needed. Questions may also be more general in scope or on topics related to computer graphics but not necessarily related to the course topic at hand. The professor then answers these questions and the questions and answers are placed online anonymously. Students can then browse the questions that have been asked and answered, which reduces the number of redundant questions over the life of a course as well as over subsequent course offerings. Consequently, students may also submit questions directly to the CGQR. In this way, the CGQR's effectiveness can reach beyond a single course.

The CGQR provides several means for students to access the information. Every question can be tracked by current course, topic, technology, date as well as specific keywords. Which elements are tracked and recorded depend on what the professor enters when answering the question. When browsing, the student uses drop down menus that are constructed at run-time based upon the entered fields in the database. Students can examine questions related to their particular course; other courses in the department; specific topics such as multimedia, imaging, et cetera; by technology such as HTML, Photoshop, Flash; by date; or by searching for a specific keyword. Once a student has made a selection, all questions pertaining to a particular topic, technology, et cetera are displayed in chronological order on the right hand side of the screen. Students can see the entire history of questions related to their query.

The CGQR has had many positive effects within the courses in the Department of Computer Graphics. The most significant effect is that use of the CGQR has alleviated student fear of asking questions. Students are much more open to questions concerning specific course materials as well as general topics. Although not quantitatively supported, it is assumed that free inquiry by students has been enhanced the CGQR. Additionally, student evaluations frequently comment that the CGQR is one of the best course resources that they have ever had the opportunity to use in any course at the university. Consequently, professors that choose to use the CGQR find that their student evaluation scores are higher as a result. It is assumed that this is due the ability to have oneto-one contact with students. Although face-to-face communication may not be possible in large courses, students perceive the CGQR as an adequate and effective alternative.

One of the primary concerns of professors new to the CGQR is the number of questions they might receive in a given course. With their time already pressed, many shutter at the thought of having to type in questions and their answers for numerous questions. However, within the courses in which the CGQR is being used, on average there are usually less than five questions per lecture or demonstration in a course of 100 students. Sometimes, there are no questions at all. Although the number of questions may vary, generally the time required to answer the questions is negligible, taking less than 15 or 20 minutes following each class meeting. Yet, as revealed by student evaluations, this time is one that is perceived as most valuable by students. Often even if a student asks no questions via the note cards, the option of being able to ask a question is perceived as significant.

Evolving the Computer Graphics Question Repository

The predominant technologies used within the CGQR include an SQL database, server side VBScripting (via Active Server Pages), client-side JavaScript, and HTML. Because most of the data for the CGQR is stored within the database and pulled via ASP pages, very few files required editing. However, the editing that was required was made more difficult due to the meshing of scripting and HTML. Although there are over 700 questions currentlyin the CGQR, the totality of the major search pages and form pages for the site number 15. As noted earlier, editors and site management tools do not generally support rules of well-formedness. Therefore editing the CGQR pages was performed by hand using a text editor.

Although the number of pages that required editing was few, the biggest concern for evolving the CGQR was the data contained within the database. Over the years, a variety of embedded HTML, that is HTML directly entered into a question or answer, had been placed into the database. As noted in the rules of well-formedness, specific character entities can be problematic. Similarly, open tags were also an issue because XML readers require closure on every tag for proper interpretation. To help resolve this problem, specific queries where developed within the database to help find potential problematic fields. Once found, the field data was modified to follow the rules for well-formedness.

Although minor issues concerning the evolution of the CGQR are still being dealt with, the predominance of the site conforms to the rules of well-formedness. Because of the limited number of pages, the CGQR offered an excellent and somewhat limited opportunity to determine the difficulty of evolving from HTML to xHTML. The time required was rather minimal, less than 40 working hours. However, it is obvious that larger sites with various complexities not dealt with in this example may pose more of a problem. The important point is that the evolution of resources such as the CGQR must occur in steps, if the evolution is to occur at all. Leaping from a very simple and base technology to one with the complexities defined in XML is a daunting task. Successful evolution requires small steps rather than major leaps. Additionally, the distribution of changes over time makes evolving from one technology to another much more cost effective and much more easily implemented.

Due to the success of the CGQR as a student and faculty resource, future endeavors will focus on continued technological evolution to enhance its features and functionality. Currently further tests and modification are being performed with XML browsers and XSL formatting to foster increased functionality.

Conclusion

Regardless of the capacity in which an institution is using web-based materials, it is imperative that they be created in a way that permits them to evolve as easily as possible to future technologies. Developers of content and the institutions that financially support the creation of these materials cannot do so in a vacuum. Wherever and whenever possible, materials should be designed with open-technologies and with foresight of coming technologies. Change is an inevitable part of designing for the web. Thus, educators and developers currently working on web materials should design those materials with the rules of well-formedness, and the eventual and inevitable evolution to XML and XSL, in mind.

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There's Trouble in Paradise: Problems with Educational Metadata Encountered during the MALTED Project

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Abstract: This paper investigates the usability of educational metadata schemas with respect to the case of the MALTED (Multimedia Authoring for Language Teachers and Educational Developers) project at University College London (UCL). The project aims to facilitate authoring of multimedia materials for language learning by allowing teachers to share multimedia materials for language teaching, and offering a comparatively easy interface for retrieving materials and composing exercises and courses from them. Although a brief description of the MALTED system is given, the paper focuses on usability problems encountered by the project during the development of the MALTED system. This work finds that there are serious incompatibilities between the current educational metadata schema, as promoted by the Learning Object Metadata (LOM) working group of the IEEE Learning Technologies Standardization Committee, and the way language teachers actually go about authoring teaching materials.

1 Introduction

1.1 Metadata

Metadata was introduced to facilitate searching for items not only via the items' technical attributes but also via additional information about the items. For example, web pages often contain metadata describing the content of the page, enabling search engines to determine the content of the page without having to search through the whole page. Consequently, rich metadata schema allows sophisticated or very specific search requests to be carried out.

1.2 Education and Metadata

The idea of searching for educational materials from external resources and reusing them is not new. Education professionals regularly use and reuse materials from outside their classrooms as part of their teaching materials, e.g., newspapers, videos, posters and other props. Educational metadata schemas, such as the one specified by the Learning Object Metadata (LOM) working group of the IEEE Learning Technologies Standardization Committee, aim to help teachers find the right multimedia materials that suit their pedagogic needs, by facilitating sharing of those materials among education professionals. LOM objectives go as far as to enable exercises to be automatically generated by computer agents that are given certain specific criteria. Consequently, LOM metadata schema is extensive. The schema archives a wide range of information concerning the materials, ranging from the description of the materials to the kind of student interactions the materials are authored for. This not only enables teachers to search for materials by subject or a particular course but also specifically by students of certain age, level of competence or the kind of interaction the teacher would like the multimedia material to use.

Other related metadata projects aim to deal with the practical problems of LOM extensive schema by either creating a subset schema that is compatible with the more extensive LOM schema (e.g. ARIADNE) or creating an alternative lightweight schema (e.g. Dublin Core Metadata Initiative).

1.3 The MALTED Project

MALTED (Multimedia Authoring for Language Teachers and Educational Developers) is a European Commission-funded project led by University College London (UCL). The aim of the project is to facilitate authoring of multimedia materials for language learning. Computer-based multimedia exercises can enrich the self-study part of language learning, which requires a certain amount of drill-style practice, for several reasons:

1. By utilising sound, video and animation, a wider range of language skills can be exercised than through paper-based exercises.
2. Computer-based exercises provide immediate feedback to the learner.
3. Well-designed multimedia materials appeal to many learners and thus increase the amount of self-study.

For these reasons, many language teachers would like to utilise multimedia exercises. Authoring effective and attractive multimedia materials is, however, time-consuming and requires a level of computer skills that many teachers do not possess or have time to acquire. Building a time-telling exercise with an animated clock and sound clips, for example, can take many hours. MALTED aims to reduce the effort required to produce effective and attractive materials by allowing teachers to share multimedia materials for language teaching, and offering a comparatively easy interface for retrieving materials and composing exercises and courses from them. MALTED collects multimedia materials in a repository for re-use by other teachers. To allow teachers to identify suitable materials for a particular exercise, materials submitted to the shared repository have to be tagged. Without tagging, identifying suitable materials would require tedious and time-consuming scanning of long lists of materials in the repository. Since effective and efficient re-use of educational materials is at the core of MALTED, it offered a case study of educational metadata in action.

While this work will outline the technical implementation of the MALTED system (Section 2), the focus of the work will be on issues concerning usability of metadata from the point of view of language teachers at UCL who are using the MALTED system to author teaching materials for their courses (Section 3). In particular, the work will highlight serious incompatibilities between the metadata schema advocated by LOM and the processes that language teachers actually employ to author teaching materials (Section 4.1).

2 The MALTED System

2.1 System Architecture of MALTED

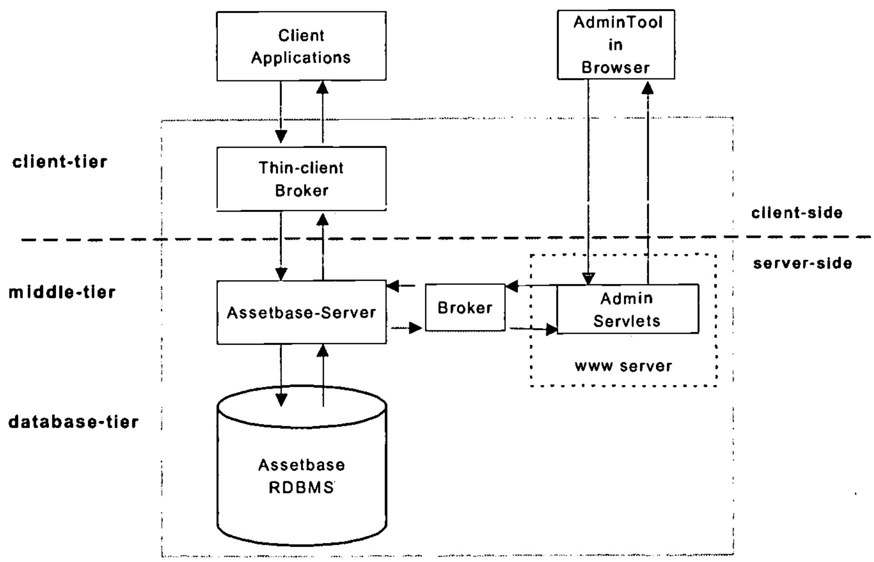

Figure 1: Simplified MALTED System Diagram

The MALTED system consists of three main parts: MALTED clients, MALTED assetbase and the database backend. Figure 1 presents a simplified system diagram of the whole MALTED system.

The client application provides an interface for teachers to access and manage materials or "assets" and their metadata via the MALTED assetbase, allowing them to perform tasks such as searching for and adding new assets to the back-end database. It is solely through this client application that teachers will interact with the MALTED assetbase. The client application also provides facilities for authoring and managing materials.

The assetbase performs the standardisation of metadata between the client and the database. This is accomplished by converting a database query or an update requested by the client in eXtensible Markup Language (XML) into the appropriate Structured Query Language (SQL) query or update for the database and vice versa. A custom data dictionary (DD) -- containing a mapping of XML attributes to database tables or views, with associated typing -- is used together with a Document Type Definition (DTD) to enable the assetbase to store the assets and their metadata in the appropriate place on the database. This gives the advantage of flexibility as different subsets can be used for different asset types. For example, technical information such as resolution is appropriate for a video or image file, but meaningless for a text file. The same data dictionary is used to create the XML files to return to the client following a query by extracting and combining data from multiple tables, where each XML file represents the metadata associated with a single asset.

A database is used to store assets and their metadata in order to optimise the speed of access for queries and to enable complex queries, which may be inefficient if carried out via XML, to be performed. While it is possible to use other database packages, the MALTED system uses Oracle, which communicates with the assetbase via JDBC (the assetbase having been written in JAVA).

3 Handling Metadata in MALTED

It is possible to achieve a number of LOM objectives directly through the use of metadata to tag educational material with relevant information on the material. The following LOM objectives (LOM, 2000) are particularly relevant when designing a system to handle metadata:

- To enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects.
- To enable the sharing and exchange of Learning Objects across any technology supported learning systems.
- To enable the development of learning objects in units that can be combined and decomposed in meaningful ways.

Teachers using MALTED first encounter metadata when searching for assets on assetbases and then while contributing new assets to assetbases. The MALTED project has encountered some significant usability issues concerning metadata while implementing facilities to support these two tasks. The following issues were raised during both formal and informal interviews and focus groups with users of the MALTED system. Consequently, for this section, the term "user(s)" will refer to language teacher(s) at UCL, unless explicitly stated otherwise.

3.1 Searching via Metadata

From the user's point of view, metadata is first encountered when searching for materials on an assetbase. To support this task, MALTED provides a search dialogue in which the user specifies what to search for in which metadata field. At this stage, large number of fields in the metadata schema is very useful to the user as a large number of fields allow the user to very specifically define a search. For example, the user can search for assets for *French language* teaching at *first year undergraduate level* with *multiple-choice questions* as the interaction type for students whose mother tongue is *not French*. Even fields that have little or no pedagogic value can be of some use for the user – the fields for file size and format can be of use if the user is concerned with download time or compatibility issues.

After a search request has been submitted, the search result is then displayed to the user showing information about the assets structured by the metadata schema. Again, the fields in the metadata schema are useful for the user as the schema gives structure to the information on the materials. However, if all fields are displayed to the user at the same time, some information that are given to the user may be irrelevant and, if there are a large number of irrelevant fields, the user may experience information overload.

3.2 Tagging Material with Metadata

The rich and extensive metadata schema that helps the user search for and view asset information are, however, significant overheads for the user when he/she is adding new material to an assetbase. There are a significant number of usability problems concerning metadata that arises when the user performs this task.

3.2.1 Too many fields

The problem experienced by the user, at this particular stage, is not so much information overload, but information "over-demand". Although almost all of the fields are applicable (i.e. the material does have attributes which can be categorised by the field), they may not be important. Users feel that it is not necessary to identify all possible characteristics of the materials they are submitting to the assetbase, just the "relevant" or "important" ones. We found that such overhead imposed on the user could deter the user from using the system because it takes too much effort to share materials. Previous research (Davis 1993) (Fullan 1982) on the factors influencing implementation of educational technology strongly suggests that the user's perceived practicality of the system is one of the main factors to influence whether the system will be used or not. In the case of MALTED, the user was spending a lot of time filling in each field and also working out the most appropriate content of each field. MALTED users feel that this process takes far too long.

3.2.2 *Ambiguous field names*

Often the user is presented with two or more fields that, in their opinion, refer to the same attribute of the material they are trying to add. For example, users often consider the fields "Content" and "Description" to be the same. Consequently, the user finds it difficult to fill in some fields as it is felt that the information has already been entered in a previous field. As in the previous problem, the user feels that more work than necessary is being demanded of them by the system.

3.2.3 *Irrelevant fields*

Users often do not think about their materials in terms of the fields offered. This is particularly the case with users who teaches modern languages. For example, if the user wants to add a picture of a cat to the assetbase, the user must specify which language and level of competency the material should be used for. While such information on an asset may be appropriate for a whole course, these fields are clearly not relevant for such low-level materials such as pictures. Furthermore, such material can be useful for authoring lessons or exercises for a wide range of subjects, from modern languages, art and even physics! Consequently some fields demand information, which are too specific for certain materials. Ironically, highly specific tags may prevent materials from being widely used; contradicting the notion that metadata was introduced to allow greater sharing and reuse of materials.

3.3 MALTED Metadata Interface

The design of dialogues dealing with metadata in MALTED has to solve the following problems:

- How to present large number of fields without overwhelming the user?
- How to get the user to complete the fields as quickly and accurately as possible?
- How to reduce the number of fields to be filled in by the user?
- How to determine which fields are relevant for a certain material?

3.3.1 *Automatic Field Completion*

There are a number of fields that can be automatically completed by the system. These are information that can be derived from the file system, such as file size, file format and other technical information. MALTED automatically fills these fields in for the user when the material is submitted. If the user is adding a course to the assetbase, all the assets in that course inherit the tagging from that course.

3.3.2 *Reduction of the number of fields*

MALTED reduces that number of fields for a material by displaying only the fields that are relevant to the type of material being added. Taking an earlier example, MALTED will not prompt the user for information concerning "Image Resolution" if the user is adding a text or an audio file to the assetbase. This helps to reduce the problem of having too many and/or irrelevant fields. Additionally, MALTED differentiates between mandatory fields and optional fields by hiding optional fields from the user unless the user explicitly requests to fill in those fields.

A possible counter-argument against reducing the number of fields can emerge from what has already been discussed in *Section 3.1: Searching for Material.* Large numbers of fields allow the user to define a search very specifically. There will always be a case where a user might want to search for materials under an obscure field, such as the "Semantic Density" and the "TaxonPath" of a material (LOM schema). However, by attempting to satisfy every possible use of metadata, the metadata schemas such as LOM may have made themselves unusable to small-scale or individual users.

4 Discussion

While the MALTED project has not been able to solve all the usability problems concerning metadata that it has encountered, it has managed to highlight issues that require further debate and enquiry. From a broader perspective, during the development of MALTED, knowledge about what functionalities are required by language teachers when authoring electronic multimedia materials has been acquired. This in turn has raised the issue of the appropriateness of educational metadata schema in relation to how language teachers actually go about creating teaching materials.

4.1 Material Usage and Metadata

Problems discussed in Section 3, such as over-demand and overload of both relevant and irrelevant information about assets, raise the possibility that sharing and reuse of educational materials between users happens at a much lower level of granularity. In the case of MALTED, users just want to pick out elements of a course or just find a single diagram that they can use in their own question. The LOM metadata schema suggests that users would want to reuse other people's whole exercises or even courses. This raises a fundamental question concerning how teachers and lecturers go about authoring their teaching materials and what kind of computer support they actually require.

4.1.1 Syllabus and Instructional Goals

The current view of the teacher's task, in which constructing teaching material is one of adapting an existing course created by someone else to suit an area of the syllabus that he/she is trying to cover. The LOM metadata schema codifies the course in terms of the syllabus that the course is covering. This assumes that what the teacher is trying to accomplish in class – instructional goals – is very similar to the syllabus or at least derivable just from the syllabus. However, in the case of language teachers (users of MALTED), the task they engage in is a very different one. Instead of finding a course or exercise that deals with a certain part of the syllabus and adapting their instructional goals to suit the course/exercise, language teachers approach material authoring from the opposite end. That is, they first form a set of instructional goals and then find materials – such as pictures, audio or a particular element of an exercise (e.g. time-telling elements of an exercise) but **not** a whole exercise or course – that can fulfil or be adapted for each individual instructional goal. The main reason for this "reversed" approach is because language teachers feel that they need to know the students' abilities first before writing instructional goals that would be the road map for those students to accomplish what the syllabus have set out.

While the goal of creating teaching materials by reusing previously authored materials is the same in both cases, the sub-goals or how the main goal is achieved are very different. Teachers are not looking for "ready-made" courses or exercises to use. Users of MALTED feel that it is their responsibility as teachers to identify the instructional goals for their students. Moreover, other people's exercises may cover the right part of the syllabus but not necessary via the most appropriate instructional goals. Supporting the task model where the instructional goals are set by someone else would be a critical failure to support the correct sub-goals.

5 Conclusion

While it was very important to solve technical problems encountered during the implementation of MALTED, the issues of the usability of metadata management facilities in MALTED are very significant factors in determining whether the system will be used or not by the teaching profession.

While extensive metadata schema for educational materials facilitates very accurate search queries, the schema has serious usability problems from the end-user's (teacher/lecturer) point of view when contributing new materials to an archive. In order to use the extensive LOM metadata schema, a professional archive manager will be needed to perform the tagging as the process is too time consuming for the teachers to do themselves. MALTED uses a subset of the LOM schema that can be mapped to the more extensive schema.

A significant finding during the MALTED project is that language teachers reuse materials at a much lower level of granularity than LOM metadata schema would suggest. Language teachers write instructional goals based on the abilities of their students then find materials that would satisfy the pedagogic needs of those instructional goals. Separate assets of a course or exercise, such as pictures or audios, are individually picked out by the teachers and are used to author a new course or exercise. Consequently, the user requires authoring support at a much lower level of granularity. While the highest possible level of granularity of reuse is using a whole pre-authored course, language teachers hardly reuse courses by adapting them. They reuse smaller components of courses that are appropriate for instructional goals that have been set by the teachers themselves. This model of usage may also be applicable to other cases where teachers reuse multimedia materials from resources other than their own. It may also be applicable to other subject areas and other levels of education.

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IEEE Learning Technology Standards Committee (LTSC) Learning Object Model (LOM) Working Group -- http://ltsc.ieee.org/wg12/index.html

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Virtual Communities: a New Distance Learning Application for a Telecommunication Company

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Abstract: Online Distance Learning System from CRT Brasil Telecom, has showed that technology and education found a commum point to perform good educational methodologics. Contents and ODL(Online Distance Learning) programs reached a very good point of performance and moreover, internal culture is much more prepared to use Online Learning than ever. The next target now is: how to orient employees to get good results on a "sca" of knowledge. CRT Brasil Telecom Knowledge Communities are assembled to give a natural orientation specifically prepared for professional and applied educational needs.

Introduction

CRT, a recently privatized Telecommunication Company in Brazil, is now very well positioned at the global cenary of the competitive Corporations. Considering the increasingly need for education methodologies, CRT has developed a Distance Learning Strategy to prepare the Company for the future. Starting with the launch of a Distance Education and the establishment of a development team, now CRT has a full ODL (online distance learning) structure running over Intranet. So, what is the next corporate challenge for education ?

Objectives and Constraints

The CRT Online Distance Learning structure, called SEND, was created to contribute on the search for an educational model for a Telecommunication Company, specifically adapted to internal culture aspects. This search started in December 1999 and already opened a full set of new possibilities of employees development. These opportunities could not be planned considering traditional paradigms of education. It was needed to embody aspects like continuing education and non presential training for the ODL development team and changes on internal culture for CRT employees. In short, CRT is an year old company trained over Intranet on a model that seems like to be definitive in terms of improvements on distance learning events.

These events reflect specific needs for technical, commercial (business) and administrative areas of CRT. That is why programs were created with different approaches in order to adequate the training to the employee. For sure though, this is not enough. Survival for CRT now means to reach telecommunication goals that will make possible to start competition on different areas of Brazil. The key for this objective is the strengthening of the knowledge community with an oriented educational plan. Knowledge communities are composed by groups of professionals that share the same information and act on similar areas. As an example, it is pointed the Consultant Team which takes care of CRT business costumers. This group handles a lot of different technologies regarding telecommunication systems and also have to be well developed on communication, interpersonal and sales skills.

As a multidisciplinar group, training for this community is far away from exposing a deep set of distance learning contents and waiting for the conclusion of all events. As an example showing them a big library without orientation, employees usually don't have the aptitude of conduct their own development. So, the CRT Distance Learning System as being the system responsible for their education and development, has the mission of connecting suitable contents to specific knowledge communities.

Implementations

Some aspects must be considered in order to create and integrate a Knowledge Community. CRT Training and Development area have developed human resource instruments like education tracking and expert identification. This information composes data bases where it is possible to identify similar skills on education and job areas.

Training Consultants contribute with analysis of development needs, strategic plans and targets of each business department. With these information, it is possible to define communities with their respective plan of development and the nature of information needed to support a good job performance and communication flow for the teams.

Teleducation		**Online Library**
Chat		**CD ROM**
Web TV	**SEND**	**Home Access**
Mailing List	**Student**	**Virtual Classroom**
SENDMeeting		**Forum**

Fig. 1- Systems available to an ODL Student

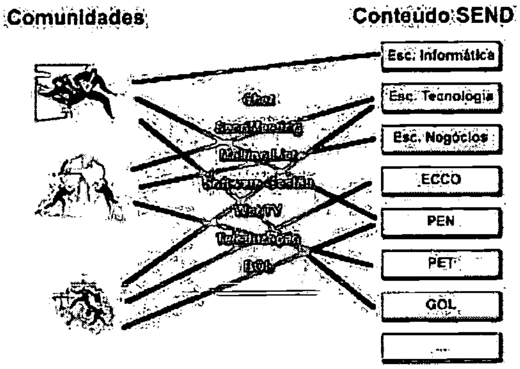

Fig. 2- Knowledge Community concept

Distance Learning programs developed on SEND can now be connected specifically to each knowledge community. It represents the content element of the diagram shown on Fig.2. Connection elements are SEND services, that represent the interaction ways, giving access and further information for all online students.

B. Connection Elements

The implementation of interaction tools represents the students channel that enable him to keep in touch with other students and with Online Tutors during synchronous or asynchronous events. These elements must be positioned around the employee and must be accessible at any place. See Figure 1.

C. Practical Developments

C.1 – Continued Commercial Education

Commercial area professionals of CRT was divided in two communities in order to design the development programs to the follow activities: telesupport (teleatendimento) and Commercial Outlets.

As characteristics of telesupport team, there is a high turnover level of employees and some non-employees from partners companies. Premisses for development skills of these students is the commitment with the Company by learning about telecommunications business, products & services and costumer needs. This community is developed with the production of instructional materials based on Video on Demand in the format of Learning Objects (small pieces of information for continuous education). With the use of Learning Objects it was possible to assemble an education path for each student in order to organize an individual professional career.

As a motivational aspect, students feel more comfortable being certified with professional improvements.

C.2 – ADSL Team Community

Implementation of new Telecommunications services motivated the creation of this community specific for Network Installers. New professional skills should be developed for these teams, since these employees were not skilled in dealing with Computers Architecture and Data Communication. During the installation process of an ADSL (for costumers) they must give all professional information about installation levels in order to reach targets, downloads of documents, contacts with equipments providers, access to Products and Services informations and costumer care proceeding. Also, the exchange of news and troubleshooting among professionals are shared with the use of mailing lists and forums accessible in a web site specially designed and developed for them.

C.3 – Tutor Services

Virtual Communities in CRT have a tutor, which is responsible for that community. This tutor shows a new model of learning-teaching (that came with the concept of virtual communities) : now people bring their needs to the community and other peers can help them in these needs. It is a process where all people are involved and where everybody can teach and, at the same time, learn something . The old teaching is concept had to change: formal tutors are worried about how people work in a virtual community, that means that students became "actors" in their learning process, instead of giving the contents courses to the students and answering questions.

The virtual community success point is: people have to interact and feel that they are part of the community and responsible for it's nourishing and growing and also for the contents application in the organization.

Results and Conclusions

SEND already trained about 3000 students, on 12 different development titles and 4 distance learning programs. For the near future, content development will not be the main success point for a learning organization, but the way students access all contents. Technology development in distance learning is also a technique used to conduct and orient professionals in order to support performance and efficiency on the job. SEND might be the most efficient one for a Telecom Company Environment. The new concept results showed that people learn more, get more involved and participate more on their own learning process, besides that, this process helps the company to manage it's knowledge and also get more results on it's business.

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Guidelines for Developing Network Based Education in Vocational Schools

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Abstract: The VETO project is part of the Ministry of Education national strategy to develop an Information Society Program in Finnish schools. The focus of the VETO project is to develop and identify relevant guidelines for the implementation and integration of network based education solutions in vocational schools. In this paper, we identified three major indicators of technology integration. These indicators were netpedagogy, technology, and usability and were studied within the context of vocational teachers' planning, implementation, and evaluation.

The purpose of this study was to evaluate how and what kinds of learning contexts and processes network based education support in vocational schools and workplace. Several questions guided the study: What teaching practices (pedagogy) did network based learning environments support in vocational schools? What delivery and productivity tools were used to create and design NBL environments? What usability issues were associated with network based learning environments in vocational courses? What implementation strategies did vocational teachers use? Three underlying theoretical frameworks guided our inquiries: teachers' pedagogical knowledge (Grossman, 1990, Shulman, 1986), constructivist and socio-cultural learning theories (Collins, Brown, & Holum, 1991; Jonassen, Davidson, Collins, Campbell, & Haag, 1995), and instructional design models (De Corte, 1995; Lehman, Newby, & Ahn, 1998).

Literature Review

The scope of the literature review is to describe the conceptual framework by which we evaluated network based learning environments in vocational education. The conceptual framework is grounded in the following principle: "Powerful learning is characterized by a good balance between discovery learning and personal exploration on the one hand, and systemic instruction and guidance on the other" (De Corte, 1995, p. 41). For this reason, we guided our research based on three technology integration indicators. These were netpedagogy, technology, and usability. We framed these indicators within the context of technology integration: Plan, Implement, and Evaluate (Newby et al., 1996).

Before the selection of delivery tools and any other technological devices, teachers must determine what exactly they want to accomplish. This begins by selecting a pedagogical strategy that drives the selection of the technological tool, which in turn must work well over the World Wide Web. The idea is not to use technology for its own sake but to be driven by pedagogical considerations (Chizmar & Walbert, 1999). A brief look at the research reports on online education shows that most of the issues pertaining to it are clearly pedagogical, not technological (Lee, 1997). Laurillard (1996) said this best:

> So we must not begin with what the new technology offers. Examining instead what students need, we are led to a quite different analysis of how new technology can help. Most importantly, it should (a) give students more opportunities to engage with the practice of their subject; and (b) give them more opportunities to discuss and articulate their ideas.

Netpedagogy

We believe that good teaching practices should support deep approaches to learning by encouraging learners to participate in activities that promote "deep understanding of subject content, the ability to analyze and synthesize data and information, and the development of creative thinking and good communication skills" (Alexander, 1995, p. 6). Behaviorist learning theories are best known for supporting learning that its main goal is to impart facts, procedures and rules. Instructional goals based on behaviorist theories are frequently used in vocational education for facilitating initial factual knowledge acquisition in a field (Doolittle & Camp, 1999). Cognitive learning theories view learning as an active mental process of acquiring, remembering, and using knowledge. Learning is evidenced by a change in knowledge that makes a change in behavior possible.

When the instructional goals require that learners engage in the active production of knowledge, constructivist and social cultural theories of learning become the instructors' choice. Adherents of *constructivism* suggest that through the use of higher order thinking activities and the encouragement of ownership of learning deep understanding can occur. Some of the approaches used to facilitate higher order thinking are those that encourage analysis, synthesis, problem solving, reflective thinking, and metacognition (De Corte, 1995). By giving learners control over how to plan, design, and work, and encouraging them to generate hypothesis and to pursue the end result are some of the ways in which learners' ownership of learning can be supported. *Social cultural learning theories*, in addition to supporting these types of deep approaches to learning also advocates the use of authentic activities that simulate the level of complexity expected in the terminal performance (Lave & Wenger, 1991; Pantel, 1997). Another activity promoted by social cultural learning theories is the use of legitimate peripheral participation. That is, novices in the field observe experts and other learners from the side (Lave & Wenger, 1991).

On the whole, learning theories guide the development of instructional materials. They identify for the instructor the types of activities that must be available for the goals of the instruction to be achieved. Before evaluating learning materials, we must look at the pedagogical approaches chosen for the development of the materials. This means that the instructional goals and perhaps overall curriculum must be clear to the teachers, since these goals will drive the focus, evaluation, and ultimately the production and selection of network based learning materials and environments and other related network based pedagogical decisions.

Technology

Technology is a key issue in online learning. It deals with issues on how to choose tools that can best help prepare the individual components of the learning program, which tools can help bring together the individual components into a single course, and which tools are most effective in managing online learning (Carliner, 1998). Technology tools help to develop course materials and deliver these.

> Developing [course materials] consists of the software used to prepare the learning materials for presentation online, such as the elements of a database used to manage knowledge, a module in an online tutorial, a lesson in a course that's broadcast on the Internet, or a tool to monitor a worker's performance and provide relevant coaching. Delivering [course materials] consists of the hardware and software needed to store learning materials and transmit them to learners when and where the learners need them (Carliner, 1998).

Usability

The issues that relate to usability in network based learning environments are enormous and range from design issues to technical issues. After determining the instructional goals and selecting the technology tools and pedagogical practices that can help us attain these goals, teachers are ready to develop network based learning materials. The teacher must decide on the most appropriate learning environment based on his or her pedagogical orientation, instructional goals, students' abilities, and resources available (Moreno, 1999). If the decision is for using computer mediated instruction, such as network-based education, then the teacher must be aware of some basic usability design issues that deal with content, navigation, layout, and interactivity.

Methodology

The underlying methodology of this study is phenomenology. Phenomenology is "the study of how people describe things and experience them through their senses" (Patton, 1990, p. 69). The basic assumption underlying this inquiry paradigm is that individuals can only know what they experience "by attending to perceptions and meanings that awaken [their] conscious awareness" (Patton, 1990, p. 69). Hence, we can only get to people's perceptions and meaning through interpretation. Interpretive research "is interested in including the meanings of actions from the actors' point of view" (Erickson, 1986, p. 120). The interpretivists "focus on the process by which these meanings are created, negotiated, sustained, and modified within a specific context of human action. The means or process by which the inquirer arrives at this kind of interpretation of human action is called Verstehen (understanding)" (Schwandt, 1994, p. 120). Verstehen refers to "the process by which we make sense of or interpret everyday world" (Schwandt, 1994, p. 120). It is the "process of comprehending and grasping what has been interpreted in a situation or text" (Denzin, 1989, p. 32).

Site and Participants

The vocational schools were selected from a group of projects funded by the National Board of Education (Opetushallitus). The National Board of Education selected these projects because of their initiatives in using network based learning environments in vocational education. For this study, we chose three teachers. All participating teachers came from different vocational areas.

Teemu taught at a Vocational Institute. The teacher was in the process of planning and developing a course on the Basics of Multimedia. He expected to potentially teach hundreds of students at a distance. He used computers with his students because of the nature of the course. Even though WebCT was available to use, the teacher chose not to use it. He found that WebCT was good as a management system, but found it quite inflexible for producing content. He instead used other software for producing content. He found getting students to use collaboration and communications tools was "almost impossible". He also chose not to use WebCT with his students because he had heard that students had difficulties learning how to use it.

Sanna taught at a Commercial institute. She supervised 37 students during their work place training. This was the first time she guided students training using the Internet. She participated in a training session on how to use WebCT, but felt that "it wasn't enough" to feel comfortable with it. She and her students used the Internet for searching Web pages, sending and receiving e-mail, exchanging information and tasks. While using the Internet during one of her face-to-face sessions with her students, the server went down and students could not access any web sites. This experience taught her no to trust the technology and to have other options ready. Overall, this teacher kept a critical attitude toward the use of the Internet.

Marjut and Anni taught a course in Basics of Hygiene at a Health Care Institute. This was their fourth time teaching the course. They taught 20 students (5 groups during the school year) ages 15 to 16 years old. The teachers used the Internet to teach this course, because they believed that it helped increase student motivation for the course. Another reason for using the Internet (or network) for learning was the great possibilities to visualize concepts, besides the opportunity to learn the material out of class.

Data Collection

Interviews focused on how vocational teachers plan, implement and evaluate the learning processes (pedagogical practices, learning materials, and technology). The researchers contacted the teachers over the phone and arranged a face-to-face interview. In the future, we plan to observe the actual lessons as well as to go through their teaching and learning materials to make a thorough evaluation of the usability issues.

Data Analysis

The data analysis from the interviews was arranged in terms of teachers' netpedagogy (i.e., practices for fostering learning, knowledge building, and stimulating environment) and technology uses for production of NBL environments and delivering of teaching and learning materials. There is a brief analysis on teachers' navigation structure of their Web sites. A more formal evaluation on teachers' usability issues will be performed later.

Practices for Fostering Learning and Knowledge-Building

The literature suggests three practices for fostering learning with network based learning environments (Pantel, 1997; Wilson, Jonassen, & Cole, 1993). These are scaffolding and fading, cognitive apprenticeship, and collaborative learning. All these practices originate from constructivist and social theories of learning. Besides fostering knowledge, we want students to use their knowledge in new situations. Some of the practices used to bridge the gap between schools and job settings are case-based approaches, simulations, and microworlds (Wilson, Jonassen, & Cole, 1993).

Scaffolding and Fading

None of the teachers used sophisticated programs to allow for automatic tracking of students' performance and adjust the level/feedback of the instruction. The materials placed on the network (Internet) provided links to relevant information or self-contained instruction. For instance, in Teemu's course, Basics of Multimedia, students followed a module-based instruction that contained exercises and information. If students encountered any problems they could ask him or he would have them looked on the help manuals. Sanna, the supervisor of the Work-place training course, used the e-mail to help students with any questions. The nature of the course, work place training, may have allowed for scaffolding and fading, although no conscious planning for this was described. Sanna kept relevant links on the course web site to help students during the work place training. She also helped students through their face-to-face contact and e-mail. Marjut and Anni, the Health Care teachers, had instructional materials on the web to help students understand the basics of aseptic (e.g. hygiene) in health care. The course included a practical training session. To prepare students for the practical training we could assume that teachers might have used some sort of scaffolding and fading for fostering learning and knowledge-building.

Collaborative Learning

Only the Health Care teachers, Marjut and Anni, incorporated collaborative learning in their course, although individual work was also expected. The teachers arranged students into five groups. Within each group, students discussed the materials introduced in the classroom and/or WebCT. The teachers required students to bring their thoughts and answers to the specific tasks to the discussion forum and expected students to also comment on what other students had to say. To encourage the use of the discussion forum, the teachers evaluated the discussions that took place at the forum. Besides using Web-CT's discussion forum, students also used chat, e-mail, and electronic calendar. Teemu did not think of using collaborative and communication tools with his students. "I was thinking not to use any collaborative and communication tools in my own course, although many researchers emphasize the activeness of changing opinions and so on. I feel that it is almost impossible to get students involved in network conversations, especially in vocational education (intermediate level)." Having said this, at the end of the interview he felt that perhaps he should reconsider his view on collaborative learning and try to understand the gist of it. He felt that many times the "group work does not necessarily progress they way that is wanted." Moreover, he feels that the Internet feels more like a tool for behavioristic learning. In Sanna's course, students worked individually. She planned to incorporate this type of learning in the future. During the interview, she suggested that she could have a student who works on a travel agency share his/her experiences with another students in a hotel, and together they could compare their experiences by chatting.

Cognitive apprenticeship

Teemu considered himself the students' coach and expert. He would model for his students the different multimedia software. In terms of creating a real work experience, he had not thought about that.

Sanna's practical training course allowed for cognitive apprenticeship to occur. At the workplace, students were placed with a tutor, who guided them and showed the basic details of their job. Marjut and Anni have incorporated into the course several hours of practical training that gave students the opportunity to learn while doing. From the feedback received from students, they planned to add to the instructional materials on the web some "unexpected things" to happen. These changes, however, would take place on their advanced course on Hygiene. One of the most significant changes was the inclusion of a patient that students could follow up on what happens to him/her when specific treatments are chosen or ignored. This would allow students to think critically about the information presented.

Practices for a Stimulating Environment

Any instruction must consider strategies in order to provide a stimulating environment where learners feel safe and motivated to learn. Network based learning environments must support ways in which learners perceived ownership of learning, become challenged with higher order thinking activities, and participate in authentic activities.

Authentic Activities

All three courses provided a level of authenticity to the tasks that students had to perform. Sanna's course by its very nature gave students the opportunity to work on an actual setting (i.e., hotel or travel agency). Marjut and Anni had the practical training component in the course that gave students a sense of authenticity. Also, in the advance hygiene course by adding a "patient" to the instructional material on the Web, students could see the consequences of their actions. In Teemu's course students learned the software program's features that they most likely would use in a work setting. He does not try to teach as if all students would like to become multimedia designers. Insteady, he provided students with specific information that was pertinent to the specific software program.

Technology

Productivity and Delivery tools

For creating the instructional materials, Teemu used PhotoShop, Dreamweaver, Gleener5 and Sampletude programs. Sometimes, he just used the browser's editor for coding html. Overall, he felt that the Macromedia tools were the most practical and popular. As a delivery tool, he used one of the Internet browsers available on the market, although he was aware that WebCT was a good tool for managing the content. However, he felt that for developing "flashy" or stylish material it was better to use one of the other productivity programs and then use WebCT as a management tool. Sanna used Word as a productivity tool. She gave a technical person a manuscript with information on the tasks and contents and other information on how she wanted it to appear on the Web. At this point, she was still not using WebCT, although she was positive about its benefits in the course.
Marjut and Anni used PhotoShop, Pagemill, and Netscape's editor. They used it because they were available when they started working on this project. They got professional help for learning how to use these tools. As a delivery tool, they used WebCT because the city where their Institute is located purchased a license for it. They had looked over Lotus Learning Space and thought that WebCT was a more simple and easy to use learning platform.

Usability

Teemu used a linear structure and organized the information in modules. The Web site in Sanna's course was primarily used as a resource of Web site links. Marjut and Anni used the WebCT to manage the instructional Web sites. The navigational structure of their Web sites was referential.

Discussion

Network based learning environments provides unique instructional capabilities that never before could have been attained. Learners can link to a great array of information sources. They provide support for new instructional approaches, such as cooperative learning with other learners at a distance, demonstrations, online references, powerful simulations, tips, tutorials, and wizards (Carliner, 2000). Network based learning increases teacher productivity by providing accurate information about students' progress more quickly, allowing teachers to help more learners at one time. They offer new ways to think about the design and learning processes. Network based learning can be tailored to individual learning and working styles, provides learners with different ways to experience the content (e.g., text, video, animation, graphics), allows learners to actively participate in the learning process by sometimes exchanging ideas, questions, and concerns with experts and other students. Ultimately, through effective design, the network based learning environment can track learners progress and provide alternative explanations and/or exercises until they understand it (Carliner, 2000).

In addition, for the power of network based learning to be realized, administrator and teachers must have a plan for the technology integration and management (Carliner, 2000; Newby et al., 1996). The first step is to form a technology committee. This committee should represent all the stakeholders including parents, community, and students. The second step is the development of a vision. The vision should meet students, teachers, curricular, and societal needs (Newby et al., 1996). The next step is the evaluation of the status of technology implementation. This step must be completed prior to the technology committee becoming too specific about its technology implementation plan. Some of the information that should be gathered during this step is to catalog hardware and software resources, identify current uses of technology, assess faculty and staff proficiency, and evaluate students' use of technology. The final task of the technology committee is to develop a framework for integrating technology that takes into consideration the availability of hardware and software, curriculum, and individual's teaching styles.

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Hypermedia and Education: A Technology Integration Course

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Introduction

Technology has become a major focus of education policy and reform in recent years. Both new and experienced teachers, however, are still not adequately prepared to teach with technology (CEO Forum on Education and Technology, 2000). This paper describes a graduate technology integration course offered at Teachers College, Columbia University. The purpose of the course is to help students *learn about* and *learn with* technology and its implications in education.

Background of the Course

Hypermedia and Education is an introductory course offered by the Department of Communication, Computing and Technology in Education (CCTE) at Teachers College. In this paper, we describe a section of the course that is collaboratively taught by the authors. Hypermedia and Education is a course that attracts students from a number of different departments at Teachers College. Students enrolled in the course are either pre-service teachers or experienced teachers who pursue a graduate degree on a part-time basis. They come from different academic backgrounds and are interested in integrating technology in a broad range of subject areas. Therefore, the purpose of the course is to provide students not only with technical skills but also with an understanding of why, when, and how they can integrate hypermedia in education.

Description of the Course

The course is comprised of three main areas related to hypermedia in education: a) Introduction to hypermedia: definition, evolution, strengths and weaknesses; b) Hypermedia in education (Hypermedia in Language Arts, Math and Science); c) Theories and principles for the design of hypermedia products. Although acquisition of computer skills is necessary for effective use of technology in teaching, the course places more emphasis on the pedagogy required for successful technology integration. Students in the class: 1) learn how to evaluate hypermedia products; 2) learn why and how they can use technology in teaching; 3) learn how to create effective technology-rich environments; 4) are exposed to exemplary technology-based projects, resources and teaching strategies;

The instructional delivery of the course is based on the assumption that learning is an active process and knowledge is constructed from experience. Moreover, the constructivist view emphasizes that students should learn to construct multiple perspectives on an issue. Multiple perspectives can be generated only through collaborative sharing of ideas. Consequently, throughout the course, in addition to arranging for resources, the instructors act as facilitators to student cooperative investigations.

Aside from the weekly readings and class activities, students are responsible for completing three projects during the semester. For the first project, students assume the role of educational consultants who need to convince principals of the quality, technical, and educational merits of some software package worth buying for their schools. The end product needs to be a multimedia presentation developed in *Hyperstudio*, a popular multimedia program. There are three reasons why this assignment is valuable. First, students learn to develop and apply criteria for the evaluation of educational software. Second, by creating a report in *Hyperstudio*, students learn how to author their ideas using hypermedia. Finally, by working in groups, students refine their knowledge through argumentation, structured controversy, and reciprocal teaching (Dunlap & Grabinger, 1996).

The second assignment requires students to select a topic related to hypermedia and/or education and construct an annotated bibliography of resources. The bibliography needs to contain well-organized collections of web-sites, software, books, articles, and journals with insightful comments on the value of each resource. The end product needs to be presentable on the web. The assignment aims at helping students become critical users of printed and digital information so they can become fully literate in our multimedia society.

For the final project students have two alternatives. They can either develop a working piece of software using tools explored in class or design a lesson plan that can be utilized in conjunction with some existing software or web-site. The nature of the final project allows students to reflect on their understanding of hypermedia in education while considering key questions in the design of technology based learning environments. Some key issues that students need to investigate in their final project include: a) the nature of the problem that their product seeks to solve; b) a clear elaboration of educational goals; c) the rational for using hypermedia; d) characteristics of anticipated audience; e) the learning theory that guides the design of their product; f) the setting and context in which the product will be implemented; and g) plans for the evaluation of the product. The final project culminates with a class presentation where students get feedback from their instructors and their classmates.

Learning by Modeling

Successful incorporation of technology in educational curriculum can not be accomplished without effective modeling by teacher educators (PCAST, 1997). The following are some ways we have modeled pedagogically appropriate uses of technology in our Hypermedia and Education course:

- Email: Email has always been the dominant means of communicating with students.
- Discussion Forums: Discussion forums are used for further analysis of topics addressed in the course.
- Presentation software: *PowerPoint* is used for the delivery of mini-lectures.
- Web-site Development and Online Resources: A web-site was developed to provide information for the course. The syllabus, readings, assignments and lecture notes are posted online. Moreover, the course site provides numerous links to online resources and tutorials that aim at helping students become more competent in the use of the various hypermedia tools (i.e. Hyperstudio, Dreamweaver etc.) introduced in the class.

Summary

Transforming computer machinery into tools for teaching and learning largely depends on educating teachers on the pedagogical possibilities offered by new technologies. The course described in this paper offers an example of how technology can be introduced in pedagogically appropriate ways. Students participating in this course do not only become more technologically proficient in using hypermedia and multimedia tools but they also learn how to effectively utilize these tools in their own teaching of various subject areas. Moreover, modeling activities by the instructors expose students to examples of good practice. Currently, the authors focus on assessing the impact of this course on participating students using extensive qualitative analysis of data.

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The Role of Pedagogy in the Use of Networked Learning Environments

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Introduction and Research Questions

During the last twenty years, the introduction of new technologies in schools coupled with the recent growth of the Internet have allowed students access to a vast amount of educational resources. This vast increase in the amount of information, however, poses numerous challenges to teachers, since access to information does not automatically create better educational experiences for the students. The purpose of this study is to describe the nature of teaching and learning in six classrooms in which teachers used, for the first time, a web-driven science project known as *Alpine*.

The *Alpine* project is an effort to mobilize the resources of the web in order to create an information-rich and complex learning environment that can support sustained exploration in science classroom. We first give a brief description of *Alpine*. Then, we discuss two questions pertinent to the implementation of networked learning environments in education: a) How did teachers implement the features of *Alpine*? These features included problem-solving collaborative activities, authentic weather data, sharing of information and web based curricula material; b) How did the implementation of *Alpine* influence student interest and motivation in learning about weather?

Description of Alpine and Theoretical Framework

The *Alpine* project aims at helping students study weather concepts and learn scientific techniques through a pedagogical model called Goal Based Scenario (Schank, Fano, Bell, & Jona, 1994). Students spend 4 to 6 weeks assuming the role of the U.S. Ski Team coaching staff who need to decide on a location that would be adequate to host the U.S. Ski Team Training Center. Students form six groups and each group is assigned a specific location within the continental United States. Weather criteria for assessing the adequacy of each location are listed in the task description. In pursuing this goal, students are required to form hypotheses based on observations of weather products, collect and analyze archived and real-time data, construct interpretations of weather patterns, collaborate with other participating students, and make decisions. Moreover, a major goal of the program is to help students develop appreciation of science and instill an interest in the study of weather.

Methodology

This study took place in a mid-sized public school in the eastern region of the United States. The participants included six fifth grade school teachers and their students (N=126). There were four new Macintosh computers in each classroom and a television monitor connected to one of the computers. All computers were networked.

Data were collected from multiple sources, including: a) field notes of classroom procedures (e.g. teaching style, spatial arrangements, time usage, etc.), b) student and teacher pre- and post- surveys, c) analysis of student group folders, d) unstructured interviews and interactions with multiple groups of students from each classroom, and e) informal conversations with teachers.

Findings of the Study

Teacher implementation of the Alpine features in the science classroom: In orchestrating the resources available in *Alpine,* teachers followed a path aligned with their traditional teaching approach. All teachers focused on completing the activities rather than taking advantage of the web resources provided in the program and its interactive features. Therefore, students were restricted from using the discussion forums and sharing their findings with other groups in their school. Moreover, students were not given enough opportunities and stimulus to form questions, test hypotheses, solve problems, or discover new relationships. Finally, students were not allowed to collect real-time data or use web resources to support their investigations. It became clear that teachers did not foster emphasis in the processes of inquiry and invention and most resources available in *Alpine* remained unexplored.

Student interest and motivation for learning about weather: Student attitude toward science refers to positive or negative feelings about science (Koballa & Crawley, 1985). Motivation is also defined as the process by which goal-directed activity is instigated and sustained (Pintrich & Schunk, 1996). Findings from pre-surveys revealed that students exhibited a fairly positive attitude toward science. Most students (76%) stated that they liked science, although they liked other subjects better. A small part of our student population (19%) said that they were very interested in learning about weather while most students (63%) exhibited little interest in the study of weather. In addition, a small group of students (18%) reported that they had no interest in learning about weather. These findings did not change after the use of *Alpine*, despite the fact that instilling an interest in the study of weather was a major goal of *Alpine*.

Observation of students interacting with the program under the guidance of the researchers revealed encouraging messages. When students were given the opportunity to explore all features of the program, they became engaged in forming questions and exploring weather patterns. Many students became interested in visiting various ski sites on the Internet, getting snow reports, talking about their personal skiing experiences, and contacting meteorologists to ask questions about the weather. Other students accessed weather information and data available in the program in order to convert temperature from the Fahrenheit to the Celsius scale and forecast weather conditions in other places of the world. Furthermore, most students expressed real excitement in using all these unexplored features of the program. The above findings indicate that proper use of *Alpine* can result in self-inquiry and self-realization of the importance of weather in our life and can motivate students to explore available web-resources.

Conclusion

Teachers using networked learning environments for the first time often follow a traditional approach to teaching, similar to the one employed using textbooks. Students do not get engaged in a subject when all material is circumscribed. In the case of the *Alpine* project, teachers utilized the material using a step by step approach that failed to capitalize on the pedagogical potential of the program. In order to promote student inquiry and interest for learning about weather, teachers need to foster collaborative relationships, sharing of ideas, problem-solving, and decision making. These approaches, however, conflict with the traditional didactic approach prevalent in most schools. In order for new technologies to be successfully implemented in the classroom, there needs to be a shift in pedagogy. Therefore, adequate time must be devoted in helping teachers understand the purpose of educational technology in the classroom and the underlying philosophy embedded in the new inquiry-based approaches to learning. For this reason, our current studies investigate the influence of technology related professional development on the beliefs, knowledge, and practice of participating teachers.

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A Neural-Network system for Automatically Assessing Students

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Abstract: This paper is concerned with an automated system for grading students into an ability level in response to their ability to complete tutorials. This is useful in that the student is more likely to improve their knowledge of a subject if they are presented with tutorial material at or just beyond their ability (Bergeron et al 1989). However, dynamically responding to a student's changing knowledge about a subject usually requires the presence of a human teacher, an altogether expensive resource. The system discussed here can grade both a student and the questions in a tutorial with minimal input from the human teacher. In order to accomplish this a specialist neural network is employed. The design and operation of our system is discussed along with arguments as to why a neural network approach is suitable for this problem.

Introduction

The Tutorial Supervisor (TS) is an automatic system for grading a student into an ability level in response to the student's interaction with tutorial questions. Once the student has been graded then a question or tutorial can be selected which is inline with best pedagogic practice (Bergeron 1989). Our TS is an expansion of the TS designed by Bergeron et al (1989). Our TS improves on Bergeron's original specification by having the additional ability to adapt to both students and questions/tutorials as the system is in use, as opposed to requiring the system to be taken off-line and reprogrammed/trained. The TS's ability to respond in real-time to a student's changing ability and how a population of students perceive a particular tutorial or question is brought about by the use of a specialist neural network device that is able to learn and adapt without human intervention. A thorough description of our TS along with complete details of its design and testing can be found in Mullier (1999, chapter 8).

Operation of the Tutorial Supervisor

The TS is simple in operation. A set of questions to be given to the student is recorded in a database and is graded with a difficulty level by the author of the question. A student can then be given an appropriate question, depending upon the student's ability and the difficulty of the question. However, in order for a student to progress in their learning it is necessary to pitch questions so that they sufficiently tax the student without it being impossibly difficult (Bergeron 1989). Therefore it is necessary to track the student's change in ability as they progress through the learning material. Our system achieves this by recording the student's interactions with questions and mapping this onto an ability level. The system is robust to exceptions in the student's behaviour, since a student may generally perform well but make a mistake with one particular question. Similarly, the system is able to regrade questions in the question database. For example, a question may have been graded by the author as being relatively easy. However, it may transpire that a population of students actually find it difficult. This will be bourn out by most students who should have performed well with the question actually performing poorly. Such a situation negates the pedagogy stated above. Our system is able to statistically determine that a question has been misgraded and is able to remedy the situation. The remainder of this paper will discuss the issues relating to the design and implementation of our TS system.

Rationale for Using a Neural Network

A neural network is an Artificial Intelligence (AI) system that is able to learn rules in response to being presented with many examples. The neural network is said to learn the rules from the examples. In contrast a traditional rule-based system would have rules encoded within it that a designer has previously identified. The advantage of neural network systems is that it is not always possible for a human designer to express and encode rules in a reasonable time-frame or even express then at all. A further disadvantage of rule-based systems is that if the rules change for some reason then it is necessary for the designer to reincorporate the new rules within the rule-base (Hagan et al 1996).

A further reason for choosing a neural network for the TS in preference to a rule-based system is that, unlike a rule-based system, a neural network can be domain independent. It is unlikely that, for example, a high level student produces results in the same range for every type of domain. Thus the rule "IF SCORE >70 THEN LEVEL 10" is only likely to apply to the domain that it was initially defined for. This is the reason why Bergeron et al (1989) use a neural network for their Tutorial Supervisor. Their neural network holds the rules that it has learnt from its training data (the first domain). It is then able to change its rules in response to new data (new domains), by retraining off-line. In this manner the neural network can adapt to misconceptions or inaccuracies in the original rules and adapt to new situations. This would be a difficult and time-consuming process for a symbolic rule-based system, since it would require the re-engineering of the rule-base by a designer, in that the new rules would have to be identified and then encoded. In essence, the neural network is doing the job of the human rule designer. Designing such rules is not necessarily a simple matter, since it requires the human designer to examine many student interactions with various questions and tasks so that a valid grading of each question can be made (e.g. this question was answered well by novice students, it is therefore easy and can be presented to other novice students). The situation is further complicated by the possibility that different populations of students (students from different classes or tutorial groups) may have different previous knowledge of the domain and therefore the initial question gradings may not apply to them. It would therefore be helpful if an AI system could be employed to accomplish the task of dynamic question grading and therefore remove some burden from the author. However, Bergeron et al's (1989) TS is unable to readapt to different domains without being manually provided with new training data and then retrained off-line. The remainder of this paper describes the neural networks used for our Tutorial Supervisor, which improves upon Bergeron et al's (1989) design by allowing the automatic on-line adaptation to different domains.

Tutorial Supervisor Architecture

The Kohonen self-organising map is a specialist type of neural network with the ability to learn without human intervention (Hagan et al 1996). This is useful in our system since the distinction between a novice student and an expert student, in terms of marks at tutorial nodes, may be small, or may vary significantly from domain to domain. For example, the majority of students may achieve marks between 50% and 60%, with a few results between 60% and 75% percent and a few between 40% and 50%. There are therefore two large ranges of numbers that occur infrequently (0-40 and 75-100). If a standard type of neural network were to be used to model the above problem then these mark ranges must be identified beforehand or the neural network's outputs would have to be designed to produce student ability levels between 0 and 100, in order to accommodate a broad range of scores. Identifying scores beforehand is not likely to be practical since it would require the collection of a large amount of data (with no initial benefit for the student). Designing such a generic neural network also introduces the following difficulties. The standard neural network must have enough ability levels (outputs) to clearly demonstrate the distinction between students in these highly clustered areas, necessitating an increase in outputs for all areas to cover for all possibilities, even those that are unlikely. The increase in outputs renders the neural network more complex, resulting in a network that is more difficult to train. Further, and most crucially, once the trained standard neural network is used for different domains, then there is no direct correspondence between an ability level for one domain and an ability level for another. This is because an output of the standard neural network does not correspond directly to a student ability level, since the student ability level may vary between domains. The upshot of this is that the standard neural network would require complete retraining for different domains.

A Kohonen network can solve the above problem by continually adapting to input stimuli whilst it is being used by students. This is because of the way a Kohonen network operates. A Kohonen network is given a number of outputs by the network designer, representing the number of categories that the network designer wishes the network to identify (the number of required student levels in our case). It is left to the network itself to sort the input data into this number of categories, since it is not implied by the training data itself. In the case of a standard neural network it would be required to include an example solution with the training data. If there are ten or more distinct patterns in the data then a correctly trained Kohonen will learn by itself to distinguish them (Kohonen 1989, Masters 1993, Gurney 1997). Therefore, it is irrelevant to the network if the actual values of the input data change; it will still attempt to separate them into the number of categories represented by the number of outputs that it has. The outputs of a Kohonen neural network therefore behave as fuzzy sets, whose boundaries may change over time. The Kohonen neural network is therefore simpler than the standard neural network for the TS in this case, since the number of outputs can be kept small since is not necessary to design for all unlikely possibilities (the network will adapt to them if they occur).

Training Data

A neural network has a number of inputs, which in our case represent the student's responses to questions and a number of outputs, each one representing a unique ability level. The inputs to the Kohonen neural network must incorporate history data in order to make a more informed evaluation of the student and therefore avoid a restriction of Bergeron at al's (1989) neural network, namely reacting to a one off error (or success) from a student. History data can be used to prevent the TS from making snap judgements on the student. For example, if the student is generally performing well, but gets one question wrong, then if no history data is taken into account the TS is forced to make a decision based only upon the most recent presentation and the student is likely to drop a level. The student ability itself represents a degree of history data, in that if a student is regarded to be an expert student, then they must have performed well in the past. However, the direct incorporation of history data prevents a continual changing of levels based upon one interaction only. The incorporation of history data can be achieved by presenting a number of previous interactions with tutorial nodes to the neural network. Each time a new interaction is presented the previous interactions are shifted along the inputs to accommodate the new input and the oldest interaction is lost. Training data supplied to the neural network are figures that represent a percentage value of a student's interaction with a tutorial. For example, if the student achieved a 50% success level with a tutorial question, then it is this figure that is passed to the TS.

Re-grading Questions Using Fuzzy Logic

Each question level is generally presented to a student of the same level, or just below, a pedagogy used with success by Bergeron et al (1989), in that a level x student should be able, overall, to answer a level x question. A question may however, be graded incorrectly by the domain author. This can be determined by the system after a number of interactions with different students (a population of students who should be, generally, getting a question right are getting it wrong or vice versa). It is not suitable to immediately re-grade a question with respect to an interaction with one student, however. As has been discussed earlier, a student is a complex entity and it is difficult to formulate rules describing them accurately. In order to resolve this problem each question level is modelled as a fuzzy set. This allows a question's level to be adjusted slightly, within the level, without necessarily affecting the overall level (as presented to the student), thus there is a buffering effect and the question does not rapidly leap back and forth between levels. The use of fuzzy sets also provides a mechanism for allowing a question to belong to more than one question level set, providing a smoother transition between levels. This differs from Bergeron et al's (1989) approach in that they collect data from the students and then periodically use it to update the training of the neural network. There is therefore a delay, which ensures that the question levels do not suddenly change, which could potentially result in the question level continually changing and thus be distracting to the students. However, the drawback is that this is a manual process that requires the direct intervention of the system designer. The process for regrading questions described below is achieved automatically, whilst still maintaining the delay between the question being presented to a student and changing its level.

A question is re-graded by a population of students' interactions with the question being determined as incorrect by the TS, for the reasons described above. Such erroneous interactions cause the question ability to move within the fuzzy set until it crosses into a different fuzzy set.

A question's ability level is therefore only changed after a number of erroneous interactions with students, the actual number being dependent upon the size of the fuzzy set, the fuzzy set is therefore acting as a buffer. A simple fuzzy processor accomplishes question re-grading. The fuzzy processor compares the level of the current question and the student level output of the TS neural network. The buffer can be implemented using three fuzzy rules (Kosko 1996):

1 IF S_LEVEL > Q_LEVEL THEN Q_LEVELf = Q_LEVELf + 1
2 IF S_LEVEL < Q_LEVEL THEN Q_LEVELf = Q_LEVELf - 1
3 IF S_LEVEL = Q_LEVEL THEN Q_LEVELf = Q_LEVELf (remain unchanged)
where

S_LEVEL is the level assigned to a student

Q_LEVEL is the level of the question, used to decide whether it is suitable for the student.

Q_LEVELf is the fuzzy membership number of the question.

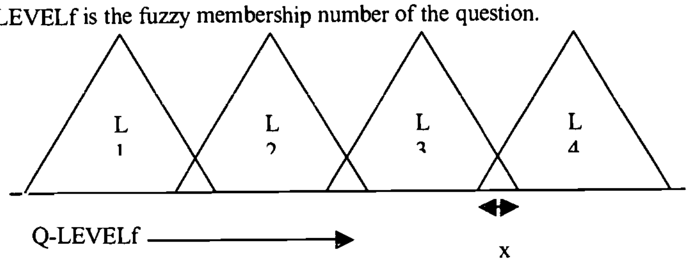

Figure A Membership of the fuzzy sets

Using the figure A, a question may belong to one or two of four levels. If the question has a value of Q_LEVELf corresponding to x, then the question is regarded as both level three and level four. If however, as a result of interactions with several students, rule one is repeatedly fired, then the value of Q_LEVELf will increase and the question will become graded as level four only. Conversely, if rule two is repeatedly fired then the value of Q_LEVELf will decrease and the question will be graded as level3 only. Such changes may result in further increases or decreases in the value of Q_LEVELf, which may become any of the levels available. The utilisation of this fuzzy system ensures that the level of a question is not changed (in terms of presenting to students) in response to individual interactions with students. The fuzzy logic is able to distinguish overall trends and is therefore robust in the presence of exception data.

The changing of levels is dependent upon the size of the fuzzy sets, since the size of the fuzzy set directly affects how many interactions are required before a question migrates from one level to another. These start and end points also define whether a question can belong to more than one level or not. It is intuitively sensible to provide a small overlap of neighbouring fuzzy sets. This provides a simple buffer that will help the question to find its true grade. For example, if fuzzy sets were to be defined separately (or as a discrete set) then a question may be presented as a difficult level but become graded as an easier level after several interactions. Once this change has occurred then the question is no longer presented to the original class of students that graded it. This may result in the question becoming stuck at a particular level. If instead the question is presented to both the original class of student and the new class of student, then a smoother progression from one level to another may result and the extra information enables the question level to settle more easily. If the fuzzy sets are defined so that a question may belong to more than two levels, then the question level may not settle at all, as one level of student may push the value of Q_LEVEL one way and another level may push it in the opposite direction.

Experimental Trials

Our TS was designed using a Neural Network package, NeuroShell2 by Ward Systems. Several configurations of neural network were built and tested with both simulated data and real student interactions. The most successful architecture is discussed below. A full description of the experimental trials can be found in Mullier (1999, chapter 8).

The Kohonen neural network proved to be a successful neural network architecture for the problem of grading students into ability levels. Most permutations of parameters produced neural networks that converged upon a solution. A fast and reliable neural network could be produced with between five and twenty inputs or outputs. It is possible to increase this number, but this is unlikely to be required, since it is not desirable to use information from too far in the past, since the network does not have any knowledge of time. It has been experimentally determined that the number of outputs should not rise above twenty. If more levels are required then the outputs may be combined to form fuzzy sets.

Parameters for a generic Kohonen Tutorial Supervisor, i.e. one that will converge on a solution and provide a high degree of student grading for a variety of domains are suggested as the following:

• 5 Inputs – this has been found to provide the network with enough information with which to evaluate the student. It is suggested that an input filter, as described above is employed if more than this number of inputs is required.

• 10 Outputs – corresponding to ten student levels, if more levels are required then it is advised that thirty levels is the upper limit, beyond this the neural network becomes less likely to activate all of its outputs.

• Any form of data extraction may bc used to form the training set, however a large number of examples are required to produce a fully trained network. One thousand student interactions provide enough examples. Note therefore, that for a network to be trained with real student data is probably impractical. However, since the Kohonen network is fully adaptable, it is suggested that a network be trained upon generated data and then allowed to adapt to real students. The generated data could be designed to represent realistic but uncomplicated situations. For example, training the network to model simple rules such as "If result in the range 40-50 THEN set student level to 5". The neural network is then able to adapt to any misconceptions present in these rules. Once a neural network has been trained it may be saved and replicated.

Discussion and Conclusion

The Tutorial Supervisor is intended to be an automatic system for gauging a student's abilities with tutorials. This imposes a restriction upon the kind of material that can be offered in a tutorial, since it must be suitable for automatic assessment. Automatic assessment effectively rules out assessments that cannot be graded in a relatively simple fashion. For example, it would not be possible, with current technology, to have an essay automatically assessed, since this would require a complex understanding of the essay on the part of the assessor. Automatic assessment is limited to tasks that can be broken down into elements that can then be individually marked. A tutorial may, for example, take the form of ten questions, each of which could be answered by the student and graded as right or wrong, or graded as containing relevant keywords. However, assessment is not the role of the TS, which is presented with completed assessments (results). Assessment is therefore limited to multiple-choice questions or identifying that the student has visited certain nodes (or a combination of both).

A key issue of concern regarding the TS is the number of student levels that the TS is to recognise and output. Each student level should have tutorial material generated for it; since it is important to target tutorial tasks at the student's ability, this is seen as being of more educational benefit than offering the same tutorials to all students and then assigning a student level based upon the grade that the student achieves (Bergeron 1989, Hartley 1993), although there is no technical reason why the latter could not be done. The number of student levels therefore may change between domains, since some domains may have a richer set of assessment questions than others (for a number of possible reasons). A possible conflict therefore could arise between the number of student levels that has been designed into the TS by the system designer and the number of student levels that are required by the current domain author. A possible solution to this problem is for the system designer to provide a TS that is capable of outputting a large number of student levels and then each domain author can allow it to adapt to their domains and ignore the inactive outputs from the TS that will naturally arise if there is not sufficient input student levels. The benefit of this approach is that one TS configuration could be used for many domains without the need for reconfiguration. However, the drawback is that some outputs of the TS will always remain inactive, although the experiments carried out as part of the research demonstrated that active outputs tend to cluster together and so are easily identifiable. A problem related to the number of outputs is the number of inputs.

The amount of history data presented to the TS directly affects the grading of the student, in that the more history data presented to the neural network, the greater the effect of previous results with tutorials. This is a similar situation to that of the number of student levels, in that it is possible to design a TS with a large number of inputs and then use only the required amount. However, it is not a simple matter to determine how much history data to present to the neural network in order to aid the student the most. This issue is difficult to reconcile without extensive trials with real students and even if this were done it would still be unlikely that any real conclusions could be drawn since proving the effectiveness of educational systems is notoriously difficult in the educational field (Dillon and Gabbard 1998). The purpose of the TS here is to explore the technical issues relating to the feasibility of providing an automatic student grading system. Whether this facility is useful is open to educational debate. However it is likely to be the case that it will be useful should the correct set-up of the TS be achieved during trials with real students, since Bergeron et al (1989) found their TS to be useful.

Further issues arise concerning the adaptability of the neural network used for the TS. The neural network architecture used by Bergeron et al (1989) requires off-line training and is therefore under the control of the system designer. The drawback with this approach is that it requires the manual intervention of a person who can interpret the student interaction data with tutorials and determine whether it should be represented to the neural network. The advantage of the Kohonen neural network architecture is that it is able to train continually without any intervention from a human. However, there are situations where this adaptation is undesirable, most notably when different skill levels of students use the same domain at different times. For example, if a class of first year students use the system followed by a class of final year students. However, this is not a problem if the questions and tutorials have been adequately assigned a difficulty level, since the first year students will only be offered easier tutorials and so can be graded only as lower level students (although they can still progress if they continue to achieve success with the tutorial). Problems can arise only if both the student abilities and the question difficulties are unknown beforehand. This is because the TS acts as a bi-directional mapping device, in that if either the student abilities or the question difficulties are known beforehand then the TS can produce the unknown parameter. It is not, however, able to produce values when nothing is known beforehand. The TS's ability to re-grade questions automatically is an exploitation of this bi-directional mapping facility, in that the student ability can be changed in response to improving results and the question difficulty can be changed if a significant proportion of students who should get the question right in fact get it wrong.

Research into the TS has demonstrated that a fully adaptable system for automatically grading students is possible and practical. The approach of using an automatic tutorial supervisor has been practically justified by Bergeron et al (1989). However, their system requires manual periodic retraining which renders it unsuitable for a generic tutorial system, or a tutorial system that can be used without the need for reprogramming or otherwise rearranging the program code of the system.

Further research is concerned with incorporating the TS within a hypermedia tutoring system (Mullier et al 1999, Mullier 1999) so that the students' interactions with the TS can be studied. It is anticipated that such a study will prove useful for determining how the TS reacts to different domain, where the rules that describe ability are different, with a view to reengineering the TS so that it is able to learn such a vast set of rules without conflict. A "superTS" such as this would be useful in a more generic tutoring environment such as may become more prevalent on the WWW.

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Is the Future of eLearning in Mobile Devices?

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1. INTRODUCTION

Today, eLearning is adapting to industry, corporate bodies and government departments at an ever-increasing speed. It is expected to be a product that will improve education and training and make learning time-independent. The main marketing feature of elearning in corporate education is that it is technologically enhanced learning. However, should we look at eLearning from a pedagogical point of view - not from a technology-oriented point of view.

In the future we will see a tremendous increase of wireless multimedia network terminals that are similar to mobile phones. These intelligent smartphones together with 3G networks and applications are able to access the Internet as easily as web browsers today. Furthermore, major mobile phone companies have agreed on wireless application protocol (WAP) that will "bring Internet content and advanced services to digital cellular phones and other wireless terminals".

Clearly, the Internet has proved to be a great improvement for learning and distance learning. Could wireless multimedia network terminals and *mLearning* be the next wave?

- 3G networks, devices and applications
- time-and-place independent learning
- learning materials in an online environment
- content production for wireless devices
- wireless devices and user interfaces
- mobile eLearning

In this panel, we will first briefly discuss the relationship between the concepts of *eLearning* and *eEducation* or *eTraining*. Then we will define the *mLearning* concept and discuss the pros and cons of mLearning.

2. CRITICAL ASPECTS OF MOBILE LEARNING (JAAK HENNO)

As "the prince of pop culture" Marshall McLuhan already observed, in our communication-based information society "all ... job patterns tend to blend ... into forms of work that more and more resemble teaching and learning..." This prediction has become remarkably true and even more; nowadays "lifelong learning" has become a necessity, especially in technologically developed societies, since success in global competition depends on our ability cope with new information. Nowadays explosive growth of new information also creates an explosive need for teaching and teachers. New information (e.g. scientific research, technologic news etc) is presented in high volume and in a very high-level form (language), which is difficult for laymen to understand. The main task of teachers and teaching is re-designing of new information (scientific research results, statistical data etc): to select the essentials and present them in form that is understandable to learners. And to cope with this task, teachers are the first "lifelong learners". The rapid ever-increasing demand of "digested information", teaching and education has created many new forms, both in the teaching organization and in teaching technology. Education was until lately mostly the concern of society and social organizations (governments); nowadays education is quickly becoming a market-driven commercial activity. In addition to traditional schools/universities forms of education, many commercial educational enterprises that are using new information technologies (WWW, mobile wireless etc) for distributing their educational product have appeared. In this new educational environment quick access to relevant information (in a suitable form), not diplomas, is essential. If the necessary information can be accessed by mobile, (information) consumers will use mobiles to access it.

Every piece of information/knowledge also has a life span - the period of time when this information is significant and essential (nowadays who knows Victorian mathematics or theories of flogiston?). With the increase in technological development and research the life span of new information is rapidly decreasing. While universities propagated "universal" and eternal truths using books and living scholars as a distribution media, new commercial educational enterprises distribute truths which have shorter and shorter life spans. They will be replaced by new, "better" truths tomorrow or next week. Since "I need to know (how to do) it by Monday", learners will be willing to pay to get those truths as quickly as possible - also by wireless, if the presentation of those truths can be adjusted under bandwidth restrictions. Modern media distribute truths, which are significant for the moment and (most probably) forgotten by tomorrow, thus they are becoming replacements for our (short-term) memory. Not "the media is the message", but the messages, our need for the latest, up-to-date, precise information is pressing the development of media, to allow necessary information to be available everywhere and every time.

3. ELEARNING IN MOBILE INFORMATION SOCIETY: WHAT TECHNOLOGY ENABLES US TO DO(JUHA PEKKA LIPIÄINEN)

3.1 Introduction

The advent of digital communications and rapid technological development are resulting in fundamental changes in how society and commerce function. Many have characterised this as part of the transformation from the Industrial Age to the Information Age. In the new net economy enterprises derive efficiencies and competitive advantages by capitalising on the technologies of Internet and mobile communications.

Consequently, competitiveness in the new global economy will be directly related to how well tools of the digital age are exploited and used. Citizens in the Information Age will need to develop new digital literacy skills and adapt to the needs of lifelong learning in an environment of constant change and greater access to information.

3.2 Technical Architecture for the Mobile Information Society

Nokia is developing a technical architecture that will address important issues when implementing mobile internet application. This architecture consists of three sectors: consumption, connection and contents sectors. The architecture describes how these sectors are linked together and guidelines for constructing each sector.

The consumption segment corresponds to how (mobile) terminals will be used by the final customer. The connection segment corresponds to access networks and core network functionality managed by network providers and the content corresponds to the content servers managed by service and content providers.

3.3 A Reference Architecture for mLearning

Technical mobile Internet architecture enables the construction of an Internet infrastructure that makes it possible to implement seamless connectivity from a variety of devices to educational content. This reference model, or example, paints the picture of what sort of learning environment we may have in a few years time.

4. MOBILE DEVICES: A COMPLEMENTARY CHANNEL FOR ELEARNING (MATTI HÄMÄLÄINEN)

Can mobile devices play a significant role in the delivery of eLearning? If we consider mobile devices as complementary channels for learning delivery and interaction, instead of looking at their limitations as a primary delivery medium, we find a lot of interesting opportunities. For the sake of clarity, in this discussion mobile device means a mobile phone or other personal portable-computing device (e.g. PDA) that has wireless telecommunication capabilities. Also, we focus on data communication aspects even though voice communication is certainly a relevant channel for tutoring and other activities that otherwise would require face-to-face contact.

Mobile devices have certain inherent limitations: the user interface is one of the key constraints. The memory and processing capacity are also far from the capacity of desktop PCs. The wireless telecommunication networks will continue to have smaller bandwidth and higher network latency compared to wireline networks, limiting the data that can be transferred and the guaranteed response times. But the strengths are also clear: mobile devices, phones in particular, are personal devices and people always carry them (shower and sauna excluded). They provide freedom to move around and access to services wherever the user is. Mobile phones are considered to be trusted devices and we shall soon see several forms of payment systems available on mobile phones. User identity is closely tied with the phone. This makes it possible to create user-specific and profiled services. Mobile phones are also becoming location-sensitive, which enables location specific services.

It is possible to create eLearning applications on mobile devices that provide highly engaging and compelling interaction despite the limitations. Such applications include self-evaluation and testing, instant feedback, educational games, and various other forms of edutainment. These are highly relevant to improving motivation, guidance and responsiveness. For example, we have found knowledge and opinion games to be a good means for providing intellectually stimulating interactive content on mobile devices. Interactive question/answer applications are highly usable even on the mobile networks and devices of today. In the future mobile devices will have more local processing capability to enable downloadable and loadable applications with richer media, even though their user interface due to form factors will still be somewhat limited. Thus, we see mobile devices as a new complementary delivery channel for learning delivery and interaction. They provide the possibility of additional stimulus, motivation and feedback in situations where it would not be possible with conventional wireline solutions.

5. BIOGRAPHY

Jari Multisilta is a professor of multimedia at Tampere University of Technology, Information Technology at Pori, Finland. He got his M. Sc from the University of Tampere in 1992 in Mathematics and his Dr. Tech. at Tampere University of Technology in 1996. The title of his doctoral thesis was "Hypermedia Learning Environment for Mathematics". Prof. Multisilta has published over 50 articles for international conferences and journals. Prof. Multisilta has studied learning and modern communication and information technologies and has taken part in several research projects on this area. Currently he is the chair of IFIP (International Federation of Information Processing) working group 3.3 on Reasearch on Educational Applications of Information Technologies.

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The Shadow netWorkspace

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Abstract: The Shadow netWorkspace™ (SNS) is a web-based work, collaboration and learning environment designed to improve education by opening classroom and schoolhouse doors to advanced information and communication services of the Internet. It is called 'Shadow' because it follows you wherever you go; your network-workspace is accessible at any computer anywhere that has a connection to the Internet. SNS provides much of the functionality of a personal PC with the added benefit of being accessible from any computer via the World Wide Web. The SNS environment is designed to be installed at individual school locations, is provided for free, has an Application Programming Interface (API) so others can develop applications for it, and is open source (GNU Public License) so that everyone can participate in enhancing and supporting it. It operates on a Linux-based server and utilizes the Apache web server, MySQL, and Sendmail.

The Shadow netWorkspace™ (SNS) is an Internet-based workspace designed for opening the classroom and schoolhouse doors to improve the processes of learning and schooling. The Web-based Education Commission in its report to the President and the Congress of the United States starts its report (Web-based Education Commission, 2000) with the following quote, "Across America, people told us that the Internet offers one of the most promising opportunities in education ever. And yet they were troubled by their inability to harness its potential advantages." SNS is a type of new technology that helps schools bring the potential advantages of the Internet to all teachers, students and parents. An analogy is to imagine the desktop of a computer that has been specifically designed to support learning existing on the Internet. Using a browser, such as Internet Explorer or Netscape, the user connects via a secure login to a Shadow netWorkspace web site. Here she finds a desktop for accessing her files and applications. Several applications are currently implemented including a calendar, a graphic editor, a word and media processor, a portfolio manager, a homework notifier, and text conferencing. An on-line folder system that operates similarly to Windows or Macintosh is used to access and store files. Files can be uploaded or downloaded from the local hard drive and can be shared within groups or maintained as private information.

SNS enables the integration of Internet-based services to support a learning community. Imagine a team of third graders building their multimedia report on whales on the computer in Mrs. Smith's classroom. They are working in SNS and have a workgroup document. On the way home from school, Mary stops at the library and scans a picture as well as checks some facts. She accesses SNS from the library computer and adds the new information to the report. Meanwhile Mary's dad checks the Homework Notifier in SNS from his office to see what assignments the children have. His fifth grader has some math problems and dad is happy that the teacher has provided some links to helpful web sites. He sees that he will need to review the whale project document with Mary and wonders if mom, away on a business trip, could log in from her hotel room tonight and use chat for a family review. That night the family uses SNS to review the whale project using a scoring guide provided in the system by Mrs. Smith. Later that week all of Mrs. Smith's class will create review groups for science education majors at the university to examine and provide feedback on their projects. All of these network services are available on the Internet today, but they are not integrated, nor easy for the teacher, student or parent to use. The above scenario depends on a network system that is secure, easy to use, customized, inclusive of all key members of the school community, powerful in representing media-rich information, and provides a variety of communication and sharing services.

A key aspect of SNS that is beneficial to schools is support for facilitating the activities of groups. Currently SNS has three primary types of groups: class groups, work groups and review groups. Groups are distinguished by the social roles within the group. For example, class groups have teachers with certain authority and responsibility; in work groups everyone is equal; and in review groups the owner can place items online for review and response by parents and other community members. Chat sessions and discussion forums can be invoked within any group at any time. The primary features and functions of SNS are intended to make the information processing of a school or class digital, accessible and shareable.

The Shadow netWorkspace is a system for enabling a learning community and is designed to be installed and operated within the school setting. In this way the school "owns" the SNS implementation. The school creates the rules and policies, establishes membership, adds software, customizes the implementation, and individualizes the system as its own.

SNS is licensed as Open Source software and operates on an Open Source platform. This means that users will not have to pay to use it. SNS operates on a Linux-based server and utilizes the Apache web server, MySQL DBMS, and Sendmail. The server-side application programming interfaces and applications are written in Perl. The client software is written in HTML, JavaScript and Java. The barrier to entry to begin utilizing SNS is low. The client-user only needs an Internet connected computer running a web browser. Several schools are currently using SNS to pilot networked learning capabilities in their communities. As of Nov. 2, 2000, SNS has been available for download, examination and use by any educator, developer or researcher at http://sns.internetschools.org.

SNS brings the advanced capabilities of the Internet to the teaching and learning process, not just for the few teachers and students who are technologically savvy, but hopefully to every teacher and student who has the basic capabilities of using windows, folders, and word processing. Our vision is that every student will be engaged in active, meaningful learning at an appropriate level and in an appropriate way to meet his or her needs and interests. The Internet is a powerful tool to move from vision to practice by building resourceful and resource full learning communities. However, to truly effect the education of students, we cannot simply improve the teaching of a few teachers or the technologically adventurous. We need to change the practices of the entire school. In order to do so, the Internet tools for representation, sharing, communication and collaboration need to be easy to use by all members of the learning community, and they must be available in ways that are responsive to the concerns of school leaders for accountability, costs, security, and ownership. SNS is an innovative new technology that substantially addresses these needs, and because it is an open source licensed application there is great potential for SNS to evolve and develop in ways that are responsive to the needs of school improvement and reform.

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Emergent-Collaboration in Web-Supported Academic Courses

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Abstract: Emergent-collaboration is the process by which group configurations and transactional patterns evolve among participants during the course of learning. This study focused on the integration of a Web shell for supporting emergent-collaboration activities in six graduate courses (115 students) in the Tel-Aviv University School of Education. The research questions addressed: (a) the didactic modes that have been devised for supporting emergent-collaboration learning processes, and (b) the extent of participation of students and teachers in Web- supported emergent-collaboration learning processes. Quantitative as well as qualitative data regarding different modes of collaboration are presented. The results indicated that the use of the technology affected learning and teaching processes in significant ways, increasing the students participation and involvement in the courses, supporting a wide range of transactional modes, and contributing to the groups' social climate and collaborative work.

Web technology has become a powerful instructional means in higher education instruction (Bates, 2000; Collis, 1998; Flanagan & Egert, 2000). Among other salient capacities of the technology, its potential for supporting collaborative learning processes deserved particular attention among scholars and developers (e.g., Anderson & Kanuka, 1997). Collaborative learning refers to an instructional situation at which students interact while accomplishing an academic task. According to the partners' (students, teachers) needs and goals while performing learning assignments, interactions (among students, students and teachers, students and knowledge resources) may fulfill varied functions, e.g., co-operation, collaboration, competition, distribution (of knowledge), or sharing (of knowledge resources).

New technology-based models of collaboration imply an expansion and even a transformation of the variables, components and processes characterizing collaborative learning events (Sharan, 1994). Examples of issues affected by the use of the technology are: the *setting* of the activity (e.g., asynchronous non face-to-face interactions); the *dynamics* of the interactions (e.g., dynamic definition of ad-hoc roles and functions within the); the *configuration* of the group (e.g., occasional participation of additional partners according to emerging needs); or the variety of *communication means* used for interacting (e.g., mail, chat, collaborative-work tools).
In addition, we would like to distinguish here between two learning situations: structured and emergent-collaborative. Structured collaborative tasks are well planned didactic solutions that follows the conceptual guidelines proposed by researchers and practitioners. In contrast, emergent-collaboration is the process by which group configurations and transactional patterns evolve among participants during the course of learning, in correspondence with the (extent and quality of the) students involvement in the learning process and their commitment to different aspects of the task (Ogata, & Yano, 1999). As the task proceeds, transformations in the group functioning may occur, e.g., changes in configuration, exchange of roles, formation of ad-hoc subgroups. This shift in perception of collaborative processes has practical implications for the planning, implementation and research of collaborative learning situations. The planning process will focus now on the definition of goals and constraints, rather than on the detailed formulation of structural or organizational aspects. And as researchers, we will be more interested in the transactional fabric (among all participating agents), the emergent-collaboration patterns and their evolution in time, and self-organization mechanisms.

In the project reported in this paper, we adopted the emergent-collaboration approach. Within this approach, we refer to the whole range of interactions taking place among students in terms of *educational transactions*. These transactions, which are the building blocks of emergent-collaboration, comprise the many-to-many teaching and learning interactions by which partners (students, teachers), holding defined goals, both contribute-to and are benefited-from the course's course of events. In this paper we depict, both in quantitative and qualitative terms, different instructional models involving educational transactions and emergent-collaboration processes as they evolved with the integration of Virtual-TAU (a Web-shell for supporting online learning) in the teaching of graduate courses in the Tel-Aviv University School of Education. Two main principles guided the implementation of the Web-shell into the academic teaching: (a) Virtual-TAU is not intended to replace the "real" courses by complete virtual courses. It is rather conceived as powerful tool complementing existent face-to-face teaching; and (b) The participating teachers adopted the goal to develop different models of integration of Virtual-TAU in their courses, rather than adopting one common model

Our study focused on the following questions:

1. What didactic modes have been devised for supporting emergent-collaboration learning processes?
2. What is the extent of participation of students and teachers in Virtual-TAU based emergent-collaboration learning processes?

Method

The study was conducted during the 1998/1999 and 1999/2000 academic years, focusing on six classes participating in four one-semester (12-14 weeks) courses. All courses dealt with theoretical and research aspects of using ICT in education: Cognitive technologies for learning (two classes: 'a' and 'b'); ICT- Based learning environments (two classes: 'c' and 'd'); Web-Based learning (class 'e'); and Virtual environments in education (class 'f'). The research population included 3 lecturers, 3 teaching assistants and 115 graduate students. Data were collected by means of: (a) log files of students' hits and page views within Virtual-TAU; (b) transcriptions of forums' and collaborative activities with the shell. Virtual-TAU, the Web-shell used in this project, is similar to commonly used shells (e.g, WebCT, Learning Space, see Collis, 1999).

Results

Web-supported emergent-collaboration modes

Our first research question relates to the variety of collaboration modes that emerged through the development of the Web-supported courses. The analysis and classification of the Web-supported educational transactions resulted in the following six functional categories:

1. Web-supported social interaction

This category refers to activities related to the consolidation and maintenance of the courses' social fabric. As an example of emerging social transactions, teachers reported all along the semester on the "Who's Tamy" effect: there was always a student, at the beginning of a class, asking to know who was her partner (i.e. Tamy) in the last night's forum discussion or chat exchange. In regular lecture-based courses it is a commonplace that participants get acquainted mainly with their limited group of friends or close classmates. There is little opportunity (and need) to interact, and therefore to want to know, "who's that Tamy". In contrast, within Web-based activities students meet each other (virtually) around different topics and discussion themes, prompting the motivation to meet each other (really) in the class. This emerging ingathering at the social level sets the ground for emergent-collaboration at the learning level.

2. Web-supported critical group-reading

In traditional academic courses reading is mostly an individual activity. Only part of the students participate in class discussions following reading assignments. In addition, the types of reading assignments are usually limited in format. Two outcomes could be clearly observed from the very early stages of this study. The first was the rich repertoire of reading-support tasks evolving as the courses proceeded, e.g., directed-reading discussion forums, e-papers contest, bibliographical-sources group synthesis and integration, or "apply-the-paper's-model" for group analysis of computer-based learning materials. The second was the dramatic increase in the students' reading performance, both in terms of scope and personal involvement. The requirement to participate in the group-reading tasks and to make concrete (written) contributions affected the students' disposition towards the bibliographical materials.

3. Synchronic and asynchronic issue-discussion

Exchange of ideas, opinions and beliefs about key issues can be considered at the core of group-based knowledge-building processes. The Web-environment offered the opportunity to expand (in frequency) and enrich (in quality) issue-discussion activities. For one aspect, these activities took place also in asynchronous mode (in addition to only-synchronic class discussions), increasing considerably the number of group-discussion events. In another level, a variety of discussion configurations emerged (e.g., student-moderated, teacher-moderated, or non-moderated events at which the leading role in the debate passed among participants).

4. *Peer evaluation and review*

A key characteristic of knowledge generating communities, (e.g., scientific or professional communities) is the dissemination and mutual review of ideas and intellectual produce. In regular courses based on traditional teaching/learning means, there is little opportunity to exercise these types of transactions. In the courses included in this study, several forms of Web-based peer evaluation and review activities were developed, e.g., response to peers' contributions, formative evaluation of peers' work-in-progress, or judgment of peers' contributions in selection or contest tasks.

5. *Collaborative construction of knowledge bases*

The idea of the cooperative accumulation and preservation of knowledge generated by the group members stood behind the creation of activities at which the students were asked to contribute to a common knowledge base (e.g., the joint creation of an annotated database of educational Websites). The resulting knowledge bases not only served the learning of the original contributors, but also are now offered to new groups of students which in turn continue to enrich them.

6. *Group-projects online presentation*

A well-known phenomenon regarding courses' final assignments or projects is that these become mainly a teacher-student event. The student (or small group) hand out the work to the teacher (possibly after a couple of iterations), which is evaluated then stored with little chance that other students will read or use it as reference for further work. Within Virtual-TAU a project-presentation mode was developed, offering the students a platform for developing their work and making it public at any desired stage.

The above presented six modes of Web-based transactions developed by the courses' teachers, are but a sample of the promising ways the communication tools may contribute to both expand our repertoire of didactic solutions, and trigger more meaningful emerging-collaboration processes.

Students' Participation in Virtual-TAU Activities

Students' involvement and participation in Web-supported transactions was of no precedent compared to the situation in traditional courses. As students stated it: "I never worked so hard and so comprehensively in an academic course; I felt that the course is running after me; If two days pass without going into virtual TAU, I felt that I miss something important happening right now". Table 1 presents the extent of the students' participation in Virtual-TAU forums within the six courses participating in this study.

Course	No. of students	No. of forums	No. of entries to forums	No. of messages	Ave. messages per student	Entries Per student	Entries Per messages
a	20	4	400	90	4.5	20	4.4
b	22	6	431	196	8.9	20	2.2
c	18	8	815	231	12.8	45	3.5
d	15	5	745	346	23	50	2.2
e	30	7	1560	442	14.7	52	3.5
f	10	4	250	114	11.4	25	2.2
Total	115	34	4201	1419			
Course average	*19.2*	*5.7*	*700.1*	*236.5*	*12.3*	*36.5*	*3.0*

Table 1: extent of participation in the courses' forums

The overall figures reinforce in quantitative terms the students' subjective assertions. An average of 700 entries (site visits) per course (37 entries per student), and 237 messages per course's forums (12.3 messages per student), are indicators of intense Web-based activity. The individual student visited the courses' sites about 3-

4 times a week in average, out of which once a week in average contributed to a forum's discussion. These figures can be read also as indicator of two modes of engagement in the forums' activities, namely operational versus observational modes. About 3/4 of the times students entered a forum not to contribute a new message, but to observe what is currently going on in it (e.g., to trace the discussion, to check reactions to her messages). This is a clear evidence of the creation of a virtual-transactional-milieu within which the students' felt involvement and commitment to the course's concerns.

Table 2 summarizes data on students' participation in 25 forums, for different modes of emergent-collaboration. The two most intensive modes of emergent-collaboration in terms of students participation were the student-moderated issue discussion, and the collaborative construction of databases. The most frequently used mode by instructors was the Web-supported academic reading. Above half of students' contributions to the forum were responses to messages posted by others, implying an intense flow of transactions during the discussions.

Activities	No. of courses	No. of forums	average duration (weeks)	moderation	ave. No. messgs. per forum	% of responses	ave. No. messgs. per student
Social Interaction	3	3	5	none	49.3	50.7%	2.3
Web-Supported Reading	4	12	3.25	lecturer	33.3	41.1%	1.7
Issue Discussion	3	9	1.6	students	65.1	68.8%	3.9
Knowledge Base Construction	1	1	5	none	146	49.3%	4.9

Table 2: Students participation in selected activities

The following are examples of emergent-collaboration processes in two different instructional modes: student-moderated discussion and critical group reading.

Students-Moderated discussion groups

In course 'd' three issues were assigned for students-moderated discussion. For each forum, 3-4 students were appointed as discussion-moderation group. Their responsibilities were to work collaboratively aiming to (a) prepare the background for the discussion; (b) present it to all students participating in the forum (about 15); (c) open the discussion, and moderate it during two weeks; (d) summarize it with the class; and (e) post a report on it to the course's Website.

Two parallel processes took place during the moderation-group's work. The first was the collaboration process within the moderation group (e.g. meeting for planning, assigning rolls, writing up the report) following structured collaborative learning schemes. The second process comprised the emergent-collaboration transactions between the moderators and the rest of the students in the course.

Table 3 presents the extent of participation of the students in the three discussion groups of the course. In all these discussions, the enrolment was very high. An average of 19 messages were contributed to the discussion by each participant, more than three messages a week. Moderators involvement was also very high, although varied among groups. The use of additional communication tools (e.g. polls, chat, e-mails) was also an initiative of the student-moderators.

	Forums (no. of messgs.)		Poll	Chat	e-mail (to whole group)
	Total	moderators			
Issue 1	87	27	√	√	1
Issue 2	108	50	-	-	4
Issue 3	90	14	√	-	2
Average	**19.1**	**30.3**			

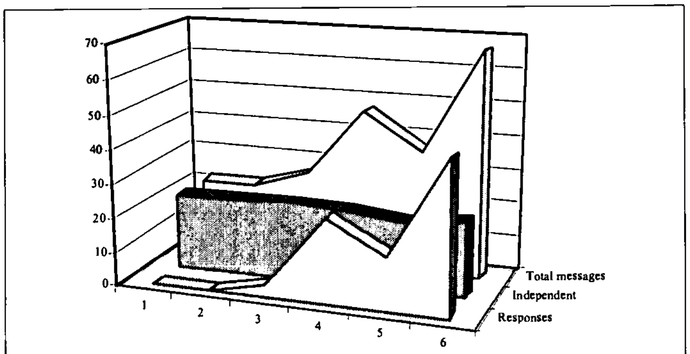
Table 3: Usage of communication tools as facilitator of emergent-collaboration during three two-week student-moderated discussion groups (n=15).

According to the self-report of all the students that served as moderators, their role was extremely effortful, and meaningful. As one of the students stated it, "This activity was extremely demanding both because of the intensity of our moderation group interaction and the responsibility we shared in keeping the discussion alive and on high level. However, I learned a lot from the processes, and enjoyed it very much. I think this kind of activity should be integrated in many more courses". One of the concerns of the moderators was how to engage the entire class in the discussion. Therefore, they invested a lot of time and creativity to create a contextual-framework to the discussion, and used e-mail to encourage their classmates to participate.

Web-supported Critical Group-Reading

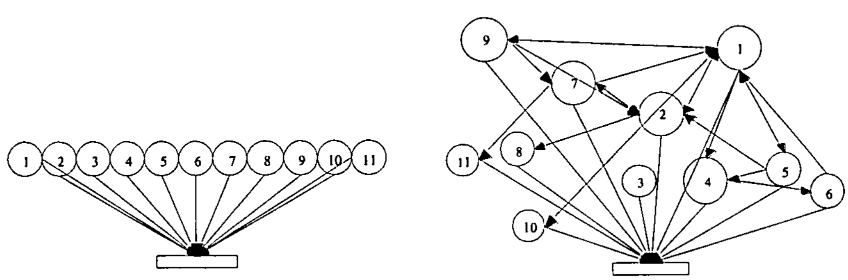
Bibliographical resources are essential components of any academic course, serving as raw materials for the implementation of diverse learning formats (e.g., class debates, public trials, topical surveys). In most courses the students do critical reading at a limited extent due to diverse reasons, e.g., the size of the class, students' degree of motivation and perception of the readings' learning value, or even language barriers.

Figure 1 shows the evolvement of the transactional volume in quantitative terms. The course (22 students) included six forums focusing on critical-reading tasks. For the first two forums, each student entered one message, according with the minimal requirements. By the fourth task the participation increased notably, up to a triplication of the initial values in the last task. The interesting aspect of these figures are that the number of independent contributions remained the same for all tasks, while the amount of responses to each other messages increased –none at the beginning up to 45 in the last task.



	1	2	3	4	5	6
Responses	0	0	4	25	16	45
Independent	22	22	23	22	20	22
Total messages	22	22	27	47	36	67

Figure 1: Number of transactions in six forums of a course



Forum task 1 Forum task 6

Figure 2: transactional patterns for two task forums

However, a clearer evidence of the emerging collaboration patterns can be appreciated if the transactional map is depicted as in Figure 2. For clarity reasons, only half of the students are represented. In task forum 1 at the beginning of the course, all contributions were made independently (only one per student). This configuration gradually changed, becoming in task 6 an intricate web-like pattern. Active subgroups emerged (e.g., students 1-2-4, and 7-9). And analysis of the content of the messages showed that this subgroups, besides participating in the debate, assumed a variety of functions (e.g., moderation, information supply).

Discussion and Conclusions

The first question addressed in the study focused on the different modes of Web-based transactions that emerged during the planning and implementation of the experimental courses. At the level of this particular study, the reported results show that even within its limited setting (e.g., six courses, three teachers, and a Web shell in prototypical stage) a fairly interesting set of learning assignments and collaborative tasks emerged. The learning events ranged from transactions aimed at supporting group reading and bibliographical work, up to the development and (digital) presentation of collaborative projects. At a more general level, the results represent a valuable (if modest) contribution to the endeavor shared by many educators and researchers aiming to define new pedagogical schemas (a Webagogy?) fitting the features and qualities of the Web technology (e.g., see Mioduser et al., 1999).

The second research question aimed to examine the extent and quality of participation of the students in the different activity modes, with the support of the Web tools. The results unveiled an intense involvement of students and teachers in the courses' activities. The distinction between two modes for visiting the courses' sites, namely operational and observational modes, was also a revealing indicator of the students' continuous concern with the courses' affairs. The students' perceptions of their experience can be summarized by one participant's claim that the course, instead of a "14-meetings-course", became a "14-weeks-course". The sense behind this claim is that while the traditional course was perceived as a series of discrete events (namely class meetings, and limited time spent in out-of-class assignments), it is now perceived as continuous intellectual engagement comprising face-to-face as well as virtual meetings, and anytime/anywhere transactions among all partners. However, it should be noted that the complementary aspect of taking part in continuous learning transactions and being mindfully attentive to the others' (students, teachers) requirements -is an increase in time and effort devoted to a course's affairs

The experience reported in this paper also represents an alternative view about the role of advanced learning technology in distance learning processes. By the traditional view the main focus is on individualization of the instruction, allowing each student to engage in learning activities at her own pace and demand. In contrast, this study focused on harnessing Web-based tools in support of collaborative processes that are of great contribution to the individuals' learning. From this perspective, we expect a major role of the Internet in education to be to support and enhance collaboration and socialization processes among students. In addition to the traditional model based on one-individual access to distant knowledge resources, we expect the multiple-participants transactional model to be come a central component in the development and implementation of novel distance learning systems.

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Abstract

This tutorial will examine instructional designs for online learning and teaching in particular designs that stand to take greatest advantage of the unique attributes of online educational

afford because of their time, place and pace independence; and b) electronic and flexible access to multimedia based resources. We will begin with an overview of contemporary

innovative instructional designs such as: *Distributed problem-based learning; Computer* *-ba* *-based role play simulation; and Learning by designing*. This part of the session will comprise demonstrations and critical of innovative instructional designs from a range of subject areas including *ng for Entry-* *Practice, International Politics*, and studies. The focus of this demonstration and discussion will be on both the *pedagogical* and the *architecture* models. The most of the workshop will be the creation of online learning designs by participants that will be developed into articles to be published in a *Special Edition* of the -reviewed *"Distance Educ* http://www.usq.edu.au/dec/decjourn/demain.htm

Intended Audience

This tutorial will be suitable for a range of skill levels (from novice to expert) from among:

1. Instructional designers, Educational developers.
2. Teachers involved in online learning and teaching.
3. Computer programmers and Web designers and developers.

Note: I confirm that I will be present at Ed-Media 2001 to run this Tutorial/Workshop.

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THE VIRTUAL PRINT EXHIBITION: A CASE OF LEARNING BY DESIGNING

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Abstract

This paper describes work that has been in progress on the use of information and communications technology in the transformation of teaching and learning in several subjects in the School of Fine Arts, Classical Studies and Archaeology at the University of Melbourne, Australia. Its specific focus is on the "Virtual Print Room" project. This project involves the development of a rich database of high quality digitised images of a large number of prints (from the Baillieu Library's Old Master Prints Collection) comprising the works of famous artists such as Dürer, Marcantonio, Raimondi, Rembrandt and Hogarth. Most importantly, this database enables the study of fragile prints outside the "white-gloved" controlled environment of the conventional print room. One such novel form (which is described in this paper) is learning by designing a "Virtual Print Exhibition". Students involved in this subject create a virtual exhibition from the database of prints and experience at first hand, how to construct an art historical argument in the form of an exhibition. As part of this presentation, we will demonstrate the online learning environment that supports this group-based learning activity.

Keywords

Interactive learning, simulation, teamwork, collaborative learning, old master prints, renaissance, baroque.

The Virtual Print Exhibition: A Case of "Learning by Designing"

The *"Virtual Print Exhibition"* is a collaborative learning task in which senior students of Art History work in small groups to plan and present a virtual exhibition of prints from a database of rare prints. This task comprises a core learning activity in a subject on Museology and Curatorship. The principal attributes of this innovative learning task are as follows. First, it offers students the opportunity to acquire knowledge not only by being told about it, but also by being involved in the experience of designing an exhibition (i.e., learning by doing). Second, it enables the studying of renaissance and baroque prints (comprising the works of famous artists such as Dürer, Marcantonio, Raimondi, Rembrandt and Hogarth) away from the snobbery and preciousness of the conventional print room. This is made possible with the creation of a rich database of high quality digitised images of the selected prints which students can access in an online and flexible learning environment to search for, select and view images in a variety of formats (i.e., thumbnail, zoom-in and zoom-out). Third, by utilising group work, it fosters collaborative learning whereby students work in teams to prepare a concept for an exhibition, which is then presented to a director of a museum. Fourth, by being an online learning task, it provides access to a resource of rich and rare collection of renaissance prints that is otherwise not readily accessible for teaching and learning. This work is currently in progress in the School of Fine Arts, Classical Studies and Archaeology at the University of Melbourne. In this paper we outline the educational foundations of the project, report on its development, and approaches to the formative evaluation process.

The Case for "Learning by Designing"

Design as a means for acquiring content knowledge is very appropriate in practice-based disciplines (Newstetter, 2000; Hmelo, Holton & Kolodner, 2000). For instance, design experiences such as building models in engineering make it ideal for the understanding of the subject matter. The obvious benefit of a design task is its inherent situatedness or authenticity. In design-based learning activities, students' understanding is "enacted" through the physical process of conceptualizing and producing something. The designer's knowledge is embedded in, manifested through, and articulated by the design artifact. The structures created, the functions sought, and the behaviors exhibited by the design solution offer a means to assess knowledge of the subject matter. As such a student's conceptual understanding or misunderstanding of domain knowledge can be ascertained from that artifact. The failure of that artifact, for example, may suggest an incomplete understanding of the subject matter.

A big advantage of a design task is the variety of cognitive tasks required to move from a conceptual idea to a product. These include information gathering, problem identification and constraint setting, idea generation, modeling and prototyping, building, and evaluating. These tasks represent complex learning activities in their own right, but when they become the environment in which knowledge of the subject matter is constructed, students have the opportunities to explore that content in the different phases and through different representations. The complexity of design activities makes them excellent vehicles for knowledge acquisition. Domains of knowledge or skills that might be separated out or abstracted away for individual treatment in other situations actually coalesce and mutually inform one another in design tasks. Moreover, design complexity requires iterative activity toward better solutions that can support refinement of concepts. Design complexity also dictates the need for collaboration. A workable team possessing different kinds of knowledge and skills can tackle complexity more successfully than an individual. On student teams, one student might have good research skills, another domain knowledge, another drawing and representation skills, and another construction skills. When working together, the group can take on design complexity, combining the varied types of knowledge and skills and ideally, learning new things from teammates.

Implementing Learning by Designing

Implementing "learning by designing" tasks is a complex undertaking that needs to be carefully ochestrated (Barron et. al., 1998; Kafai, 1996; Kolodner et. al., 1998). The process of designing requires learners to manage multiple constrains while dealing with complex situations. Schauble, Klopfer, and Raghavan (1991) reported that, when students carryout design tasks, they tend to focus on creating products rather than *"constructing"* understanding and meaning. This is understandable because the outcome (some artifact that works or looks good) is a concrete product, whereas understanding the internal workings of a system or process is more abstract and less tangible. These authors suggest that the many tradeoffs in using design tasks to promote learning include:

- Striking a balance between having students working on the design task and reflecting adequately on the design activities. Incorporating reflection is important to encouraging an understanding-orientated approach.
- Being able to integrate real life experiences without letting it overwhelm the students with irrelevant information that might be distracting.
- Maintaining extended student engagement in a manner that emphasizes understanding of principles rather than task completion.

Our approach to the specification of the design activity in this project is based on an awareness of the above and the principles of problem-based learning (Barrows & Kelson, 1995). A problem-based learning (PBL) session begins by presenting a group of students with a complex problem to address. While working on the problem, students pause to reflect on the information they have collected, generate questions about the information, and hypothesize about underlying relationships that might help explain it, or potential solutions to the problem they are working on. They identify concepts they need to learn more about to address the problem and then they develop plans for proceeding. Students usually work independently to research the learning issues they have identified. They regroup to share what they have learned, reconsider their ideas, and/or generate new ones in the light of their investigations. They continue by attempting to address the problem, based on what they have learned, sometimes going over this cycle several times through question generation and additional research.

The "Virtual Print Room" Project

The *"Virtual Print Room"* project is part of a larger effort to transform the approach to teaching and learning of several subjects in Museology and Curatorship at the University of Melbourne. This work recognizes the role of new learning technologies in the management of collections, as one of the most important issues in contemporary museum practice. The database of print resources that is being developed as part of this work will be used by specific art history courses on renaissance and baroque art which incorporate the study of old master prints. In its fully developed form, the Virtual Print Room would comprise an educational resource that will allow the study of fragile images outside the controlled environment of the conventional print room, and also in novel and innovative ways. One such form (which is the focus of this paper) is the design of a *"Virtual Print Exhibition"* on different themes from the electronic database of the prints.

Students involved in this subject are able to create virtual exhibitions from the database of print resources and experience at first hand, how to construct an art historical argument in the form of an exhibition. Curatorial students are able to gain an important experience by participating in the creation of a virtual museum. Most contemporary job descriptions in Australian museums ask for some knowledge of the implementation of new technologies, such as knowledge of digital image databases as all museums are engaged in the creation of on-line catalogues for permanent collections and temporary exhibitions. Students involved in this project are able to study the print collection in ways that has the capability to modernize connoisseurship by a comparison of details on the screen, through the use of detailed and high quality images at varying resolutions (see Figure 1). Close study of details also result in knowledge of how to determine the authenticity of prints, the techniques with which they are executed, and the authenticity of signatures and printers' marks.

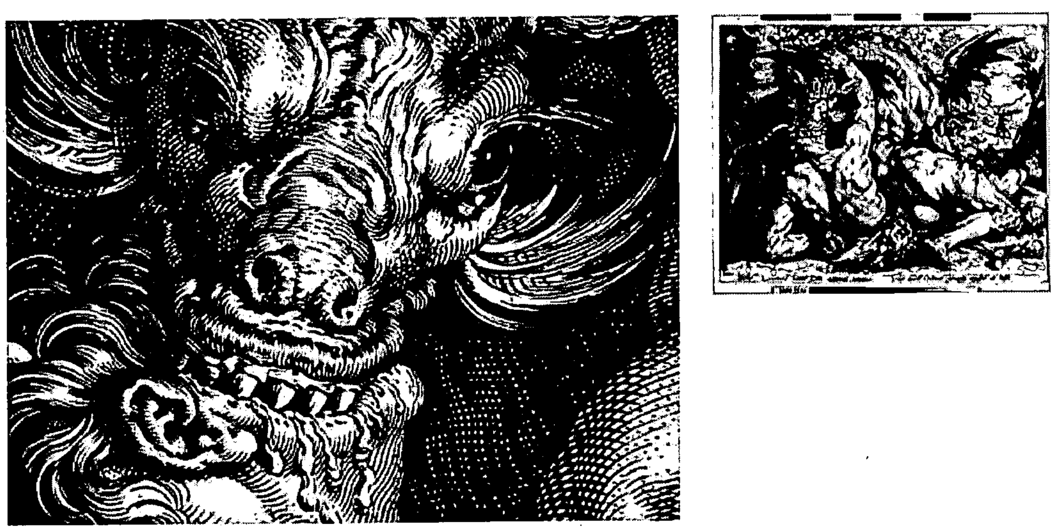

Figure 1

Prints have been scanned at high resolution allowing details to be shown on the computer screen at very high quality.

Getting Started

Students taking the subject that comprises the *"Virtual Print Exhibition"* project are presented with the following scenario at the beginning of the term.

> The *National Gallery of Victoria* (in Australia) is planning a major exhibition to celebrate the re-opening of its print room in 2003, for which they have received a grant of $100, 000. You and your colleagues have been asked to put together a *virtual exhibition* from the newly developed electronic database of Old Master Print Collection in the University of Melbourne Library. To accomplish this task, you will need to prepare a proposal, in which you design, install and curate an exhibition online, focussing on an appropriate theme of your choice.
>
> The Director of the Gallery would like to see you put together a detailed plan with time lines, and a budget with a detailed rationale before it can release the funds for you to begin work. The group with which you will work will have access to an asynchronous computer conference facility, to which you and your colleagues will be automatically subscribed. You must conduct all your planning activity using this medium. You should complete the proposal in three weeks time, submit it for discussion and feedback from other curators in the gallery, and the exhibition committee. You will be also required to present your team's proposal in a seminar to the director of the museum at a curatorial exhibition meeting.

This online learning environment that supports this group-based learning activity enables the use of a mixture of individual and team-based learning tasks. Students can work on their own to create exhibition proposals, for example, but must come to an agreement within their team about the content and layout of the final exhibit. As students engage in this type of learning activity, their work is stored in individual student *folios*, which are available for reflection upon by the students themselves, and which also comprise as records for assessment by the lecturer. Documents and messages produced for and by a team are available for review by all members of a team.

To produce the virtual print exhibition students have access to a very large online database of images and catalogue information about the prints. They can search this database for suitable prints, zoom in for detailed analysis, mark them for inclusion in their exhibit, and position prints on a "virtual wall" in the exhibition spaces (see Figure 2). We will be demonstrating the functionality of this environment as part of the presentation of this paper.

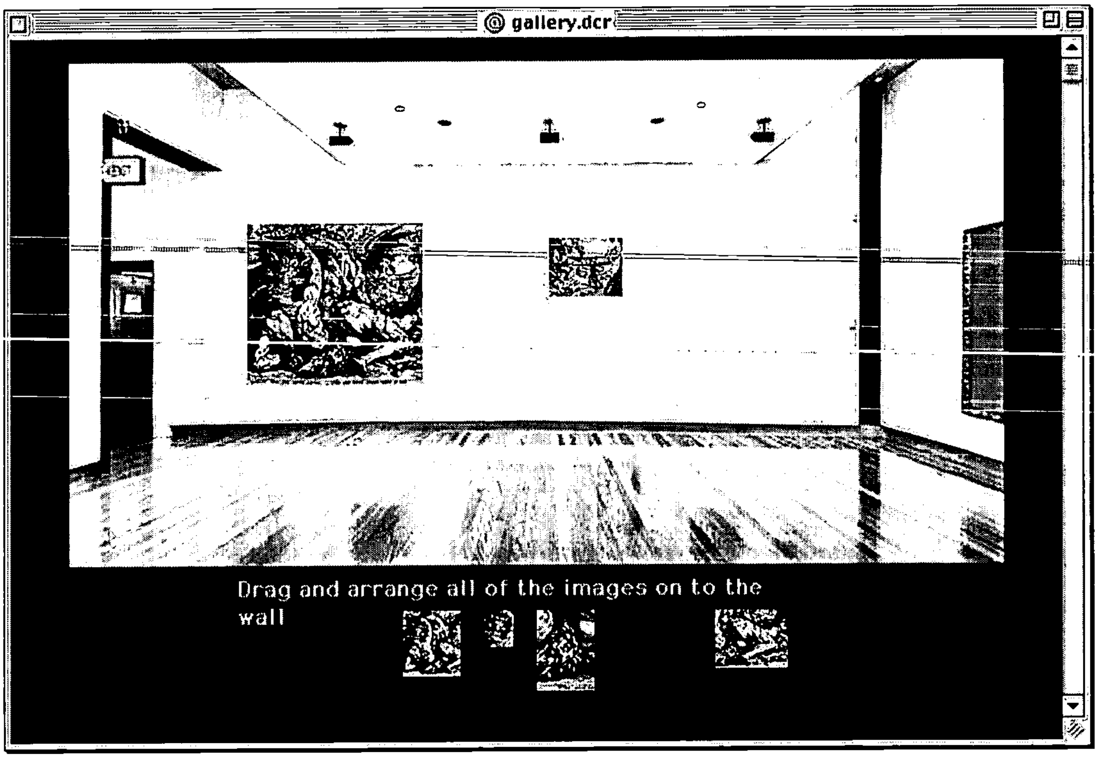

Figure 2.

The Virtual Wall: A layout tool that allows students to position their selected prints in various exhibition spaces.

Evaluation

The evaluation of the design, development and implementation of this project comprises:

- **Formative evaluation** (which focuses attention on improvement of the design and development processes of the teaching and learning environment. It comprises peer-review of the design specification and pilot testing of the course design with a sample of the users);
- **Summative evaluation** (which focuses attention on impacts, effects and/or outcomes of the teaching and learning innovation. It comprises evaluation of the full-scale implementation); and
- **Monitoring and on-going evaluation** (which attempts to keep abreast with the extent to which the innovations are being integrated into regular teaching and learning activities, and how students are coping with the innovation).

At the time of the writing of this paper, some aspects of the formative evaluation task (such as peer-review of the design specification) have been completed. More detailed data derived from other aspects of the formative and summative evaluations will be available at the time of the presentation of this paper.

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Analytic Studies of Bulletin Board for Cross-Cultural Communication

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Abstract

Over the past few years we have been working on the construction of a web-based interactive learning course for Japanese culture and language. Upon completion of this system named "Images of Japan," we conducted a survey on its overall framework and contents. The data were gathered from two groups of students: one from Dokkyo University in Japan; and, the other from University of Illinois in the United States. The results of the survey clearly showed that the informants had found this course quite interesting and informative.* (see Nakanishi et al 1999)They also responded that they were willing to collaborate with each other in learning more about Japanese culture and in exchanging ideas on this website. In the following months, however, we did not observe as much communication as we had expected. Thus, the purpose of this paper is to present possible interpretation for the lack of participation and to introduce the pilot study which we are now working on to further investigate the possibility to develop a system to encourage cross-cultural communication.

1 Introduction

"Images of Japan" has been constructed to disseminate information on Japanese culture and to encourage cross-cultural communication. We expected the users would obtain a deeper understanding about Japanese culture and ways of thinking on this website. The original data collected from over 200 students at Dokkyo University and University of Illinois respectively revealed a wide gap in the perception of Japanese culture. We expected that this perceptional gap would serve to facilitate cooperative and collaborative learning and sharing of knowledge between Japanese and non-Japanese students.

2. Results of the Survey

In the survey mentioned above, 100% non-Japanese students and 71% of Japanese students responded that they were willing to exchange ideas and to participate in the discussion on the Bulletin Board. Thus, we expected that we could observe an active discussion and be able to have enough data to investigate the process of cross- cultural communication. However, in the following months after the installment of this courseware we could not observe an active participation. Since the website counter shows a constant increase, though not sharp enough, and the results of the survey indicated that the informants responded rather positively on the usefulness and the attractiveness of its content, we need to figure out other possible reasons for this lack of participation. So far it seems reasonable to conclude that 1) users are not as much interested in Japanese culture as being willing to write messages on the Bulletin Board, 2) users may find it a little embarrassing to discuss certain issues with the people whom they do not know, 3) writing messages in a foreign language might be burdensome for them, and the last and most presumable reason is that it is not only difficult to write comments or messages without a specific issue in mind but also very hard as the given topics are too vague or too broad to discuss.

3. Improvements

3-1 A Pilot Study

Under these circumstances and judging from the results of the survey, we have decided to carry out a pilot study in which a certain number of students from Dokkyo University and The University of Illinois are arranged to participate in the cross-cultural communication on the Bulletin Board. Through this pilot study we collect data to find out (1) how much knowledge sharing can be achieved, (2) what kind of problems they have with cross-cultural communication, and (3) whether the Bulletin Board will serve as a means of encouraging cross cultural communication.

Accordingly, we have newly conducted a survey using fourteen criteria to figure out what kind of images the Dokkyo students have about American people, and what kind of images the Illinois students have about Japanese people. Each criterion is assigned to a scale of –3 through +3. The scale is used to profile the informant's perception of the people as measured by each of the criteria. The fourteen criteria consist of kindness, assertiveness, preciseness, delicacy, reliability, conservativeness, rationality, independence, creativeness, intellectuality, cooperativeness, being traditional, being idealistic, and open-mindedness.

The exact same survey will be carried out after two months of discussion on the Bulletin Board and will be compared with the one before the discussion. Even though various factors need to be examined in detail, we have concluded that the difference in the profile before and after the discussion will indicate the effectiveness of using the Bulletin Board as a means of cross- cultural communication. We give herewith an example of the findings in the Table No.1 to show what kind of images Japanese students have about American people before participating in the discussion. So far a total of 41 students responded. The students who have been to the United States and have some American friends have both strong negative and positive images about American people, while those who do not have any American friends nor have been to the Untied States have quite positive images about American people. In other words, the scale shows that the Japanese students without any exposure towards American culture responded positively on all of these criteria, comparing to those students with some exposure the American culture.

Table No.1 Result of questionnaire

Have American Friends?	Been to the U.S.A?	Marked minus in the scale	Marked Positive in the scale	Mean
Yes	Yes	-10.0	13.4	3.4
No	No	-3.2	17.3	14.1
No	Yes	-5.0	17.4	12.4
Yes	No	-6.0	21.2	15.2

3-2. Expanded Use of Bulletin Board

In order to facilitate the analysis of the data, we have constructed the "Bulletin Board" equipped with "additional linking and recording functions." With this "Bulletin Board," the names of the participants and the number of participations are to be automatically recorded. Whenever something is written on the Bulletin Board, the writings are automatically sent to another page and classified under the name of each participant with the date and the time. With this data collection system, we can accumulate data on each individual and observe 1) how do they develop their understanding of a different culture, 2) how do they share their knowledge, 3) how often do they communicate, and 4) what kind of problems do they have in cross-cultural communication.

4. Future Plans

Based on the findings obtained from the pilot study, we once again investigate what kind of measures need to be taken to encourage users to participate in the discussion. We also need much more participation of other universities in the Unite States, particularly those which they have Japanese language programs or courses on Japanese culture. We would like to think about installing a function to let the group of students have a real-time chat on the internet as well as audio communication as such facilities will further encourage students to carry out cross-cultural communication. In the meantime, we would like to find out the possibility of adding another version of "Images of Japan," namely "Images of America" made by the group of Illinois students. Then the users can compare the images held by either side of the Pacific Ocean and find this worldwide website more interesting and will be motivated to participate in the discussion.

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Assessment of Class Organization based on the Computer Skill Level

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Abstract We have been teaching a computer literacy course to over 140 freshmen a year majoring in Human Sciences in Osaka University. We adopted the ability grouping strategy for the course, and found the class re-organization based on the midterm exam score to be effective especially for low-skill-level students. In these two years, the differential of the computer skill level among freshmen became bigger at the enrollment. So, last year, we organized three classes based on the questionnaire survey at the beginning of the course. This trial was also successful. The questionnaire survey, however, showed there were students who felt more uneasy at the term end than at the beginning of the course. We left this problem to be solved in the course of this year.

1 Computer literacy class

This research focuses on the computer literacy course for freshmen majoring in Human Sciences, Osaka University. Five teachers including the authors have been teaching this class since 1995. We organized 140 students into three classes, which proceeded at the same time. Included in the course were, word processing, spread sheet, HTML and presentation.

2 Class organization at the beginning of the semester

We had adopted the class reorganization method for three years based on the mid-term exam which requires hands-on computer operations. This experiment showed us that the class reorganization was effective especially for low-skill-level students. Since the differential of students' computer skill level has increased these days, we tried, in 2000, to organize three classes at the beginning of the semester based on their skill level.

Questionnaire survey at the first lecture

In order to assess the students' skill level, we used a questionnaire survey, which consisted of 9 items related to computer experience before enrollment, 9 items of self-assessment of computer operation skill, 12 items related to attitude to computers, and 18 items related to uneasiness to computers. Each item was 5 point or 7 point Likert Scale.

How to organize three classes

The method of the initial class organization was very simple. We gave higher score to positive response in the questionnaire survey, and summed up all the scores. Students were ordered according to the total score and put into three classes, namely, the most skillful students were in class A_1, the least in class C_1. Then we started teaching in a way which, we believed, would best-fit for each class level.

Validity of the class organization

To examine the validity of our class organization method, we introduced the factor analysis on the questionnaire survey items, then extracted factors. Among these factors we picked up the important factors for class organization and calculated the composite scores shown in Table 1. Each score was normalized so that full score should become 20 points. It should be noted that the higher were the scores related to uneasiness, the more strongly the students felt uneasy.

The one-way ANOVA of the scores showed statistical significance that the average score of class A_1 were higher than scores of other two classes. That is, students of A_1 would be more positive to computers than other students.

Table 1: scores of questionnaire survey at the beginning of the semester

composite name	Class A_1	Class B_1	Class C_1
computer experience	12.1(2.55)	7.9(1.95)	7.9(1.66)
self-assessment score	14.0(2.71)	8.7(2.09)	8.9(2.47)
attitude in daily life	7.6(3.62)	4.4(1.33)	4.4(1.62)
computer environment at home	12.9(4.47)	9.1(3.54)	9.4(4.98)
uneasiness toward computers	8.8(3.36)	13.3(2.68)	12.6(3.88)

(full score is 20 points. SD is in parenthesis)

Table 2: Result of mid-term exam

class	average score	SD
Class A_1	63.1	15.5
Class B_1	57.0	13.1
Class C_1	61.1	15.2

(full mark is 100)

Table 3: Final exam scores

class	average	SD
Class S_2	21.5	4.55
Class A_2	20.8	4.70
Class B_2	21.8	4.12
Class C_2	21.0	4.61

(full mark is 30)

Results of mid-term exam

Table 2 shows the score of the mid-term exam, which would take about an hour to complete using a PC. The one-way ANOVA of the average scores showed that there were no statistical difference among students in three classes. The fact that the standard deviations are almost the same also tells there were no difference of computer skill level of the students in three classes. This does not mean that the class organization at the beginning of the semester based on the skill was useless, but means that the organization was effective. That is, the students in classes B_1 and C_1 became skillful by the lecture which would be well adjusted to their level.

3 Class reorganization in the middle of the semester

We showed that the class reorganization based on the hands-on exam score in the middle of the term was effective (Nakanishi, 2000). In 2000, we reorganized the students into four classes. We selected top level 12 students who got high scores and organized class S_2, in order to give them more challenging tasks. Three classes, A_2, B_2 and C_2, for the rest of the students were evenly organized, which means average score of the three classes were to be the same. The organization strategy of these three classes was contrary to the ability grouping.

Result of the term-end exam

Table 3 shows the result of the term-end exam score. The one-way ANOVA showed there were no difference among four classes (5% significance level). We think the exam was so easy that it could not clarify the students skill level at the term-end.

Uneasiness of students toward computer use

We will not show the detailed scores of the questionnaire survey at the term end because of space limitation. The multiple comparison analysis showed the increase of uneasiness of students in class A_1, which is significantly different with the students in class B_1 and C_1 (5% significance level). The students in class A_1 thought to be in good mastery of computer operations, however, this phenomenon left us a problem to be discussed and examined in 2001.

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Concept Maps
E – Learning Environments

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Abstract: Interactive E-Learning environments support knowledge distribution and facilitate proficiency. Learning activities in these environments are dynamic, and integrate multimedia, pictures, texts and graphic organizers (concept maps, tables, flow charts, etc.). Concept maps are one of the graphic organizers, that represent verbal and visual modes as well as the main ideas of texts and their interrelationships. As one of The Kaye College E-Learning sites, we have developed a course for teachers in training that combines e-learning with face to face activities: *Using Concept Maps in Learning, Instruction and Assessment.* In our presentation, we will demonstrate a few site pages, including text, relevant tasks, and a conversation thread in the discussion group. We will discuss the advantages and disadvantages of learning and instruction through this new experience. In addition we will present our plans for the ongoing development of the site as part of enhancing academic written proficiency in a computerized environment.

Introduction

Implementing the potential of multimedia E-learning environments aims at a number of goals: (1) Developing cognitive skills; (2) Making links between new and existing knowledge; (3) Presenting a variety of opinions and representing knowledge (Ayersman, 1996; Hewitt, Scardamalia, & Webb, 1996). These goals can be achieved by means of collaborative-cognitive tools, adapted to all kinds of interaction: between students and teachers/facilitators and between users and computers. E-learning environments (especially interactive sites, discussion groups, chats and e-mail), support knowledge and proficiency distribution; learning tasks and operation of reflective processes performance; use of written discourse, especially discourse focused on text processing; writing of texts, and sharing new ideas or information. Users can move between the multiple representations through links, thereby becoming partners in a learning community, building data - bases collaboratively in divergent non-linear learning processes.

Graphic organizers are efficient cognitive tools that serve as external representations of the readers mental models constructed during text processing (Kozminsky, 1992). Graphic organizers represent, in verbal and visual modes, the main ideas of a text and their interrelationships. These can be used as learning aids before, during or after the learning process of a text (Simmons, Griffin & Kameenui, 1988). They can be constructed by an expert (e.g.,a teacher), by the learner or both, in collaborative work, that enables the students to construct and alter the graphic organizers in use, in congruency with their knowledge and comprehension. Graphic organizers facilitate the retrieval of concepts and previous knowledge (Kozminsky & Natan, 1996). Jonassen, Reeves, & Hong (1998) emphasize, that the dynamic construction of concept maps is a result of text processing, and enables learners to be involved in their own process of learning. McAleese (1998) presents an explanation of concept mapping in terms of a *learning arena*, which is the concept map itself. The limited capacity of working memory leads to the theory of off-loading (Chandler & Sweller, 1991). The visualization – one of the characteristics of external representations – supports the students and decreases loading their working memory.

The concept map is a performance aid – a *learning arena* in which students can "interpret and organize their personal knowledge" (Jonassen et al., 1998). Concept maps can be hand-drawn or constructed via computer software. Using computers for concept mapping, can assist students in several ways: (1) The concept map can be seen on the computer screen – thus activating the learners'pre-existing structural knowledge; (2) The computer encourages flexibility during mapping; the location of the elements is easily changed; one can design, add /delete concepts or rhetoric-logic interrelationships; (3) Personal feedback is essential in the mapping process, which demands awareness and self - regulation. A computerized map facilitates these processes, mentally as well as physically; (4) The computer screen reflects the students thinking processes, so their working memory is free to assess, elaborate and operate bugging and debugging processes in the concept map and mental model simultaneously, thereby stimulating higher order thinking activities; (5) Mapping software enables novices as well as experts, to create the required maps and feel successful.

Using the computer to create concept maps, as well as studying the advantages of concept map construction, led us to develop the framework and learning activities of the course: *Using concept maps in learning, instruction and assessment*, that can be integrated in a larger course: *Academic Written Proficiency in a Computerized Environment.* The characteristics of mapping as a *learning skill* can be implemented as an *instructional skill*, especially with pre-service teachers during their practice teaching. Using concept maps as an *assessment* tool for writing summaries or essays (Kozminsky & Natan, 1999), has an added value to the use of concept mapping as a learning and instructional skill.

The Internet site

The site is very dynamic, with many possibilities to add, delete or change texts and/or learning tasks, according to the context, or the needs of the students'and teachers. A booklet that includes all the site materials and references accompanies it. The site represents the three main applications of concept maps: *Learning, Instruction* (with one full example of an instructional unit), and *Assessment.* Each section includes: (1) *Theoretical review* - references to the psychological and didactical aspects of mapping. *(2) Concept bank* - includes definitions and explanations of concepts that are cited in the texts, and can be reached through links. (3) *A selection of expository texts* – each including tasks.

Working with the site

We use a *discussion group* as an integral part of the learning process. Students send their maps, learning tasks and reflections to the discussion group, and write feedback to their peers'postings, in response to the instructional activities that took place during the class, and suggest new or different ways of mapping. The teachers react to the students'messages, answer their questions, and support their learning process. It is possible to use attaching files, created in *Word, Excel, Power-Point, Inspiration* etc., as well as to add links to references *(URL's)* in the site and to other sites on the net. The site is open to anyone who is interested in the subject, with no need to use a password and username.
In our presentation, we will show a few site pages, including a text, its relevant tasks, and a conversation thread in the discussion group.
The URL of the site (in Hebrew):
http://mofetsrv.mofet.macam98.ac.il/~ilanab/kaye/atitle.htm

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"Do no Harm"
A First Measure of Effectiveness in Small Distance Education Programs

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Abstract: Records of 406 students registered in both traditional and distance classes over six semesters were examined. There is a small but significant difference between the mean grades earned in traditional (2.99) and distance (2.81) classes, but the group as a whole outperforms the college overall average of about 2.75. Performance in subsequent distance delivered courses was as predicted by performance in the traditionally delivered prerequisite course. We can conclude that we are "doing no harm" to the academic progress and success of distance students.

Introduction

Is distance education as effective as traditional classroom based education? This is the first question asked by opponents and proponents alike, and it is one of the major areas of research by those involved in distance education. Many studies (see, for example the California State University Special Projects, 2000) focus on learner outcomes, comparing the amount learned by a group of students using one mode of instruction with that learned by a group of students using a different mode. Numerous studies purport to show "no significant difference" (see the website by this name maintained by Russell) between the learning that takes place in traditional and distance settings. Criticism of such studies is common – the bottom line is that it is very difficult to control for all possible variables that may influence the outcome.

Small colleges and universities worldwide are quickly developing a presence in the distance education arena. While we certainly have an interest in the question, "is distance education as effective as traditional classroom based education", our concerns are more immediate and driven by rapid growth. We do not have the time or resources to perform large-scale, long term investigations to help us decide *our* most important questions: 1) Should we continue offering an increasing number of distance classes to an increasing number of rural Wyoming students without knowing for sure if these classes are as effective as traditional classroom based courses? 2) What is our measure for "effective as" traditional classroom based education?

Any measure we use not only has to comply with state and regional accreditation organizations, but also with the philosophy, mission and purposes of our institutions. The mission of Casper College, a comprehensive community college serving central Wyoming and the surrounding region, states that the college will develop and maintain educational programs appropriate to the needs of the communities served. In a statement of philosophy, the college supports the belief that equal opportunity for quality higher education should be available to all who can benefit. To fulfill this mission, one of the purposes of the institution is to provide innovative course designs, instructional methodologies, and delivery systems.

A college philosophy and mission statement in support of equal access to quality education and support of innovative course design and delivery systems gives us a starting point, but *does not* help insure that distance courses are as effective as traditional courses. We have chosen as our initial measure of effectiveness a concept borrowed from the medical profession, "do no harm." If effectiveness is measured in terms of access and numbers of students served, we are effective. However, our fear (and that of many faculty, administrators, and members of the public) is that distance students would not gain what they need in order to be successful in subsequent courses at our school and beyond, in traditional or distance delivery modes.

Distance students at Casper College are more likely to be non-traditional students that are female, older than typical freshman and sophomores, with family and work responsibilities in addition to school responsibilities. An analysis of a group of students taking both traditional and distance classes demonstrates what others have discovered: distance students are generally dedicated, hard working, self-disciplined, motivated, and they get good grades.

Results of the Study

We have chosen as our initial measure of effectiveness a concept borrowed from the medical profession, "do no harm." If effectiveness is measured in terms of access and numbers of students served, we are effective. However, our fear (and that of many faculty, administrators, and members of the public) is that distance students would not gain what they need in order to be successful in subsequent courses at our school and beyond, in traditional or distance delivery modes.

Records of 406 students registered over six semesters (fall 98-summer 00) were examined. To investigate our "do no harm" concept as an initial measure of effectiveness, we compared average grades within a group of students (n=406) who took both distance and traditional classes. There is a small but significant (á = .05) difference in this group between the mean grades earned in traditional (2.99) and distance (2.81) classes, but the group as a whole outperforms the college overall average of about 2.75.

As a second test of "do no harm" grades of students were compared by pairing courses consisting of a prerequisite and follow up course in mathematics or English composition. One of the pair was a distance class and one was a traditional class; in 46 of the 51 cases the prerequisite course was a traditional class, in 5 cases the prerequisite was distance delivered. Performance in the follow up courses was as predicted by performance in the prerequisite course. We found insufficient statistical evidence (á = .05) to rule out the hypothesis that the mean grade (3.12) for the prerequisite course was different than the mean grade (2.92) for the follow up course.

Conclusions

We cannot state that learning outcomes for distance classes are the same as for traditional classes, although we obviously suspect this to be the case. We *can* conclude that we are "doing no harm" to the academic progress and success of distance students. We should continue to develop our program because of the demonstrated increase in opportunity for access to education that it provides – the program is meeting the needs of the students.

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The Logistics Knowledge Portal: Gateway to More Individualized Learning in Logistics

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Abstract: The paper describes a research and development project initiated by a network of European logistics educators to promote all types, forms and levels of logistics education by benefiting from the educational potential of multimedia/hypermedia as well as information technology and telecommunications. Main outcome of this project will be a learning process personalizing, integrating infrastructure that is manifested as the Logistics Knowledge Portal available on the Internet as a resource for developing a personalized learning path for employees, students, interested bodies, based on the in-depth understanding of learning needs and goals, managed under a classification method for learners and categorization method for all available technology-based learning material. With this the project aims at providing a solution to problems in logistics learning in Europe and world-wide. Furthermore, many of its results in both, research and development, are expected to be of fundamental nature and therefore applicable to other domains of knowledge too.

1 Current Situation in Logistics Learning

Logistics learning has been chosen as an exemplary area of elaborating concepts and tools for developing personalized learning paths because of some specific features of this research and practical discipline. ***Logistics*** – in its widest scope of understanding – is an extremely rapidly developing field of knowledge and practical applications. The development goes in different directions: the one of new concepts, strategies, organizational solutions on one hand, and the one of new technical applications (most of them IT based) on the other. Besides logisticians operate in a dynamically changing environment of globalized economies linked by international and intercontinental supply chains, new opportunities brought by e-commerce. These ongoing challenges demand for an ongoing updating of professional knowledge and skills by all who work in the field of logistics, who work in other fields but have to take logistics effects into consideration, who want to or need to understand the logistics context from the technological, economic, environmental, administrative or social point of view. Even initial logistics education processes at vocational and higher education levels must be a part of these dynamic changes to enable their graduates to meet employers' needs and perform at the market. So, logistics learning is required to be flexible with respect to

- ***learners*** (in the widest sense) and their individual targets, motivations to learn, specific requirements and constraints,
- varying ***educational needs*** resulting from the learner's targets, motivations, requirements and constraints, like e. g. scope and level of knowledge, particular skills etc., and

- appropriate ***educational resources*** developed and used in form of modules and courses fulfilling the educational needs and helping the learner to reach the required, established goal.

Before this background the current situation in logistics learning can be characterized as follows:
(i) The educational resources in logistics are numerous, but scattered and not inventoried, so there is no structured access to what is available, just a little knowledge of gaps and no formal mechanism at all for identifying these gaps and filling them with good quality units.
(ii) There is a great need for various forms of education in logistics and a potentially large pool of supporting resources, but there is no interface between those two market sides (demand and supply).
(iii) Generally, learning processes are not supported by methods and tools enabling to configure personalized learning paths. Educational technology is selected intuitively with many important conditions not being considered. This often results in inefficient learning processes achieving results not in any case meeting the learner's and/or teacher's expectations.

Especially the latter is true not only for logistics learning, but for technology-based education in a wide range. So, it can be stated that there is a general need to help learners understand their targets and constraints, to translate them into educational requirements and to configure personalized learning paths composed of available resources. This is the clue to achieve the required and intended improvement of knowledge, abilities and skills, to reach the individual targets of the learning process in shorter time and better quality.

2 Portals – Technology to Provide Access to Information, Knowledge and Services

Diaz (2000) defines portals as web sites configured for each user in order to filter information. ***In the world of logistics*** there is a growing number of examples for such portals: LogisticsWorld (2000) understands itself as a directory of logistics resources on the internet guiding to thousands of web sites related to all aspects of logistics knowledge and business. Amongst many others there is also a category on education providing a list of 216 links to a great variety of educational institutions at all levels and a number of marketplaces providing educational products and learning material world-wide. transportal (2000) is a portal made and maintained by the Danish Board for Education and Training covering 130.000 people employed in transportation and logistics. It provides links to a wide range of information relevant to the portal's users. Its major feature consists in giving an overview of all educational institutions having logistics related activities, from universities to vocational training schools, and supporting apprentices to get jobs and companies to look for people.

From the educational point of view many efforts are put into the creation of libraries of educational resources such as the EOE Java Applet Library (EOE, 2000) to reduce developmental efforts by sharing small units being building blocks of larger modules or enabling the re-use of materials and solutions developed for a particular purpose. For this, standards for describing resources stored in there as well as tools to develop learning content compatible to these standards are provided (see ARIADNE, 1999 or IMS, 2000). Other developments such as Braincapital (2000), transportal (2000) or Workingday (2000) aim at creating networks and platforms to bring together learners and those offering education and training or employers and those looking for a job. Such career networks are contact points providing access to a particular set of educational needs and resources.

Although a large amount of material exists in the internet, it is not an easy task to find what you look for. Seeing this problem, existing portals act as knowledge brokers linking knowledge users and knowledge providers with respect to a specific field of knowledge. They are more or less sophisticated search engines where users have to chose a particular topic from the list or specify a set of keywords in a dialogue or menu. Usually the portal's response consists of a list of links with only a few information about what might behind them. In the end, the user would have to follow systematically all links to find the most suitable one for his or her purpose. Since this is very time-consuming again, the majority of users is selecting one of the links by randomness or according to the attractiveness of its description to see whether or not this fulfils expectations.

To help finding, structuring and delivering the best information matched with the particular needs of the learner(s) and with this to really serve educational purposes, a knowledge portal must offer additional functionality to determine the learner's prior knowledge state, to determine the nature, the quantity and the level of lessons to be imported in order to achieve a specific learning goal, and to provide a pedagogical framework for supporting the learner achieving his or her educational objectives. To fulfil these requirements and truly assist the user in creating educational or even better learning processes, a portal should be designed in a way brokering knowledge in form of educational resources from the knowledge user's, i. e. the learner's perspective rather than serving knowledge providers in selling their products. It should not only manage content, but also enable to match content more closely to the needs of users' sectors and communities. Pre-condition for this is to understand the learners' individual learning experience and behavior (expressed in different ways of learning and also different pace of evolution).

3 The Project

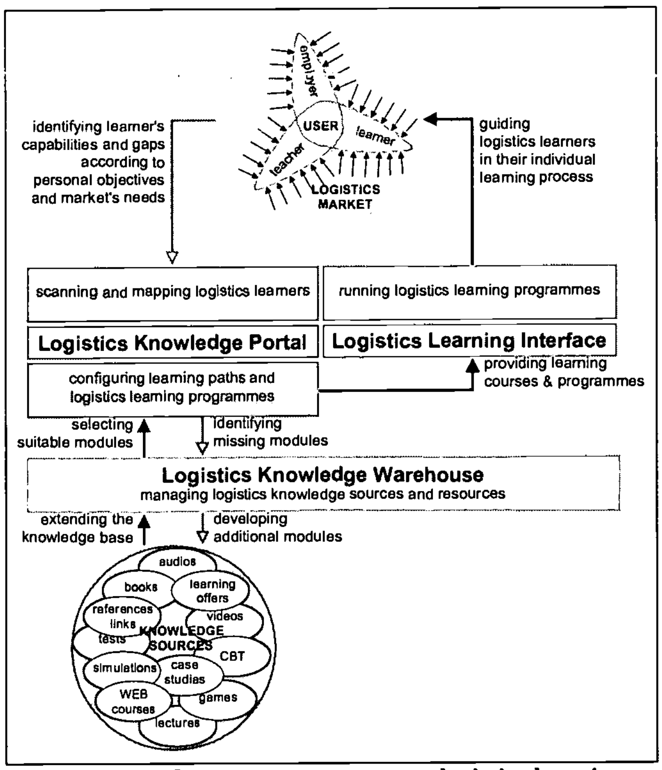

Figure 1: Infrastructure to promote logistics learning

For promoting individualized logistics learning processes according to the specific needs of the individual learner and the particular domain of logistics a European project was initiated. Project partners are experts from areas covered by the project: Pedagogy, computing and logistics as the domain. In particular the consortium brings together experts in logistics and logistics education from universities and commercial training organizations from Denmark, Germany, Greece, Poland and Sweden and experts in computing, AI and IT from Denmark, Greece and the UK. Potential users are involved in all project phases via the European Logistics Association (ELA) representing 36 national logistics organizations from all over Europe and with this providing access to hundreds of thousands of logisticians. In addition to this the project is supported by local administration and further universities; it is linked to other educational logistics networks active in particular regions of Europe such as Scandinavia, Denmark, Germany, to a transatlantic network of European and US universities and companies providing intensive logistics education in a global frame and last but not least to the ELA-LogNet which is a European network of logistics educators representing all types and levels of logistics education to promote technology-based logistics learning.

The project aims at designing, developing, setting up, testing and demonstrating a sophisticated IT-based infrastructure enabling to match educational requirements with resources in a logistics learning information network. This infrastructure will provide potential users of varying types with appropriate, innovative methods and tools within a user-friendly, adaptable environment which guides users according to their demands and individual goals through the system's broad functionality. The special value and innovation of this solution consists in its user-centered approach for providing an integrated platform consisting of more or less known and already developed functional modules, supported by unique purposefully developed modules generating personalized, dedicated, tailor-configured learning paths. As a result three major components (see figure 1) will be available, each of them covering a set of methods and tools of immense, innovative, intelligent functionality and great complexity:

- the ***Logistics Knowledge Warehouse*** which is an on-line, computer-based storehouse of expertise, knowledge, experience, and documentation about logistics,
- the ***Logistics Knowledge Portal*** which is an IT-based infrastructure for providing access to and brokering of logistics knowledge to enable personalized logistics learning processes, and
- the ***Logistics Learning Interface*** which is an IT-based infrastructure for running and managing logistics learning programs and their users (learners and teachers).

At service level, work addresses Web based services including Web communities, agent-based services, user profiling, and content mediated transactions, together with contextual, intelligent or adaptive access to, and delivery of heterogeneous assets in large distributed and multi-owner collections. It covers technical areas like consumer protection and privacy, IPR, open standards for interoperability and access management guidelines and business models. With this the project aims at building a global knowledge, media and computing space providing the right/relevant knowledge of high/approved quality on time, in good order to the user and enabling interaction which is at the same time supportive and empowering.

4 The idea and concept of the Logistics Knowledge Portal

The heart of this innovative solution is formed by the ***Logistics Knowledge Portal*** which can be described as a set of intelligent engines (see figure 2) mediating between the various types of users and the enormous amount of logistics knowledge sources already available or coming up in future. It combines sophisticated functionality to understand learners and their very special learning needs by scanning and mapping them with truly innovative functionality to develop – this is to be understood in the sense of proposing and suggesting – individual, learner-specific, personalized logistics learning paths and courses by using AI-based configuration methods and tools to select suitable learning modules from the Logistics Knowledge Warehouse and link them according to the learner's particular needs.

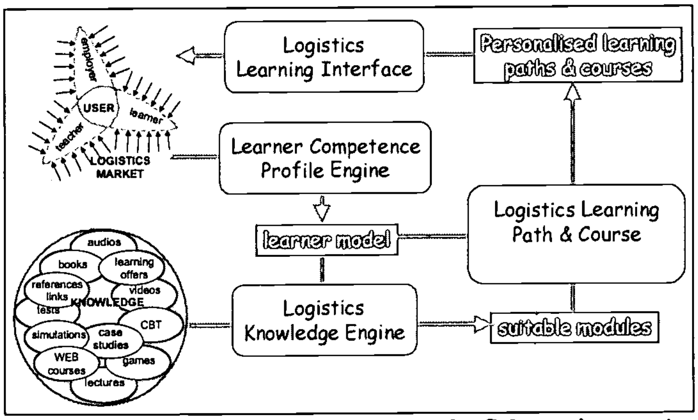

Figure 2: The Logistics Knowledge Portal – Schematic overview

The ***Logistics Learner Competence Profile Engine*** characterizes a learner or a group of learners according to current knowledge, skills, abilities, learning styles and other personal information to be included in a learner model which is used as an identity card to allow access to specialized modules/courses, or as part of an intelligent tutoring system. Information required for this can be provided either directly by the user, i. e. the learner, teacher or employer defining learners, their targets as well as educational needs or indirectly e. g. by analyzing a company's need for providing logistics education to employees. The latter methodology is implemented in a tool identifying/measuring the company's logistics maturity (represented by a radar diagram), recommending the target logistics knowledge for different categories of employees, and proposing possible educational activities. The results of this initial scanning and mapping process are stored to be the basis for evaluating the outcomes of the initiated learning process.

The ***Logistics Knowledge Engine*** links the Logistics Knowledge Portal to the Logistics Knowledge Warehouse by translating learning goals described in the learner model into a number of inter-related topics in the form of a specific domain model to be addressed including a rich set of examples, hints, simulation and usual misconceptions. For this, a contextual search engine selects those learning modules from a knowledge base which fit most to the learner's needs and user's specification and forward them to the configuration procedure. Carrying out the search for particular units and modules the system also identifies gaps in the sense of missing modules and transforms the search contents into a corresponding description of requirements to be fulfilled by a module closing this gap. With this, the stock of available learning resources evolves and grows over time in response to user demands.

The ***Logistics Learning Path and Course Configuration Engine*** contains a set of tools for the personalized configuration of learning paths for all possible established educational requirements meeting the learner's needs and targets. In a first step, conceptual learning paths for present and future learning activities are planned by selecting learning patterns with respect to the learner model and adapting them to meet the specific educational needs of the course to be configured. This empty frame of a learning path is now filled with suitable units and modules as provided by the knowledge engine. Often there is more than one module meeting particular needs or more than one possibility to inter-link them or there is a variety of learner models to be served by the course. In this case alternative learning paths are configured. Completed by appropriate tutoring models, they form the new (or modified) course which is described and classified to be added to the stock of available courses. At another situation they could be selected directly with respect to the learner model to avoid additional course creation efforts. The final version of a course is integrated into the learning interface to be used by learners and evaluated at the same time.

Although the Logistics Learning Interface can be described as the output device enabling to run learning paths and courses, it is closely linked to the Logistics Knowledge Portal. This is caused in the ***Logistics Learning Evaluation Tool*** embedded in the learning interface, which helps to understand what and how the learners really learn and encourages them to reflect on their learning. Its concept is based on an existing tool for evaluating learning activities by carrying out reaction and satisfaction measurements (e. g. on course conditions and content, or on the improvement of knowledge and skills) with the help of automatically generated questionnaires and methods for advanced statistical analysis (CUE, 2000). Information provided by it are used to evaluate both the learning path/course as configured and the learning process as run by the learner by matching them against learning needs and expectations as identified by the Logistics Learner Competence Profile Engine to determine the usefulness of content, methods and modules as well as areas to be improved and future consequences of changes in the course.

The Logistics Knowledge Portal is expected to be a practical solution to the current educational problem in the field of logistics. It shall integrate developers of educational modules and provide them with the prompt information on desired directions of new developments. It shall help learners all over Europe (whoever they are: individuals or organizations) to gain the new knowledge and skills in the most efficient way in terms of required general target, quality, time and cost. With this the concept of a knowledge portal designed to assist learning is not limited to the logistics knowledge domain only. The presented solution is based on many generally applicable principles, methods and tools e. g.

- to identify learner's capabilities and gaps according to personal objectives and market needs and to transform this input into adequate learner models,
- to describe and select learning resources and configure learning paths basing on suitable learning patterns, but adaptable to the learner's individual needs,
- to encourage feedback from the learner and analyze the learning process to understand in which scale the configured learning path and course met the learner's needs and expectations, or
- to guide the user through the configuration process and assist him or her according to the particular needs by intelligent agents

which easily can be adapted to other domains by implementing domain-specific knowledge on learners, educational needs, educational resources and last but not least the way of learning.

4 State-of-work and future challenges

As the first step for developing the Logistics Knowledge Portal a ***prototype demonstrator*** is going to be implemented to visualize the idea in principle, major functionality of the engines and the user-interface concept. It

wil
transnational user groups to gain feedback on the basic approach and identify additional user needs. According to

being presented at the conference.

Future challenges consist in

- rope-

classification framework,

conditions, current and target skills -
identified learner classes and the developed learner categorization framework,
providing tools to establish educational requirements related to given or id
respect to all specified constraints,
providing agent based tools for the personalized configuration of learning paths for all possible established

- ods and tools for encouraging and analyzing learners' feedback on experience, impressions, criticisms provided while and after the learning process,
providing mechanisms for identifying emerging gaps in the available pool of educational resources (Logistic Knowledge Warehouse) and
providing all necessary tools for the system administration.

For this only those functionality (methods and tools) will be implemented which is necessary to reach these goals and enable the Logistics Knowledge Portal's extended, valuable testing, validation and demonstration. To reduce the developmental efforts already existing approved solutions and products will be adapted and integrated as much as possible. Further research will mainly focus on understanding logistics learning needs and modeling logistics learners, identifying learning patterns typical for learning logistics, setting up a rule base for configuring learning paths according to the learning needs, enabling the system and the user to learn from the learning process, applying AI technology and providing intelligent agents to guide the user and give individual support.

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A cost-effective way to teach scattered international students with the latest technology

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Abstract: International students can't follow the native language courses, they need english education. With distance education technology one course was made available to two international groups of different universities at a minimal cost. The lectures were held in english and send simultaneously to the other university via IP-teleconferencing. Exercises could be made either in a network environment or normally in the near-end. Distant students had no tutor and they never saw their teachers live. The cost consisted of extra work of the assistant and two technicians. The results of the course and answers to a questionnaire show that no harm was inflicted in the near-end and learning was acceptable in the far-end. Some improvements can be done but the combination of the teaching systems looks promising for international students.

Introduction

Teaching through videoconferencing has become possible 1990's (Biner et al., 1994). The costs were initially high, the picture was jerky and dedicated rooms were needed. In last few years the technology has become cheap, pleasant and easy to use by teleconferencing through IP-network (Roberts 1997). The teaching place can be any room, where a network exists. The quality of audio/video is acceptable and the equipment is compact and affordable. The resolution and frame rate has increased from 160 x 120 with 6 fps (Kies et al., 1996) to 352 x 288 with 15 or 30 fps with the equipment used here. A lecture is practically unicast, but conversation is possible (von Wright, 2000). Videoconferencing can be extended to multicasting using bridge, so many universities can share same teaching. A digitized video can be taped or saved on servers to further use (CERN, 2001). Networked learning environments are rapidly evolving to support distant education (Korpi et al., 2000, Väliharju T. 1997). Each course has a private segment, that only teachers and accepted students can share. Teaching materials are easy to spread, testing the learning with quizzes is handy and student's assignments are collected automatically and evaluation of their work is recorded and displayed without extra work. These environments offer also extra communication tools to discuss separate topics.

The Case-Study

For growing need to skilled IT-professionals in Finland the universities are inviting international students. Networked learning can help to satisfy their needs with a reasonable cost. A normal course *Artificial Intelligence* was held in Lappeenranta University of Technology in the autumn of 2000 with some modifications. The language used was english and the lectures were presented as a live videoconference in the University of Joensuu 250 km apart. Normal www-pages of the university contained course structure, lecture notes, links to related www-articles and link to WebCT-pages. Exercises were presented in WebCT-learning environment, where far-end students could answer the quizzes and submit their practical assignments. E-mail was used for communication with the course assistant. Near-end students could also take guided exercises and present their assignments live. Some lectures were recorded on tape in both ends and recording were studied to see the quality of the presentations, image and sound and to find out possible deterioration of information in the network.

From the tapes we could see that the quality of video and audio was very near watching TV. All pictures, text and speech were comprehensible. Local students didn't complain in any point of the course. The questionnaire showed similar results. "Speaker's interaction with video equipment did not disturb me" was disagreed by only 15%. The same amount was slightly suffering the use of computer, but almost all others had no complaints. 75% agreed that this arrangement was just as effective as a standard lecture and 15% was neutral. Some answers are presented in table 1. The same questions were asked in an earlier study (Kies et al., 1996) in the 7-point scale.

Table 1. The effect of improved technology

	Near 2000	Near 1996	Far 2000	Far 1 1996	Far 2 1996
I paid attention to the speaker	5.4	5.4	5.7	5.2	4.1
I thought this arrangement was just as effective as a standard lecture	5.2	4	3.4	3.2	2.2
I was not influenced by the computer arrangement	5.1	4.5	4.7	4.4	4.0

Answers from the far-end show that the technology was good enough, but not for all. The picture and the lighting was acceptable to 75% and audio and noice level to 60%. The texts were legible, but not always. 80% stated that the on-line transfer computer system did not obstruct their understanding of the material and 70% that videolecturing system was an appropriate mean for presenting this material. Likewise "In a future I would be willing to take a class taught on an On-Line" was accepted in the near-end (3.7) but much less in the far-end (2.4). Minor but clear differences were found in understanding and being influenced by the system. In the first exam near-end had clearly better average (3.9 against 2.2, 1-5 degree).

Conclusions

The results seem to show that: 1) near side doesn't suffer when the lecture is transmitted, 2) the far site gets the information. 3) The distant learning experience isn't worth live person and some students have difficulties with this arrangement. 4) For the teacher extra work is feasible, except the assistant if the number of students is high
5) Cost is feasible. 6) A bit of human touch is beneficial for learning and learning as a group gives better results. Starting with live lecture and local exercises in the comparison course seemed beneficial. The cost of equipment can be very low, because common PC-packages contain almost all the needed hardware. For the convenience a dedicated videoconferencing package is advisable. If equipment can be fixed in a dedicated room, lecturing is easy and takes no extra time.

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Virtual Planetarium: Educational Application in Virtual Environment

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Abstract: We present an educational application in virtual environment, intended for teaching and demonstration of fundamental astronomy and astrophysics. The application uses special methods to display the astronomical objects realistically, as they are visible by astronauts of a real spacecraft, preserving correct visible sizes of all objects for any viewpoint and using 3D model based on real astronomical data and images. The model represents 3200 brightest stars, 30 objects in the Solar System, including 9 main planets and their largest satellites, interactive map of constellations, composed of ancient drawings, a databasc, describing astronomical objects textually and vocally in English and German languages. Stereoscopic projection system is used to create an illusion of open cosmic space. The application is destined primarily for large-scale virtual environment systems (Cruz-Neira 1993) (Göbel et al 1997), giving a perception of complete immersion into the scene, and also works in simple installations using a single wall projection. The application was presented to public at exhibition ZeitReise/TimeJourney opened in May-June 2000 at Academy of Arts in Berlin.

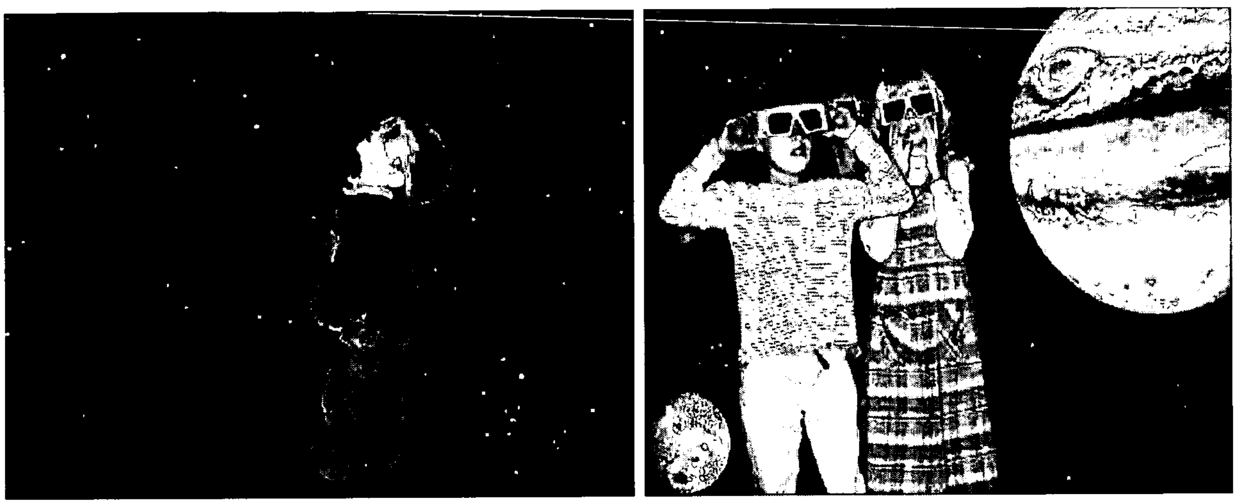

Fig.1: scolar excursion.

Main software component, driving the installation, is created at GMD *Avango application development toolkit.*

Avango (Göbel et al 1997) is a programming framework for building distributed, interactive VE applications. It is based on IRIX Performer to achieve the maximum possible performance for an application and addresses the special needs involved in application development for virtual environments. Avango uses the C++ programming language to define the objects and scripting language Scheme (Dybvig 1996) to assemble them in a scene graph. Avango also introduces a *dataflow graph,* conceptually orthogonal to the scene graph, which is used to define interaction between the objects and to import the data from external devices into the application. Currently Avango has implementations on SGI computers and Linux-PCs.

Non-linear geometrical model (Klimenko et al 2000) was used to represent the objects in the Solar System, overcoming a problem of "astronomical scales". This problem consists in the fact that a size of the Solar System (diameter of Pluto orbit) and a sizes of small planets (Phobos, Deimos) differ by factor more than 10^9, as a result single precision 4 bytes real numbers, used in standard graphical hardware, are insufficient to represent the coordinates of objects in such scene. A special non-linear transformation should intermediate real scale astronomical model and its virtual analog, mapping astronomical double precision sizes of range 1 .. 10^{10} km into VE single precision sizes of range 1 .. 20 m. Such transformation was chosen, satisfying two requirements: (1) it preserves actual angular sizes of planets for any viewpoint to achieve realism of presentation, (2) it prohibits penetration inside the planets to implement no-collision algorithm. Analogous transformations are also applied to the velocity of observer, to make the exploration of near-Earth space and distant planets possible in one demo session.

Navigation in large-scale VE system is performed using electromagnetic 3D pointing device (stylus), or joystick/mouse in more simple installations. User can manipulate by a green ray in a virtual model, choosing the direction of motion and objects of interest. A navigation panel, emulating HTML browser, is used to display the information about selected objects and to choose the route of journey. In the vicinity of planets completely free manual navigation can be used.

Sound accompaniment includes two musical themes, representing the rest state and fast motion, which are mixed dependently on the velocity, and voices, describing surrounding objects. Several samples are available in each sound cathegory. Particular sound scheme can be selected and reconfigured during runtime.

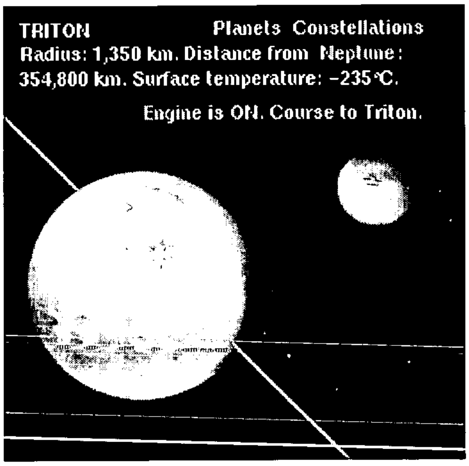

Fig.2: navigation panel.

Sources of planetary images and stellar data are public Internet archives and databases available at NASA: http://photojournal.jpl.nasa.gov, http://adc.gsfc.nasa.gov and U. S. Geological Survey : http://wwwflag.wr.usgs.gov . Images were imposed on a spherical geometry as textures and were enlightened by a composition of bright solar and dim ambient lights. Positions, intensities and colors of stars in the model correspond to astronomical data from catalogue. Additionally, high resolution images of constellations can be displayed in the sky. Source of images is ancient stellar map (Doppelmaiero 1742).

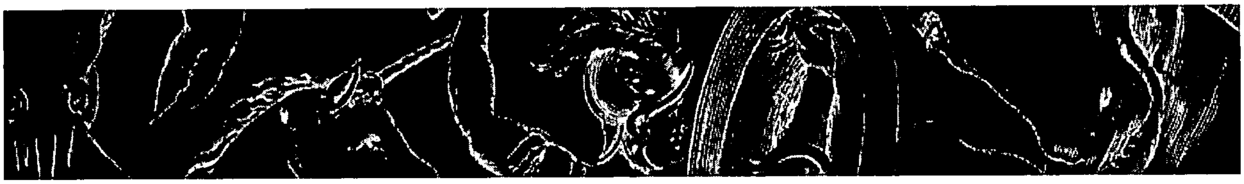

Fig.3: images of constellations.

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Designing Simulator for Construction of a Virtual Computer System Using Arbitrary Levels of Abstraction

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Abstract: We have designed a computer simulator to explain the architecture of the computer systems. In this simulator, components of an arbitrary abstraction level can be defined, and a virtual computer system can be constructed by freely connecting the components that appear on the screen. For example, the computer components can be either pre-designed by the instructor or prepared by the students themselves and computer systems can be constructed by assembling the available components. At an elementary level, the students can passively observe a computer system being constructed by the instructor. Moreover, the degree of details that are offered can be controlled so as to offer two or more levels of observation. In this paper the design and implementation of the computer system simulator is discussed.

1.Introduction

As it is impossible to investigate the internal transition of the computer systems, it is not easy to form a conceptual model for the computer system. It is known that understanding the architecture of computer systems would become easier by using the visual appeal offered by a computer simulator. However, the kind of architecture that should be visualized and the degree of details of abstraction that needs to be offered depends on the purpose of education and the level of comprehension of the target audience. If the abstraction level is high, it is easy for the beginners to have a rough understanding of the whole system, but it is difficult to comprehend the details. On the other hand, if the abstraction level is low, it is easy to understand details; however, it may be difficult to grasp the working of entire system. In this paper, we have discussed the design and implementation of a computer simulator that can be set to an arbitrary abstraction level and can simulate various system architectures. This simulator has a capability of defining any kind of sequential circuit as a circuit component. By defining the abstract circuit component, a computer system can be fabricated even with a high level abstraction. Moreover, since the user can observe the transition of the computer system from multiple viewpoints according to their interests, this simulator can be used widely.

2.Education Using the Simulator

Our simulator can be adapted to various levels of proficiency. We describe below some possible scenarios where the simulator can be put to practical use.

Observing Prefabricated Computer Systems: The user can observe the working of a prefabricated computer systems presented by the instructor using the simulator. The instructor can choose the appropriate abstraction level to show the computer system's workings according to the purpose of the lecture and the level of comprehension of the target audience. Some students might have interest in the computer systems and would like to acquire deeper knowledge. Our simulator should be able to change a level of abstraction with a simple operation so that it meets the user's requirements. In addition, the instructor can construct arbitrary computers for their purposes. To construct a new computer, the teacher can define new components in addition to system defined components.

Student-Designed Computer - Using Components: This simulator can be used to teach the design of the computer architecture; students can construct computers in the simulator using set of components provided by a teacher. The actual hardware are mostly used in such lectures. However, most existing components are not suitable for education purposes. Using our simulator, instructors can effectively teach the design of the computer architecture because she/he can provide components that are suited for individual needs. General-purpose CAD tools are also used in such lectures(Knox 1997). However, such tools are tend to have too many complexities and are difficult to use. The level of complexity in our simulator can be easily controlled by minimizing the set of components that are provided.

Student-Designed Computer - From Scratch: To promote further study, teachers do not provide components and make students design a computer from scratch; students design components. This methodology is expected to help cultivating students' originality.

3.Description of an architecture

3.1 Definition of components

Each component of a computer is defined as an object based on an object oriented model. Each component has some input/output ports and internal states. Getting an incoming message with a timestamp, a component puts a message out according to the incoming message and internal states. The system assigns a timestamp on an output message calculated from the timestamp of the incoming message and a particular constant duration corresponding to the propagation delay in the component. A connecting wire between components are also treated as a component, that gets messages from one component and pass them to another.

3.2 Simulation Engine

Signal flows between components are simulated as message passing between objects. Each component sends a message triggered by a message from an autonomous "clock" component mimicking that real circuits are synchronized by a clock generator. The simulation engine sorts all these messages by their timestamp and puts them into a queue. Queued messages are sent one by one. This makes the simulation engine possible to suspend and resume a simulation at any time by the user's request.

3.3 Building a Computer Using the Simulator

Our system has a library which contains frequently used components like basic logic gates, registers, ALUs, buses, memories, and so on. We also prepare a gate controller, which interprets machine instructions and operates gates in other components. Users can build simple computer systems with those components in the library. The system can simulate a part of a computer with a clock device even if other part of the computer is incomplete. This feature makes it possible to build a whole system by a step-by-step manner verifying each part of the computer. In order to build a computer which using components that are not available in the library, users can define new components that perform any specific functions. Each component is defined by (1) actions(i.e. outputs with some delays and next state) determined by inputs and current state, and (2) a graphics image to be shown on a display. Our system provides a graphical user interface resembling CAD tool.

4.Observing Behavior of Computer Systems

4.1 Function for Observation

Our simulator has a probe component that can monitor signal flows on input/output ports. We can observe the behavior of any port by attaching the probe component to the port. In addition, there is another probe component called "Timing Chart Probe", which gather the information from several probe components and can observe the transition of signal flows. Moreover, our simulator has a function that shows which wire or component the signal flows are on using a one by one animation, so that users can easily observe the signal flows.

4.2 Unit of Execution

Since our simulator processes messages in a single event queue in order of the time when they are issued, users can pause/resume the execution of the animation at any time. In addition, our simulator provides the following units of the execution: system clock, machine cycle, machine instruction, and macro instruction. Consequently, users can execute the animation of computer systems by any unit of the execution.

4.3 Abstraction of Component

For example, to explain how the register works, the flip-flop level of abstraction is required. On the other hand, to show the register as a component in a whole computer system, only input/output signals and control lines of the register should be displayed. By hiding the internal details of a component, our simulator can define components at a high level of abstraction. If teachers/students define components at both levels of abstraction and construct a computer system by using such components, they can change the level of abstraction of the computer system seamlessly and dynamically.

5.Conclusions

We have discussed the design and implementation of the computer system simulator for education. It can meet various purposes of education by its flexibility. Now we have made a primary version of the system. We implement it in Java in order to be a platform independent application. We are planning to use the system at various educational scenes and evaluate it.

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Bayesian Modeling Approach to Implement an Adaptive Questionnaire

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Abstract: An adaptive questionnaire, named EDUFORM, is based on Bayesian statistical techniques that both optimize the number of propositions presented to each respondent and create an individual learner profile. The preliminary results show that reducing the number of propositions we may still moderately control the error ratio. The respondents' profiling information is in most cases obtained after one third of propositions.

Major goal

This paper describes design and implementation of a software module, named EDUFORM, which allows for dynamic optimization of questionnaire propositions and profiling of learners on-line. This tool is based on the probabilistic Bayesian modeling (Bernardo and Smith 2000), and many of the features used in this restricted evaluation task can be directly used in the wider context of modern computer based learning environments (Dillenbourg 1999).

Bayes methodology

In the questionnaire context it is quite natural to model the problem domain by (m) discrete variables $X_1,\ldots,X_m$ and that a data d is sampled from the joint distribution of these variables. In finite mixtures we now make an additional modeling assumption that the data D can be viewed as if it were generated by K different mechanisms, all of which can have a distribution of their own. Furthermore, it is assumed that each data vector originates from exactly one of these mechanisms. From these assumptions it follows that the data vector space is divided into K local regions usually called clusters or profiles, each of which consists of the data vectors generated by the corresponding mechanism. The underlying intuitive idea is that a set of data vectors can be modeled by describing a set of profiles, and then describing the data vectors using these profile descriptions. Each description gives the distribution of the variables $X_1,\ldots,X_m$ conditioned that the data vector belongs to the cluster. The cluster descriptions should be chosen in such a way that the information required to describe data vectors in the cluster could be significantly reduced because they are similar to the "prototype" described by the profile. In such a "profile language" a data set D can be described by first giving the profile index for each data vector, and then by describing the differences between the observed and expected values. Construction of mixture models from a given data set D by using the Bayesian approach is described in Tirri et al. (1996).

Implementation of EDUFORM

The instruction data set (1800 students of a Finnish educational institution.) was collected in December 2000 with both traditional and Bayesian optimized questionnaire. Motivational profiling in this study is based on the Motivated Strategies for Learning Questionnaire, which is developed on the basis of motivational expectancy model (Pintrich 2000).

The EDUFORM user interface is shown in Figure 1. The propositions are on the middle part of the screen, and as seen, the seventh proposition has inspired the user to write an open comment regarding the proposition.

The left side of Figure 2 presents a dynamic situation where user has actually given 24 responses; EDUFORM has reasoned 24 responses and 37 propositions are open. Visualization of the current learner profile (groups of learners), is shown on the right side. The users are divided into different groups of learners based on their answers on the questionnaire.

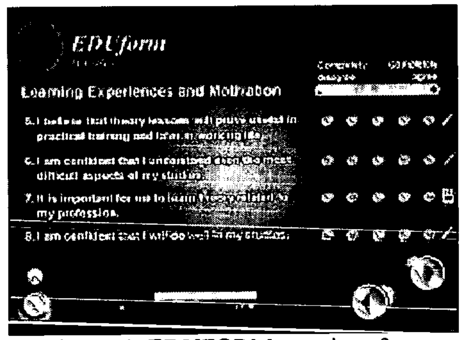

Figure 1. EDUFORM user interface.

The profile in Figure 2 gives an estimate where the learner is most likely to fit into group four or one, but the groups two and six are very unlikely.

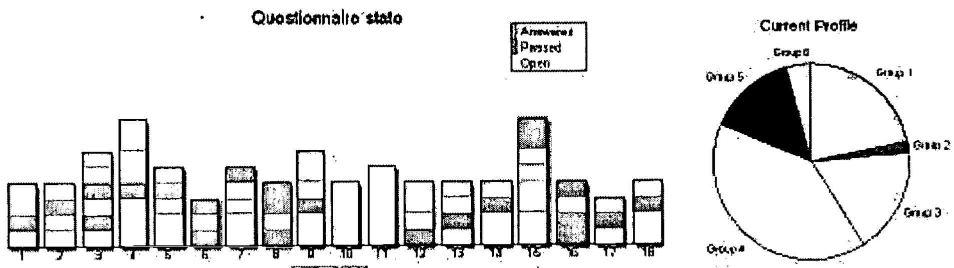

Figure 2. EDUFORM questionnaire optimization (left) and current profiling state (right).

Conclusion

The explicit advantages of applying on-line adaptive questionnaire on educational domain included a) increased task-related participation, b) absence of both second level coding errors, and c) respondents exhaustion effect, d) reduced number of propositions and e) fast feedback. The implicit benefits of EDUFORM covered matters like a) adaptation to respondents learning, cognitive and motivational strategies, b) increased reliability, c) means to implement collaborative actions and d) flexible changeovers made possible between theoretical viewpoints. Preliminary results for optimization show that error ratio is reasonable (Part A: 64% / 12%, part B 54% / 22%) and controlled within the instructional data set sub sample (N=230). Statistical techniques explored here are one possible solution to provide an intelligent messenger (or agent) to intermediate knowledge between collaborating students (Hoppe and Ploetzner 1999, 147). The architectural question (i.e. platform for software modules like EDUFORM) is difficult to solve globally due to different goals of open and distance learning research teams.

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A Model for Online Unit Development: Necessity, the Catalyst for Invention

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Abstract: Theoretical frameworks and practical processes driving online course development in tertiary institutions are currently under pressure, scrutiny and review and online courses are increasingly seen as an answer to these problems. Useable procedures, guidelines and tools are required to achieve the development of suitable courses. The new model for online unit development presented in this paper was developed by considering processes implemented in the fields of multimedia production, project management and distance education. Based on four main phases, the model recognises the centrality of issues such as course planning, media development and evaluation. As well as being suitable for a range of educational contexts, the model appears to be well suited to different cultural settings, particularly those involving Indigenous staff. Based on a semi-cyclic process, the model recognises the significance of tight timeframes, useable tools and supportive resources, and identifies the responsibilities of the major players in the development process.

The Topic and Context

This paper presents a model for online unit development which was formed to meet the specific needs of a school within a university involved in online unit and course development.

An examination of the context in which this model was developed is essential to understanding its purpose and intended outcomes. External conditions existing in the broader educational arena as well as the internal requirements of the school where the first author works were significant factors which both influenced and directed the development of this model. Instead of being inappropriately "seduced by the technology" (Buchanan, 1998-1999), the school wanted a plan which could sustain long term online unit development based on contemporary and culturally appropriate instructional design principles.

Worldwide, the theoretical frameworks and practical processes driving online course development in tertiary institutions are under pressure, scrutiny and review. In many settings, this has created an almost frenzied attempt to adopt the new technologies, one that has not always been characterised by rigorous pedagogical support (Zakrzewski & Bull, 1998). Instead, the current environment of technological change in tertiary education presents different curriculum development and presentation requirements, needs which are currently being determined by educators and student groups. Growing student demands for flexible courses combined with a resource-stretched university environment have combined to create a context where the online preparation and delivery of university courses is increasingly seen as a solution. Traditional models of unit development and delivery are no longer adequate to meet the latest needs of these two groups. George and Luke (1995) recognise that universities will have to change their methods of delivery to meet the challenges of the new age:

" ... with the public funding base for universities shrinking, and with a major shift to competitive forms of funding and serious competition from external providers, the long term viability of universities is becoming increasingly dependent on their capacity to diversify their services to meet the educational needs of new client groups." (George & Luke, 1995, p. 3).

At a local level, the need for this model of online unit development was even more pertinent and pressing. The School of Indigenous Australian Studies, Kurongkurl Katitjin, at Edith Cowan University in Perth, Western Australia, has recently begun to develop a number of online units for their Indigenous students who typically study off-campus from metropolitan or remote areas of Western Australia. With the extension of the school's curriculum and staffing levels, combined with a recent national and international demand for the courses offered by the school, the unit development plan for future semesters has been greatly increased. For example, next year the school intends to increase online unit development outcomes by at least 500% in comparison to previous outcomes. This situation has directly created a strong demand to create useable procedures, guidelines and tools to achieve the development of such courses. The authors believe that such an increase in output must be accompanied by an appropriate model of online unit development, one that is steeped in sound instructional design and based on a succinct and flexible pedagogical approach. Such a model must also incorporate practical procedural guidelines and supporting tools of implementation to be able to direct staff roles, budgets and production outcomes.

Background

Since 1998, the School of Indigenous Australian Studies has been involved in the development of online units and converting current units of study to online mode. Due to the newness of this process and the changing needs and skill levels of both students and lecturers, the process hasn't always been as efficient as the school's management would have hoped. However, within the school is a large bank of resources including skilled staff with a history of serving the needs of distance education students. For example, since 1973 the school has developed many effective strategies to develop, deliver and assess a variety of subject areas including Aboriginal cultural studies, computer skills and social science. Furthermore, many of the Indigenous and non-Indigenous staff within the school have valuable distance education, instructional design, multimedia and project management experience. From an institutional perspective, the online unit development process has met with sustained support from Faculty management and it seemed that the only element missing was an appropriate model to guide the development of educationally sound online products. The model of online development presented in this paper has utilised and accounted for this range of supporting and surrounding resources.

The individuals and groups from Kurongkurl Katitjin who have been directly and indirectly involved in the development of this online model include:

- The online development team comprised of an Instructional Designer, a Web/Multimedia Designer, a Web/Multimedia Programmer and a Coordinator of External Programs.
- Academic staff who have provided consultation regarding the model's components, review of procedures and evaluation of online curriculum content.
- Students who have provided the development team with valuable anecdotal and evaluative comments about current online units.

The development of the model was led by the first author of this paper, the school's Instructional Designer, who instigated the process of establishing a model of online unit development.

Review of Recent Research and Literature

By considering similar processes that have been successfully implemented in the fields of interactive and culturally appropriate multimedia production, project management and distance education, the new model presented in this paper is applicable to current contexts as well as being based on a sound theoretical framework, primarily driven by instructional design (Tam 2000; Weston, Gandell, McAlpine, & Finkelstein, 1999; Gustafson & Branch, 1997; Henderson, 1996).

This model is contextually specific in that it is characterised by extensive consultation processes which drew on the expertise of the school's staff as well as input from the wider community and student body. To ensure the efficiency of this process, various "sign off" milestones are integrated throughout the model. Furthermore, the model takes into account the specific needs of the students for whom the online units are being developed. By acknowledging general Indigenous ways of learning and the particular preferences of Kurongkurl Katitjin's students, the model's overall instructional design basis promotes processes in which units can be tailored to suit specific groups of learners. For example, the interface of our online units must be sensitive to, and reflect, Indigenous culture. This need was catered for by enlisting the talent of Indigenous artists from both within the university and the local community. As more online courses are developed and presented on a global scale, the necessity of culturally appropriate interfaces is becoming more important (Moore & Marshall, 1999; DelGaldo, 1990, cited in Ianella, 1992, p. 94). This model for online unit development acknowledges the fact that learners come to study these online units with an already developed accumulation of background and cultural knowledge and experience (McLoughlin & Oliver, 1999; Henderson, 1996). We hope to enable students to develop their knowledge base, skills and attitudes:

" ... instruction should be geared not just toward imparting a knowledge base, but toward developing reflective, analytical, creative, and practical thinking with a knowledge base. Students learn better when they think to learn ... They also learn better when teaching takes into account their diverse styles of learning and thinking ..." (Sternberg, 1998, p. 18).

Furthermore, this model has attempted to create procedures whereby the units developed incorporate mechanisms which encourage students to manipulate the content presented to them, rather than just interpret it (Bell & Kaplan, 1999; Harper & Hedberg, 1997). In turn, the learners are empowered by being able to control their own pathway through the unit material and develop new learning strategies as a result (Reushle, 1995). Overall, the model for online unit development aims to create learning materials in which the student concentrates on the overall content of the unit rather than smaller components such as the details of the interface or individual assessment tasks (Misanchuk, 1992).

Addressing the Problem: Goals, Approaches and Outcomes

The major problem was the fact that a clear set of workable guidelines and supportive implementation tools were required to sustain a long-term pattern of online unit development, a pattern in which quality outcomes were achieved in a flexible manner that could adapt to future needs and demands. This situation required a solution that incorporated a supporting pedagogical framework which was directly linked to practical and procedural guidelines, and suggestions for implementation at each step of the process. The implementation of this model for online unit development was based on five major goals:

- create pedagogically sound and culturally appropriate products;
- increase productivity of the online unit development team through more refined role definitions;
- establishment of an overall format of online units within the school;
- establishment and maintenance of a workable, resource-efficient pattern of curriculum design and development; and
- recognition of student and lecturer needs within the process of online unit development and delivery.

The basic approach adopted to construct the model of online unit development involved three major phases. Firstly, an analysis of the current context and existing procedures was completed. Next, a literature review and practical survey of current and recent models of online unit development was carried out. Staff within the school were also consulted during this period to ascertain their views of the online unit development that had already occurred in the school. This research then informed a draft model of development which was presented to staff for review and refinement. It is the product of this final review which will be implemented for trial in the first semester of 2001.

Solution to the Problem: Development of the Model

To date, a model for online unit development has been developed which provides a suggested set of procedures for creating online units of study for adult Indigenous students. This model is based on a semester based timeframe to design and develop the unit, subsequent semesters being devoted to the revision of future versions of existing units. It is expected to be particularly useful for the online development team within the School of Indigenous Studies at Edith Cowan University as well as the associated academic teaching staff who typically fulfil the content expert role in the development process.

The model is based on a series of four main phases, recognising the centrality of issues such as course planning, media development and evaluation. Each stage is comprised of a list of suggested tasks which are supplemented by a number of practical implementation tools.

Phase no.	Phase title	Stage no.	Stage title
1.0	PREPRODUCTION	1.1	Preparation
		1.2	Analysis
		1.3	Design
2.0	PRODUCTION	2.1	Develop
		2.2	Evaluate
		2.3	Produce/Publish
3.0	IMPLEMENTATION	3.1	Distribute material
		3.2	Teach
		3.2	Collect feedback
4.0	REVISION	4.1	Minor (first teaching)
		4.2	Minor (further teachings)
		4.3	Major revision

Table 1: Phases and stages in the Model for Online Unit Development

The Preproduction phase is where the unit's underlying theory, purpose and outcomes are considered. This is one of the most crucial phases as it sets the scene for subsequent development. The entire Production phase is driven by the decisions that are made in Preproduction. After the unit has been thoroughly designed, the design specifications are then passed on to technical staff in the online development team to create the website and any other multimedia that is required. After the first prototype of the online unit is created, it is then evaluated and the final product produced. The Implementation phase involves distributing the material to students, teaching the unit online and collecting feedback about its delivery. Lastly, the revision phase encompasses a number of semesters in which the unit's outcomes are reconsidered and changes are recommended for future versions.

The model outlines a suggested timeframe of online unit development by indicating when phases and stages should begin and end, and when it would be convenient to adopt a cyclical rather than a linear process within the model for review and evaluation purposes. Although based on a semi-cyclic process, the linear restrictions of timeframes and sign off dates are still recognised. As well as acknowledging the significance of tight timeframes, useable tools and supportive resources, this model identifies the major players in such a development process and outlines the responsibilities of each one. Role definitions are included of staff including instructional designers, multimedia developers, unit writers (content experts) and computer programmers.

The model for online unit development will be completed by the end of 2000. During Semester 1, 2001, the school plans to trial it with a view to reviewing this initial implementation period in the middle of next year. At the close of 2000, the school plans to extend the staff resources allocated to the online development process and it is hoped that with this extra amount of staff and a more streamlined process of development, ten new online units will be developed throughout 2001 in preparation for delivery in Semester 1, 2002. These expected outcomes will provide a challenging and practical context for the trialling of this model for online unit development.

The Future: Application and Implications

After six months of operation, the model will be revised and evaluation will be sought from all stakeholders including the school's teaching, administrative and management staff. The data from this review will be utilised to modify the current version of the model for online unit development with the aim of creating a new, improved version. Pedagogical results of the trial will be reported in the conference presentation.

Due to the processes employed to create the model, the authors also hope that it may be adopted by other educators who are involved in creating online units for particular cultural groups. It is hoped that the model may also be trialled, or at least tried, in similar tertiary educational institutions involved in the business of online unit development.

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Designing an Intelligent Math Tutor for At-Risk Students

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This paper describes the development of a smart learning software designed to sharpen students analytical reasoning skills. The impetus for this project came from a desire to help middle school at-risk students to successfully pass a standards-based math exam in order for these students to advance to the next grade. The software uses a "guided" coaxing mechanism to improve students' analytical reasoning skills. The software was designed to drill students on basic math concepts, diagnose student deficiencies, tailor an instructional module to address the deficiencies, and monitor student's progress. The instructional module or "virtual tutor" would correct deficiencies by guiding the student through step processes leading to a correct mathematical approach. This paper discusses in detail the issues involved in the development of the software. Preliminary data on the impact of the software on middle school at-risk students will also be presented at the Conference.

Title: CD-Drives: The Development of a User Interface for a Driver Education CD-ROM

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The presentation will present a progress report on the research and development of a user interface for an educational CD-ROM. The CD-ROM's aims are to assist in the education of risk assessment and hazard perception in young New Zealand drivers. The user interface will be an interactive multimedia interface and the research on the interface looks at how the interface should be designed to support effective learning.

The theoretical background of the research is based in advanced learning technology research specifically the work on learning environments. This research also attempts to use game design theory to assist the design of the interface, this is a new approach to traditional interface/learning environment design.

Initial findings suggest that using elements of game interfaces and the approach to game environment design is appropriate for the intended audience.

The work is still in progress, but initial findings suggest that the learning is improved.

A Framework for Self/Collaborative-Learning in the Internet Environment

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Abstract: With the rapid development of information technology, it is widely accepted that computer and information communication literacy has become extremely important, and is the main new ability required from teachers everywhere. Therefore, for enhancing their teaching skills and information literacy about the Internet environment with multimedia, a new teachers' education framework is necessary. The purpose of this study is to propose and develop a distance educational system-RAPSODY, which is a School-based curriculum development and training-system. In this environment, a teacher can learn subject contents, teaching ways, and evaluation methods of the students' learning activities, related to the new subject called "Information", via an Internet based self-training system.

Introduction

Recently, with the development of information and communication technologies, various teaching methods using Internet, multimedia, and so on, are being introduced. Most of these methods emphasize, in particular, the aspect of collaborative communication between students and teacher during interactive teaching/learning activities. Therefore, now-a-day it is extremely important for a teacher to acquire computer communication literacy (Salvador, 1999). So far, there were many studies concerning system development, which aim at fostering and expanding teachers' practical abilities and comprehensive teaching skills, by using new technologies, such as computers, Internet, multimedia, and so on. In Japan, systems using communication satellites such as SCS (Space Collaboration System) are developed and used as distance education systems between Japanese national universities. In the near future, a teacher's role will change from text based teaching, to facilitating, advising, consulting, and his/her role will be more that of a designer of the learning environment. Therefore, a teacher has to constantly acquire/learn new knowledge and methodologies. We have to build a free and flexible self-learning environment for them under the concept of "continuous education" (Seki et al., 1998). At the same time, we need to build a collaborative communication environment to support mutual deep and effective understanding among teachers. Here, the word of "self" means "autonomous behavior" for either individual or group learning, including the collaborative attitude. In general, a system for supporting distance education is categorized into two classes. One represents seamless systems for smooth communication among remote sites. The other class represents collaborative systems that positively support users' various learning activities related to distance education.

In this paper, we propose a Distance Educational Model, which is based on the concept of School Based Curriculum Development and Training System, advocated by UNESCO (Phoenix university homepage) and OECD/CERI (Center for Educational Research and Innovation), and describe the structure, function, mechanism and finally the educational meaning of this model. Based on such a background, it is necessary to construct an individual, as well as a collaborative learning environment, which supports teachers' self-learning/training, by using Internet distributed environments and multimedia technologies. A teacher can choose the most convenient learning media (learning form) to learn the contents (subject units) that s/he desires. The new information and communication technologies bring with them rich and useful opportunities for the self-development of people. With this goal in mind, we are developing the integrative distance education/training system for supporting teachers' self-learning/training, called RAPSODY (Remote and AdaPtive educational System Offering DYnamic communicative environment).

Distance Educational System- RAPSODY

Until now, when a teacher wanted to take a class on "IT-education", s/he had usually to leave the office or school. However, now it became possible to learn various kinds of subject contents by building a virtual school on the Internet environment.

RAPSODY is an integrated guide system that can logically connect individual learning units, called CELLs. The CELL corresponds to the Learning Object Metadata proposed by IEEE-LTSC(IEEE-LTSC., 2000), and is intentionally focused on three primary aspects in order to represent educational meaning within the distance learning environment: learning goals, learning contents and learning media We call this conceptual scheme the Distance Ecological Model. Each of the CELLs has also the other several attributes (slots) such as features of the material, available tools, a related CELL, Guide-Script, and so on, besides those three primary aspects. From a user's (learner) point of view, this model seems to be quite transparent in order to identify/select his/her leaning conditions, and the system can easily guide towards an adequate Learning Object, according to his/her requirements. The word of "Ecological Model" in distance learning means multi-modal "learning gestalt" reflecting learning goals, learning contents and learning media/environment including any situation of individual/self and group/collaborative learning. We use the ecological model in the wider sense of ecology, as a closed, perpetuum-mobile system, which functions without interference from the outside, once the actors (such as designer, author, and learner) and their interactions are defined.

In this research (system), the word "designer" means a person who designs/describes each value of a Learning Object Metadata (CELL) and a Guide-Script. On the other hand, the word "author" means a person who produces digital course materials such as Web-based contents, movies and sound of VOD, etc, by means of any authoring tools. A Learning Object Metadata for any learning course-material would be defined, modified and registered from far sites by designers or authors according to a certain educational goal. At the same time, authors such as schoolteachers, university professors, etc., would produce and store their digital learning contents in their local server machines individually. Of course, each of contributors may play any of the two parts. This system can logically link the CELLs based on the Distance Ecological Model of RAPSODY, which provides the learning guide environment by taking into consideration of each user's individual learning needs/conditions.

Our Distance Ecological Model is built on three aspects. The first one represents the learning goals, which are 1) the study of subject –contents, 2) the study of teaching ways (knowledge and skills), and 3) the study of evaluation methods of the students' learning activities. The second one stands for the aspect of the curriculum (subject-contents) of "information", which represents what the teachers want to learn. From the third aspect, the favorite learning media (form) can be chosen, e.g., VOD, CBR, etc. By selecting a position on each of the three aspects, a certain CELL is determined. A CELL consists of several slots, which represent the features/characteristics of the Learning Object. Especially, the most important slot in the CELL is "Script", which describes the instruction guidelines of the learning contents, the self-learning procedure, and so on. In the following, we will explain the meaning of each aspect in more details.

Learning goals aspect: For this aspect, we have already proposed three sub-goals, which are:1) subject-contents, 2) teaching ways, and 3) evaluating methods, for "information" classroom teaching. It is extremely important for teachers to achieve those sub-goals for understanding how to use and apply information technologies in order to enhance a student's problem solving ability. This involves comprehensive learning activities, such as problem recognition, investigation and analysis, planning and design, implementation and execution, evaluation, reporting and presentation.

Subject –contents aspect: In this study, we focus on the subject called "Information", which is due to be established as a new obligatory subject in the regular courses of the academic high school system in Japan.

Learning media (form) aspect: This aspect represents five different learning environments, as follows: 1) Distance teaching environment (Tele-Teaching) based on the one-to-multi-sites telecommunications. 2) Distance individual learning environment (Web-CAI) based on CAI (Computer Assisted Instruction) using WWW facilities. 3) Information-exploring and retrieving environment using VOD, CBR (Case Based

Reasoning). 4) Supporting environment for problem solving, by providing various effective learning tools. 5) Supporting environment for distributed collaborative working/learning based on the multi-multi-sites telecommunications.

CELL definition: The concept of the CELL in Distance Ecological Model is quite important, because it generates the training scenario, including the information to satisfy the teacher's needs, the learning-flow of subject materials and the guidelines for self-learning navigation. The frame representation of a CELL is omitted for lack of space. The frame slots are referred when RAPSODY guides the process of the teacher's self-learning.

Conclusions

This paper proposed the Distance Ecological Model for building the integrated distance learning environment. This model stands for the networked virtual leaning environment based on a 3 aspects-representation, which has on the axes 1) learning goals (on the study of the subject–matter, teaching knowledge/skills, and evaluation methods), 2) subject-contents in the designated subject-matter, and 3) learning media (forms). This represents a new framework for teachers' education in the coming networked age. We have mentioned the rationale of our system and explained the architecture of the training system via the Distance Ecological Model. Furthermore, we have described a Guide-Script language. The aim of our system is to support teachers' self-learning, provided as in-service training. At the same time, we need to build rich databases by accumulating various kinds of teaching expertise. In such a way, the concept of " knowledge-sharing" and "knowledge-reusing" will be implemented. As a result, we trust that a new learning ecology scheme will emerge from our environment. RAPSODY is a platform that provides various kind of learning places based on the Distance Ecological Model according to the learner's need in consideration of the relationship among Learning Objects. In this system, the function of a Tele-conference with real video/ sound and the shared window of chatting/application software are provided. So, if a learner wants to change the mode of the learning media from the individual (self) one to the collaborative (group) for some reason after he/she has finished with a certain Learning Object, then the system asks a group manager for permission to attend this discussion group to satisfy lecturer's request according to the Distance Ecological Model. As another example, the system may recommend a selection of the collaborative mode for encouraging deeper recognition/understanding for that learner, if such a navigation message is described in the Guide-Script. In this way, RAPSODY provides the integrated/free environment for distance learning that can adaptively change between self/collaborative mode according to a user's needs based on the Guide-Script in the Distance Ecological Model. In this sense, the Guide-Script contains the core information about the stream developed between Learning Objects by reflecting both the learner's needs and curriculum relationships. With this system, we can construct various kinds of learning forms and design interactive and collaborative activities among learners. Such an interactive learning environment can provide a modality of externalized knowledge-acquisition and knowledge-sharing, via the communication process, and support learning methods such as "Learning by asking", "Learning by showing", "Learning by Observing, "Learning by Exploring" and "Learning by Teaching/Explaining"'. Among the learning effects expected from this system, we also aim at meta-cognition and distributed cognition, such as reflective thinking, self-monitoring, and so on. Therefore, we expect to build a new learning ecology, as mentioned above, through this system. Finally, we will apply this system to the real world and try to evaluate its effectiveness and usability from experimental and practical point of view.

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E-learning-on-the-job in the Steel Industry

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Abstract: The use of network technology allows an extension of the learning activity beyond the formal act of learning. In the pilot project executed at CORUS Steel, learning and information were conceptually and technically integrated in one internet-based system offering a practical solution for combining learning with updating, archiving and the option of retrieving information on the work floor (see Nonaka & Takeuchi, 1995). From the start on the system was very well used both by trainees and senior employees. On the basis of these findings CORUS decided to continue and widen the scope of their e-learning activities.

Introduction

Defining e-learning solely as a means of reducing distance and time constraints for training, is an inadequate description of the possibilities network technology has to offer. In this case study we will describe a pilot project executed at CORUS, the British-Dutch steel producer, showing the strengths of e-learning as an enabler for enhancing learning and the process of information retrieval on the work floor. The study focuses on the use of e-learning along the production line in one of the steel strip mills at CORUS in the Netherlands.

Purpose of the pilot project was to gather knowledge and experience in the use of e-learning for the theoretical training of basic technical skills. The activities included the development of web based training material, study guides and the establishment of an electronic e-learning environment on the company's intranet. The pilot was executed from March till August 2000 by a team of experts from CORUS and CINOP (Center for the Innovation of Education and Training). The first experiences of the user group with the e-learning environment were evaluated and a follow-up of the project is on its way.

Why e-learning?

CORUS wanted to develop a system for time and place independent self managed learning to acquire the theoretical knowledge in support of the training in operational knowledge and skills by the coach on the work floor. The reasons for this renewal were:

- Difficulties in planning for training,
- Poor educational quality of the existing materials
- Heterogeneity of the workforce in relation with prerequisite knowledge, learning styles, learning skills and tempo
- Improvement of the integration of theory and job practice and the effectiveness of learning
- More efficiency needed in the organization of the learning process by means of a learning management system
- Better use of tacit knowledge and more flexible storage of information for retrieval and easy update.

The deliverables

- A model for the development of learning-information units, so expert knowledge could be used as learning and information material

- A model for the electronic learning environment in which the integration of information management (CINOP development) and learning management (Blackboard 4) was a central issue
- Development and storage of the expert knowledge in learning-information units in the database, which could be accessed as an information source for learning and a reference guide for information retrieval.
- Development of study guides to support the learning process. Each of these guides contain information on the topic at hand, the content, learning goal, related topics, time involved and a self test of randomly chosen questions.
- Interaction design for transparency in structure and functionality's of the electronic learning environment.
- Evaluation report on user experiences in the first phase of implementation

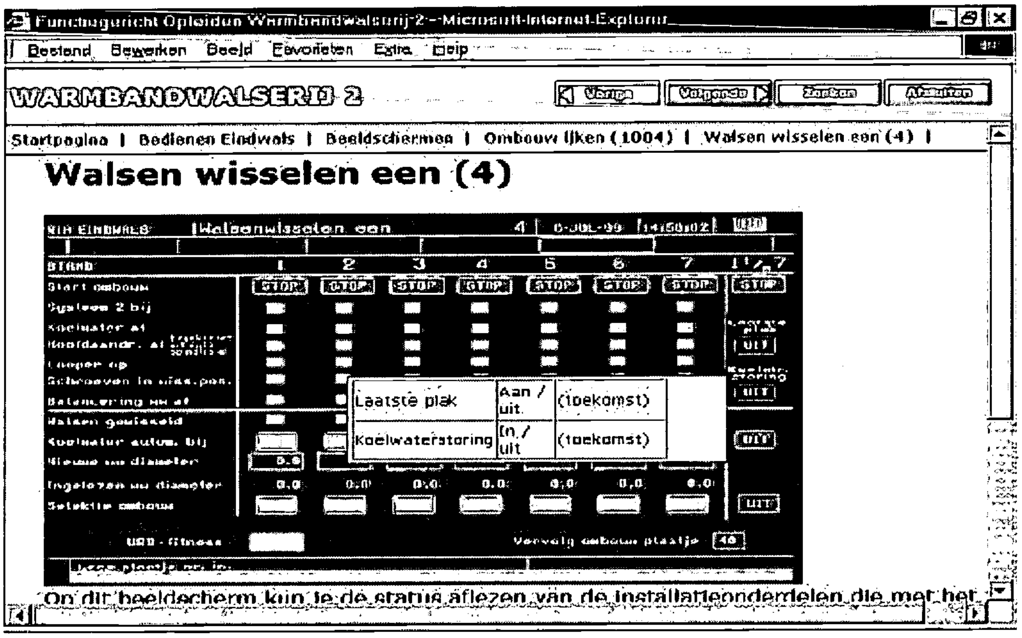

Figure 1: Example of an information unit in the knowledge system

Conclusions and discussion

The integration of information and learning in one internet-based system was an important issue and turned out to be successful. An eminent reason for that is the usability of the system for both the trainee and the senior employee (see Rosenberg 2001). What needs to be improved is the production process of the learning and information material as well as the guidance of the learning process. Also a check is needed to see if there are software systems coming on the market, that will better fit the needs of the CORUS learning environment. Current instruments for evaluation fail to clarify the return on investment issue both from an educational and a financial point of view.

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Design for Teamwork and Team-learning in an Online JAVA Programming Course

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Abstract: Teamwork is a desired pedagogical method both for learning and for the development of socio-cognitive skills. Collaboration within a team is expected to promote activities like elaboration, justification and argumentation that trigger learning mechanisms. Albeit the expectations, there is no guarantee that these activities will occur without additional educational design constraints. We describe the main design decisions that we made, which relate to (a) the structure of the setting, (b) the design of pertinent assignments, and (c) a motivating scoring plan.

Introduction

Teamwork is a desired pedagogical method both for learning (Springer et al., 1999) and for the development of socio-cognitive skills. Collaboration within a team is expected to promote activities like elaboration, justification and argumentation that trigger learning mechanisms. Albeit the expectations, there is no guarantee that these activities will occur without additional educational design constraints. This paper describes design decisions for an on-line JAVA programming course for computer science students in India. Programming is a complex cognitive activity. Programming involves tasks where teamwork is important and sometimes necessary, especially for object-oriented programming where elements (classes) can be shared and reused. Programming involves iterative activities of problem analysis, generation or adaptation of respective algorithms, design, implementation (code writing), and debugging (syntax and logic). Within all these activities collaborative work can promote both learning and the quality of the final product. In addition, collaborative work might influence how students think about the nature of working in this domain and might help to better prepare them for real-life programming projects. The project explores ways to encourage and support teamwork and team learning processes. New insights, derived from the course implementation, can be used for improving the course, as well as for the design of other on-line collaborative learning courses. In this paper we describe the main design decisions that we made, which relate to (a) the structure of the setting, (b) the design of pertinent assignments, and (c) a motivating scoring plan.

Main Design Issues

Considerations regarding team characteristics. Decisions regarding team characteristics include decisions such as team size, relation between teams, initial assignments of students to teams and the assignment of roles within a team. For the project, the initial group is divided into teams of five members. The teams' membership won't change through out the course to enable natural development of a team micro-culture. There are no initial assignments of roles, or a structured exchange of roles, as the development of the social and communication skills is not the main goal. Within the designed assignments specific domain related roles are expected to evolve.

Considerations regarding the design of tasks for the students. The design of appropriate variety of assignments for the learners has a major impact on the achievement of the project objectives. Main assignment types:

1. Programming assignments where students are expected to solve given problems individually and then the individual solutions are presented to the team for further discussion aiming for the submission of a consolidated solution. This involves cycles of individual work and collaborative work.
2. Collaborative generation of a pool of useful examples and reusable elements.

3. A team project, based on a real-life problem. Team members have to analyze the problem, prepare some initial design for sharing the work, implement and integrate. These activities are performed through a structured (and tracked) combination of individual and collaborative activities.

Considerations regarding procedures and tools to support collaborative interactions. Any tool or procedure entails some affordances and constraints, and so shapes the learning processes in some way. We use the course communication and collaboration tools of Blackboard 5™, as this is the platform used for this on-line course. The application tools, such as the discussion board, the group pages, virtual chats, and e-mail; can be used in different ways and with additional structure and this is what we are trying to explore here, mainly with regard to individual and team activities and with regard to the collaborative communication interfaces. Design decisions regarding the interplay between individual and teamwork aim to provide learners with opportunities for both reflection and communication. We try to make sure that individual and collaborative learning opportunities complement and mutually enhance each other. Research shows that individual preparation before a collaborative learning task results in better learning results (Van Boxtel et al. 1997). So most of our designed assignments start with some individual work, and continue with a structured combination of individual and team activities.

The collaborative communication interfaces should serve various goals such as post, read and track inputs; enable various search options; provide methods for referencing; support focusing etc. For the project, within the discussion board, pre-defined forums and threads are assigned to scaffold grounding and focusing processes. Students have to use the given threads and are encouraged to add relevant threads as the discussion develops. The threads provide content and goals structure for the on going learning activities. Collapse options enable an overview, while students can watch thread details for any message. We use structured activities to support the transitions between information interface (related to JAVA programming activities) and the communication interface as suggested by Hoadley and Enyedy, (1999). Through the combination of tools that we use we enable students to refer to specific code and to execute while discussing it.

Motivation considerations. For this project we are interested in the motivation of students to develop and continue relevant conversations. The previous sections can be also regarded as dealing with motivation. The tasks were actually designed for motivating collaboration and the communication protocols ensure students' commitment to continue a conversation. We use also a scoring scheme, which is expected to promote motivation. As students inputs are tracked it is possible to score their input into the conversation. This involves a special scoring scheme that takes into account not only the number of inputs, but also the quality. The quality is measured by letting experts judge the contribution to the discussion. More research is needed for fine-tuning of our scoring scheme.

Evaluation and Further Research Plans

Literature review shows that various means were used to investigate collaboration, from experimenting with respective computational models as employed with "Clarissa" (Burton et al. 2000) through experiments in authentic academic situations, along with research of the methodological issues involved in the analysis of computer conference transcripts (Rourke et al., 2001). Our main research tool will be the analysis of the logs from the discussion board of Blackboard. The logs will be analyzed both for structure and for content. Structure means patterns of use (e.g. changes in number of inputs during the course, or during various types of tasks). Content will be analyzed with regard to the contribution to team learning (e.g. justification, critique, elaboration, elaborating question etc.). For the evaluation we will investigate things such as the correlation between the quality of the assignments and some quality measure/s for the respective discussions; content and evolvement of the examples' pool and also use patterns of the examples' pool.

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An Online Simulated Golf League Multimedia Environment: A Case Study from a Postgraduate Computing Module

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Abstract: This paper describes the top level design, implementation and the overall development rational for the first operational version of a simulated remote access golf league ranking system in response to a problem set as coursework for postgraduate software engineering module at the School of Informatics and Multimedia Technology (SIMT). It concludes with the lessons learned from applying the chosen software lifecycle methodology, the Theory-W Based Spiral process model.

Introduction

This paper report on a case study based on a piece of coursework (Software Engineering Page 2001, Oriogun 2001) completed as part of the MSc Computing course at the University of North London. It describes the development of a software solution using the Theory-W Based (Boehm et al. 1998, Boehm et al. 1999, Oriogun 1999) Spiral process model. It looks at technical specifications of the finished operational model, and primarily focuses on the challenges and applicability of the chosen process model in terms of its use within a semester framework. The student project team "WizardSolutions" consisted of seven members of varying backgrounds and knowledge of computing although all students had completed required preliminary modules of initial programming and systems analysis and design.

Development Process of the SIMT Online Golf League Application

In developing the SIMT Golf League system, the student group applied processes, methods and tools common to software engineering in order to achieve the rationale and timely development of the required software. In line with the Theory-W Bases Spiral methodology (Boehm et al. 1998, Boehm et al. 1999, Oriogun 1999), the student group held sample requirements elicitation meetings with role-playing customers (the Golf League) to define the needs of the system. Stakeholders were identified as League official, Club officials, Players, Software Analysts, Project Manager, Programmers, Designers. Through a series of stakeholder (Boehm et al. 1999, Oriogun 1999) meetings, the student group analysed and detailed the initial requirement specification, adding more detail and refining requirements at each cycle of negotiation to produce satisfactory 'win conditions'.

System Architecture and Technical Specification

The project objective did not specify either the development of either a standalone executable or an online system. However it was agreed fairly early in the project to design a system which would exploit the strengths of web-based client-server technologies (Chang 2000) to deliver a robust, fast, remote system which met the user requirements. The top level systems architecture is shown in Figure 1 below:

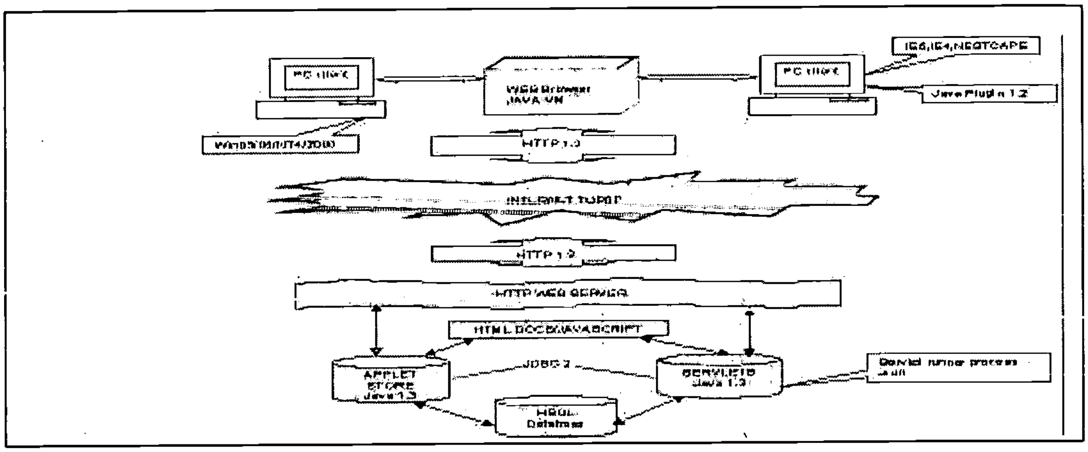

Figure 1: Architecture for the Online Simulated Golf League Multimedia Environment

Implementation of first version operational system

The system was delivered on time to an estimated 90% functionality according to documented requirements. The group also purchased their own internet domain name which was re-routed to point to the host server. The online system demo can be accessed at (WizardSolutions 2001). A username of: *4* and password of: *pass4* are required to be able to view all implemented modules. Fig 2 shows screen shot of the League Administrator menu and 'Update Club Details' applet; Figure 3 shows the report of League members displayed using Jackson Structured Programming, King and Pardoe (1992) and a conventional modelling paradigm (Lejk and Deeks 1998).

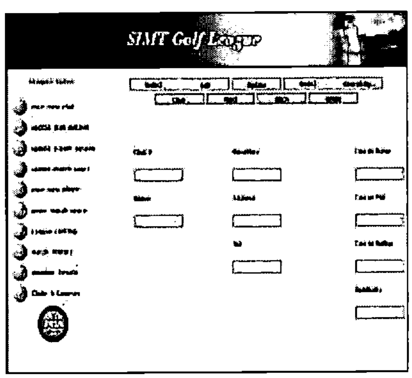

Figure 2: Screen Shot of Admin Menu 'Update Club Details' Applet

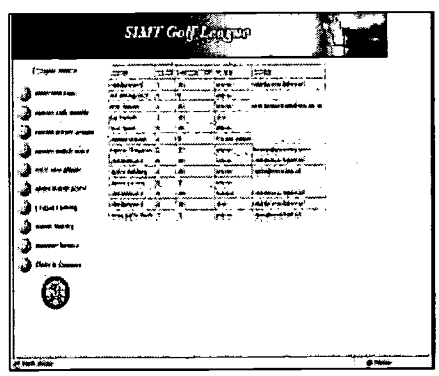

Figure 3: Screen Shot of Administrator Menu League Members Report

Conclusions

The project provided the group the chance to develop an application that actually mirrored development of such systems within real-time environment. One of the main drivers within the industry at present is the interface of mainframe and standalone systems with the World Wide Web. The use of new technologies provided the group with a considerable challenge which at times seemed fairly daunting especially with the tight timescales that all group members needed to adhere to in order to deliver the required system within the project deadline. The initial planning of the project schedule was through lack of experience in this field - perhaps a little over zealous and certain aspects of the project, such as the coding, took up a far higher percentage of the available project time than was at first thought. The main reason for this was due to the limited technical resources that the group had available to them.

Hosting the application on a 'free' site was perhaps not an ideal solution, as lack of support from such sites can give rise to connectivity and performance issues, both of which the group experienced. It must be said however that the dedication and enthusiasm of the student group was a major factor in overcoming many hurdles, demonstrating that the people are often the key asset in producing a successful project. The student group who took part in this case study consisted of a wide range of skill sets and backgrounds. Each member of the team brought something different to the project development, whether that was coding ability, negotiation skills, review techniques, design knowledge etc. Many members of the group had certainly never carried out a technical project on such a scale before. The 'real world' application of techniques taught in the lecture component of the module gave insight to their applicability to different situations and their usefulness as elements of a project lifecycle.

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Mobile technology and the social context of distance learning

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Abstract: This paper reports an ongoing study of how distance teaching and learning activities can be enhanced by using mobile technology. Thc importance of supporting the social context in order to enrich the learning environment is emphasized. The study will employ ethnographical methods and techniques to analyze emerging uses of mobile technology by students and teachers. Hopcfully, the work in progress reported in this paper can help find and shed some light on the issue of the social consequences of a widespread use of mobile technologies, as well as suggest solutions to some of those questions raised by the current trend towards mobile learning.

Introduction

In recent years new information and communication technologies (ICT) have made us reconsider our basic assumptions about the nature of education. For a number of reasons ICT have important implications for learning in general. The emerging consequences are both positive and negative. They allow for much more flexibility and the possibility for a larger group of people to take part in education. However, at the same time they trigger major transformations of learning environments. Consequently, there is a number of alarming trends that we need to consider. Firstly, distance education puts enormous pressure on teachers because of the constant switching between different students and subjects. Secondly, it increases the complexity of communication between students and teachers. These trends indicate the importance of the problem of supporting rich social context for all actors, a problem combines technical, logistical, political, educational, and social dimensions of distance education. The latter, the social dimension, is of crucial importance for solving problems concerning of high dropout rates, lack of motivation, lack of everyday support from the teacher and peers, feeling of alienation, perception of tele-learning sessions as "broadcasts", and other phenomena common for that distance education. In our view, mobile technology and artifacts have the potential to address the above problems of distance education.

The importance of turning attention from studying the possibilities provided by technology itself to the overall context of using the technology, forces us to strive for a better understanding of the social setting in which learning activities take place. The project will focus on developmental life cycles of collective activities in distant learning, emerging rules, norms and systems of mediational artifacts, as well as a social science perspective, namely a cultural – historical tradition (Leont'ev, 1978). The traditional classroom methods of teaching and learning have until now generally influenced the design of learning environments for distance education. A number of attempts to develop alternative approaches have been made recently. They include, for instance, Computer Supported Collaborative Learning (Koschman, 1996) and situated learning (Lave, Wenger, 1991). These approaches challenge us to find new technical and educational designs, more suitable to the new reality of education.

Project activities and challenges

In a study being conducted at the Department of Informatics, Umeå University, Sweden, mobile technologies are being used to address some of the above problems of distance education. More specifically, the aim of the study is to focus on how PDAs can support social context, how actors within social contexts can act and communicate more effectively with this technology, and how it will stimulate and support learning and collaboration. In our view, mobile technologies can significantly extend distance education, which is already powered with diverse technologies, such as stationary computers, laptops, and videoconference systems that provide a bridge over distant places and locations. As mobile technology more and more becomes an important ingredient of our ordinary lives, this kind of "carrying around" type of technology seems to support a more spontaneous manner of interaction between its users. The proliferation of SMS (short message service), giving users an opportunity to express themselves and notify others anywhere at any time and place, can be one of the first indicators of a future trend.

The reasons why PDAs can help solve the problems mentioned above and meet certain needs of distance education are as follows. First, they can provide the students with place-independent access to (some) course materials, such as papers, schedules, and lecture notes. Vast amount of traditional paper information can be stored in a handheld and carried around. It also provides an easy way to work off-line with the Web where the student can download the course web-site and update it when synchronizing the handheld with stationary computers. Second, they can help keeping in touch with fellow students when necessary an asking for immediate help when having a problem during individual studies, as well as sharing problems and findings with other students while working on group projects when being spatially separated from one another. Maintaining informal social contacts can also be one of the consequences of using wireless handhelds. Third, almost as important as the contacting fellow students is the possibility to contact the teacher. With other technologies, such as mobile phones it is sometimes difficult to do since teachers are often are unavailable on the phone, and do not want to be disrupted, or might be engaged in meetings with other students. Regular email is not flexible enough, since sending, replying, and receiving emails is only possible when one has an access to a desktop computer, which is often not the case for both students and teachers in decentralized education. Fourth, students that are spatially separated can be provided with the possibility to easier get notification information about what is going on within the course. Feelings of loneliness and alienation in the sense of "being away from where the action is" can be eliminated by "virtual" social practices of "mixing with the others" and "catching up on the local news". Checking with a message board or teleconference is an alternative to traditional practices and standards. Interaction during "distributed classes" is another intresting application for PDAs. These sessions have a limited range of interactions and the need for more possibilites for students to ask questions and participate in discussions is evident. Using a handheld device for asking questions and making comments during a telelearning session can be a solution because it can provide possibilities for more options for the students to contribute to their "distributed class" discussions. Finally, coordination in teacher teams can be enhanced, as well, when work needs to be tightly coordinated to avoid breakdowns

Some of the problems described above can be solved by just using a mobile phone or an ordinary phone and computer. However, PDAs have a number of important advantages, which include the possibility to distribute resources between the handheld and a desktop computer and to use many versions of "regular" applications(eg., ICQ), surfing the web, better input for sending SMS, exchanging graphics, and so forth.

The study is planned and to be performed on different groups of students engaged in distance education located in different places in Northern Sweden, during an extended period of time. We are planning to provide every member of the group with a personal PDA, in order to support their work. The study will employ ethnographical methods and techniques, that is, field studies, interaction analysis, and interviews. At the first phase of the project a pilot project is planned to be performed during this Spring that will point out some of the obstacles that we will need to be consider further before extending the study to a larger group. Potential support for actions and activities mediated by PDAs can be provided by the use of diverse types of existing software. Some of this software is widely used, and hopefully already constitutes a part of everyday environment and social life of our prospective participants. This technology is easy to carry around, and it can make it possible to keep in contact with fellow students and save time and effort during travelling back and forth between home and school. The challenge in formulating design implications for future use and development of mobile technology in distance education is an interesting and important issue. Finding new metaphors that can work as catalysts for new ideas and solutions can provide us with a better understanding of the impact of this technology on our daily lives. Hopefully, the work in progress reported in this paper can help find and shed some light on the issue of the social consequences of a widespread use of mobile technologies, as well as suggest solutions to some of those questions raised by the current trend towards mobile learning.

The study presented in the paper is being conducted within the framework of a project called "The Social Context of Collaborative Distance Learning: A Cultural-Historical perspective", which is financially supported by the Bank of Sweden Tercentenary Foundation.

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A Constructivist Teacher Training Model to Design Educational Activities based on ICT

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Abstract: by the light of the constructivist theoretical principles, the aim of this paper is to describe the phases of a teacher training model – defined after the several training opportunities offered us from the "Developmental Plan of Educational Technologies" (1997/00) of the Ministry of Education – developed to provide teachers for tools and methodologies to support their educational activities based on ICT.

Theoretical Background

One of the most important objectives to reach in the teachers training concerning the use of Information Communication Technology (ICT) in classroom is to offer new knowledge on the use of the information tools and to guide them to plan, with critic and creative spirit, new and more efficient educational activities. We think that to introduce teachers to the correct use of ICT is to promote the acquiring of working skills such as in the cognitive apprenticeship. In other terms, the training activities that we carry out with teachers move from the assumption that is not important "to know" but to be able to transfer in practice the knowledge patrimony to define and carry out projects and products.

This fundamental change reflects a well known African proverb: "if a man is hungry, you can give him a fish, but is better if you teach him to fish". Paraphrasing Papert (1980) the aim of instruction is not to feed the people with a codify learning (the fish) but is to undertake to lead the individual to discover specific knowledges which he needs (to fish). For the constructivist assumptions this is the best way to acquire new concepts and to interiorise a learning methodology allowing people to became independent in its own cognitive processes.

This idea is well consolidate in the teachers' *forma mentis*, but what happens when the roles reverse and they became students? Often we think wrongly that because they are just holder of structured and experimented knowledge don't need spaces to reflex and to share the acquired concepts. So, to structure learning environment that allow to the course participants to accept and promote the inevitable comparison among different individual perspectives is one of the aim of the constructivism: the learning is not only a personal activity, but the result of a joint dimension of the interpretation of reality.

The Designed Model

Our objective is to define a teacher training model for using ICT which aims to:
- encourage mastery of multimedia and telematics, both the ability to understand and use the various tools as well as the acquisition of new and more efficient teaching/learning, communication and project management styles;
- improve the didactic organization regarding individual disciplines and also the acquisition of general skills.

The teacher training model that we have planned is subdivided into 5 phases as described below. The first begins with brainstorming (or brainwriting) activity using keywords such as multimediality, telematics, communication, net, collaborative learning, etc., and then the trainees construct basic definitions. More in detail, the participants are divided into two or more groups depending on the numbers in the class, with the task of producing a definition based on the words associated with the keywords during the brainstorming session.

Next the individual groups read their definitions and discuss them with the others in order to distinguish similarities and differences. After this the trainer emphasizes that there isn't a right or wrong answer and all the trainees cooperate to produce a more exact final definition which is compared to the text book definition. The same procedure is followed each time the trainer wishes to formalize the basic concepts necessary for the acquisition of more complex concepts.

The second phase is focused on the explanation of theoretical aspects underlying the introduction of ICT in everyday educational activities. This is followed by the consideration of the advantages and disadvantages linked to technological innovation in the school. Moreover, the course members are encouraged to reflect on the importance of reviewing their teaching methods to fully exploit the potentialities of ICT for didactic purposes. An other element of training is to discuss with teachers about the *best practices* to present them concrete and successfully models of use of ICT in classroom.

In order for the course participants to acquire increased awareness that the essential requirement for planning didactic units based on ICT is the extensive knowledge of these tools, the model includes a third phase during which trainees take on the role of evaluators. They are required to examine multimedia resources on CD-ROMs or on the Net. This activity is a valuable input for training teachers to make a critical examination of the technological and pedagogical aspects of the multimedia resources (Ottaviano et al. 1999) and of the WEB to plan didactic units. Later these teachers will be able to generalize this knowledge to other information tools.

Following the fourth phase in which the teachers are divided into work groups with the aim of simulating the planning of one or more didactic units based on the integrated use of ICT (Allegra et al. 2000). In this phase they are stimulated to put in practice problem solving strategies, coordination skills to mediate between different points of view, communicative skills, to carry out a series of events, to select suitable tools, etc. just as in real school situations. Teachers, thanks to the multimedia and telematics resources selected for them, must structured a didactic unit considering with the support of a scheme of the main steps of the didactic planning. The most important aspect that they have to consider is the choice of the right tool in relation to specific steps of the teaching/learning process. Furthermore, they are stimulated to reflect on the strategies to exploit the added value of each technological tool.

At the end, we have foreseen a fifth phase to evaluate the success of the training course, to this aim the course participants have to complete two evaluation forms. One of this regards the evaluation of the trainer and his method to teach, the second one is focused on the evaluation of each phase of course.

Advantages of the Approach

The results emerging from our experience show that the course partecipants consider interesting the activities focused on case study, problem solving and simulations of didactic planning because these are not aimed at memorising several definitions, but at interiorizing concepts and applying them into practice. Teachers in their evaluation appreciate this method of training because it allows them to capture their attention on the process in which they are directly involved, and it stimulates a more effective generalization of the learned concept toward the planning of didactic activity based on ICT in which they will be trainer in their turn. The didactic planning is an open and flexible operation of adaptation to the emergent necessities. "To experiment" the planning in the classroom is useful to clarify the contents on which focusing the attention, orienting themselves in the definition of the objectives and organizing the ideas respect to the materials and the procedures to be adopted from time to time.

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Preparing the Teachers of the Information Society in Greece

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Abstract: The Greek Ministry of Education implements a project concerning the training of 75.000 primary and secondary school teachers in ICT as an educational and professional tool over a three year period (2000-2003). This is a wide-range project, which has been designed to be completely decentralised as far as both the model and the methodology of training are concerned. Decisions about when to undertake the training, which delivery method and training provider to use are made by the schools, taking into account the local conditions and the training needs of their teaching staff. In addition to the training programmes the training process includes a lot of support activities, which will remain even after the project has been completed. This paper addresses the design and the implementation of the project.

1. Introduction

Central issue of the changes occurring in today's educational systems is the integration of Information and Communication Technologies (ICT) in subject teaching. The educational community has recognised the value of ICT as a teaching tool since the early 80's. However, in a world crossed by the information super-highways ICT is far more than just a teaching tool. ICT can perform as the vehicle for the reform of the educational strategies towards a student-oriented learning model, transferring part of the responsibility of the learning process to the students, implying at the same time new roles for the teachers and their classroom performance.

Today teaching has become more difficult, but also more important, since knowledge and learning are central issues in the information society. "The traditions and norms of the school, which earlier gave teachers unquestioned authority, are currently being questioned and in some aspects have been partially abandoned. Since teachers are not able to rely solely on tradition as a means of support, their personal qualifications are becoming increasingly important in determining how successful they can be in gaining the interest and participation of their pupils". (ItiS, Delegation for ICT in Schools, 2000). The students cannot be anymore passive objects of teaching, instead they must themselves seek and create their own stock of knowledge with interaction with others. In this change ICT can be a powerful tool for learning and as such promote the transition.

But in order ICT to be effectively integrated into teaching and learning, the teachers must have knowledge, skills and abilities (Wild, 1996) to make decisions about when, when not and how to use ICT in teaching particular subjects. Therefore, supporting teachers towards this direction is one of the most critical factors for successful implementation of these technologies in schools (Taylor, 1997). Helping teachers to integrate ICT in their teaching process is not mainly helping people operating machines. Rather, it is about supplying teachers with a powerful educational toolkit which can enhance their own pedagogical expertise and professional practice, redefining at the same time their profession's core and demands. Additionally, in the social framework of learning, teachers' communication and collaboration with each other as well as with experts, is necessary for extending their knowledge and skills.

However, evolution in educational systems is a rather complicated process, apart from the potential of any technology, various parameters like cultural and ethical background, national curricula as well as student assessment methods, have to be taken into consideration.

The last four years the Greek Ministry of education has implemented an educational reform, which prescribes a change of focus in schools from teaching to learning and encourages the active participation of pupils in the teaching and learning process. Towards this target new and flexible curricula (Davis, 1998), capable to accommodate ICT based activities, have been developed and new educational material has been produced (books, CD-ROMs, Web sites). All schools will have Internet connection until the end of 2001 providing all teachers and students with e-mail addresses. Additionally, the schools' network is being established offering access to educational content and services over the Web and many pilot projects concerning school networks and educational software are implemented all over the country.

However ICT may contribute to educational development, only if teachers are able to utilise the new technology (Lawson & Comber, 1999). All true changes in schools must take place through the teachers, who are and will remain key figures in learning.

2. The project "Preparing Teachers of the Information Society"

Within this context the training of teachers in ICT is an issue of major importance for the Greek Ministry of Education. Therefore it proposed allocating a total of 100 million ECUs over a three years' period for ICT investments in schools. The goal is that by the end of 2003 75.000 teachers will have received training in the use of ICT in teaching and learning.

The Hellenic Pedagogical Institute (H.P.I.) was given the task of planning and implementing the project entitled "Preparing Teachers of the Information Society". This project is the largest and most comprehensive national investment programme ever to be made in the schools in Greece and offers the teachers training aimed primarily at acquainting them with the potential uses of ICT as an educational tool.

The main aim of "Preparing Teachers of the Information Society" is to raise the standard of pupils' achievements by increasing the expertise of teachers in the use of ICT in subject teaching. It is an ICT project as well as a school development project, which consists of the following components:

- In-service training for 75.000 teachers
- Establishment of a people's network which will support the training and will form learning communities which will remain active even after the end of the project.
- Establishment of local centres which will support the training process
- Creation of mechanisms for the accreditation of training
- State grants to improve the school's infrastructure and the school's accessibility to the Internet.

Also throughout the implementation of the project support will be given for administrative and organisational changes in schools, for the use of alternative teaching and evaluation methods and for the application of flexible curricula.

Basic design principles of the project

The project has been designed to be decentralised and there are opportunities to shape in-service training at the local level in accordance with the wishes and competence of the participating teachers. Decisions about when to undertake the training, which delivery method and training provider to use are made by the schools taking into account the local conditions and the training needs of their teaching staff. However the project's framework has been determined by the H.P.I., which produced the specifications' framework for the educational material as well as the training curriculum for all the training programmes.

The project offers flexible training programs as far as the content and the training model are concerned. Also quality assurance is provided placing mechanisms, which ensure that the ICT training is and will remain of the highest quality.

During the project active learning communities are being established across the country functioning as mutual help and self-learning centres. This "nctwork of people" is a factor of major importance for the project's success and will continue to influence the educational community after the end of the project.

Also, several support activities described below contribute to thc successful implementation of the project.
Local training support centres are established in each educational region in order to facilitate and co-ordinate the training process at the local level.
The participating teachers are able to receive daily support by thc H.P.I. through the Greek schools' network operating at the Web. It is very important for the trainees to know that they can find help any time they need it during their training (Papadopoulos et al., 1999).
All the trainees are provided with a PC and Internet connection for home use. These can be seen as a stimulus to the teachers, but above all as an essential tool in mastering ICT and exploiting its use in teaching. Teachers with their own computers can achieve the familiriaty required for using a computer as a professional tool i.e. for administrative as well as educational purposes.
Also, special measures are implemented for small isolated schools. Due to landscape peculiarities, too many isolated small schools -basically primary schools- exist in Greece, which are served by only one or two teachers. Especially for this kind of schools, a pilot training programme is going to operate, under the project's framework.

Basic principles of training

By the end of the training the teachers should know

- When, when not, how and why ICT can be used in the process of teaching and learning
- How to choose, organise and use sources and means provided by the ICT in order to design and prepare effectively his/her teaching.

The purpose of training is to give teachers basic knowledge of ICT as an educational and professional tool. The training will focus on providing knowledge of and familiarity with the use of ICT in teaching but also developing the teachers' grasp of how ICT is used in society at large.

Throughout the training process the pupil is a central issue. The whole training process focuses on persuading the teachers to use ICT for educational activities in the classroom (Underwood & Cavendish, 1996). The teachers are not trained only in order to support their own professional development or the ways they search for information and teaching resources but they are trained mainly in order to use ICT to enhance teaching and improve pupils' achievements in a number of ways.

The training offered by the project is built up around the teacher team. "The reason is that past experience from in-service training in schools shows that the efforts of individuals alone are seldom capable of influencing the overall development of the school. It is difficult for an individual after completing a course to have a major impact on developing and changing working approachcs in the school, primarily because there is a great deal of tradition and inertia built into many workplaces. On the other hand a group of colleagues, who participate together in an in-service training programme have a completely different range of opportunities to continue their learning and development "at work". In such cases there are much better opportunities to bring about genuine change" (ItiS, Delegation for ICT in Schools, 2000).

During the training process the participating teachers are expected to take great responsibility for their own training. Today and increasingly in the future, learning must be a lifelong process taking place in all the various places in which we live and work. In-service training is no longer a reward or solely a pleasure-oriented activity. The teachers themselves, and generally all the employees, will have to take personal responsibility and create the opportunities for their own professional development. For this reason "Preparing teachers of the Information Society" is implemented largely as "learning at work".

Implementation of the project

Prior to the actual implementation, the Hellenic Pedagogical Institute (H.P.I.) defined clearly and precisely the training courses, in which the trainees may participate, determined the training material's specifications and produced samples of original training material. Also it was determined how the accreditation of the knowledge and skills, acquired by the trainees during the training, will be performed

The training process at each region is supported by the local training centres. These centres are equipped with state of the art laboratories as well as a frequently updated digital library of educational software titles and staffed with ICT experts and experienced teachers, who facilitate and co-ordinate the training process at a local level. Also these centres are in charge of the local facilitators and the school work groups co-ordination. Additionally, they have to maintain the local nodes of the Greek schools network.

Seminars are organised for school headteachers and local administrative heads responsible for education and training as well as for the facilitators (located at the local support training centres), who are going to co-ordinate and facilitate the group work in schools.
The seminars are held by the H.P.I. in all the capital cities of the regions of the country with the contribution of the local Universities and municipalities.

The list with the approved training providers is published. The schools are free to choose the one they prefer according to their training needs. All the training centres have to meet a number of prerequisites concerning the training staff, the equipment and the services they can provide. The training providers can cover all the levels and models of training or just a part of them.

The four alternative training models offered are described in detail:

- In-school training, which includes face to face training performed either by a member of the school's teaching staff e.g. the IT teacher or an external trainer. The training content must meet the specifications published by the H.P.I. Wherever possible training takes place in the classroom or in the school computer lab, so that teachers can try things out as they learn.
- Training by the approved training providers, who have to follow the training curriculum produced by the H.P.I.. The training curriculum describes the targets of the training process and outlines the skills and abilities expected. It is for the training centres to decide the teaching methods and strategies in order to achieve the described targets.
- Self-learning which will addressed to teachers who already acquire basic ICT skills and experience in the use of ICT in the learning process and will include exploitation of the provided training material and participation in collaborative projects.
- Distance learning provided both by the training providers and the Pedagogical Institute making use of the teachers' training centre operating within the Greek schools network.

The schools determine how their staff will be trained. They are asked to fill an application form describing the training model and the resources required for the training. It is possible for a school to choose more than one training model according to the particular needs of its staff. It is also possible for a teacher to choose different training models for the various programmes he/she participates. Depending on the members of the staff seeking training and the chosen training model the schools receive a training fund to cover the training expenses and the actual training process begins.

The training programmes are structured in three levels:

- *Level 1: Training in generic ICT skills.*

These training programmes intend to improve teachers self-confidence and knowledge as far as the new technologies are concerned. The curriculum of the programmes are designed in order to fulfil the particular needs of the Greek teachers. The training material and the activities designed derive from the schools' daily programme and the particular needs of teachers. The aim of these programmes is to acquaint the teachers with: a) the use of common computer applications (word processor, spreadsheet, browser, e-mail etc) b) basic concepts of ICT c) the use of ICT tools for searching for information, for presenting and communicating ideas and for contributing to their professional development.

- *Level 2: Training in the use of ICT in subject teaching.*

During these training programmes teachers are expected to participate in activities relating to the use of ICT as a teaching tool. The curriculum of the programmes are structured over various activities. The activities include the development of lesson plans as well as the teaching process using educational software titles and common applications used in subject teaching. The effective use of ICT in the classroom implies new roles for the teachers, who are expected to act as facilitators of their students' approach to learning (Bickmore-Brand, 1996). In an attempt to promote and articulate new roles in teaching and learning process, during the implementation of the activities, teachers play the role of the student, having an expert as an instructor.

- *Level 3: Design and production of educational activities, lesson-plans and scenarios concerning ICT exploitation in classroom.*

These programmes concern teachers who feel confident in using ICT. In thc framework of the programmes, work groups are established, with the active participation of both teachers and pupils, which will implement an interdisciplinary project. The programme encourages project themes, which are of interest to the local societies of the schools, in an attempt to bring schools in touch with the real world. Additionally, schools from remote locations collaborate-using the facilities of GroupWare tools - in developing projects of common interest. In that way, the programmes are expected to perform as the kick off activity for the establishment and operation of the learning communities.

The general target of the above programmes is to provide the teachers the skills and abilities needed to evaluate ICT applications and resources and to be able to choose the appropriate one for teaching, assessment, school management as well as for self-learning and professional development. Additionally, teachers are expected to be able to determine the abilities required from their students in order to construct their knowledge model through the use of new technologies. The training is structured so as to be flexible and to accommodate for the needs and the existing knowledge of the teachers.

A pilot training programme is implemented concerning small isolated schools, which are supplied with special equipment and fast Internet lines, in order to be able to participate in on-line training programmes, using synchronous multimedia communication. The additional outcome expected from this pilot programme, is to bring the students and the local communities of these areas in touch with human and digital resources from all over the country, removing in that way their isolation barriers.

3. Evaluation of the project - Follow up activities

The evaluation of the project includes the following:

- Only approved training providers are allowed to deliver training. These providers had to demonstrate a track record of expertise and experience in providing successful training, advice and materials.
- The activity and performance of participants throughout the seminars and in the team should provide a basis for assessing successful completion of the in-service training programme and thus entitlement to a certificate (Hofman, 1996). The abilities and the skills developed by the teachers are going to be assessed through an assessment mechanism compatible with the European Union Initiatives.
- The educational material produced for the training process and during the implementation of the training programmes will be certified so as to become part of databases of educational material existing in the Greek schools network.
- A system to evaluate the overall success of the project by an independent organisation and the overall impact of the Government's ICT strategy.

The end target of the project is to establish active learning communities across the country, which will remain even after the "Preparing teachers of the Information Society" time limited mandate has been completed. This is one of the reasons why emphasis has been put on a decentralised approach in the project.

Within this context the implementation of follow-up activities is an issue of major importance.

In particular, the material and the educational activities produced by the trained teachers and their pupils are going to enrich the educational content provided by the Greek schools network functioning as reference in training material.

The support training centers at each region will establish connections with the schools and the local educational community, having the potential to encourage and contribute to initiatives and innovations undertaken by the schools.

The learning communities established by the project (including the trainees, the facilitators, the training providers) will exploit the collaborative opportunities provided by the Internet, aiming at the establishment of "a network of people", who will share common interests and will enrich and support the operation of "the Greek Web for Schools", an integrated learning environment (Papadopoulos et al., 2000), created by the HPI, over the WWW. These learning communities will support over the long term the teachers to effectively use ICT technologies in their daily work in schools in order to raise the standard of pupils' achievements and knowledge attainment.

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GAIA: Curriculum-based Exploratory Educational Software Using 3D Components

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Abstract: This paper presents the design and development considerations of GAIA, a curriculum-based, open-ended educational software, which is based on the use of multiple representations and direct manipulation, implemented through different software components. Additionally, it highlights the educational scenarios underlying the development of GAIA, as well as the use of three-dimensional representations in this context.

Description of GAIA

GAIA is a curriculum-based exploratory educational software using 3D building component. It is designed based on a number of educational scenarios that are implemented through seven well-known simulation experiments from the history of science, which are, in turn, realised through seven microworlds (Figure 1).

GAIA incorporates seven microworlds through which the student can (i) "travel" on the surface of the earth, (ii) conceptualise the orbits of satellites, (iii) study the earth's magnetic field (iv) calculate the earth's radius, (v) experiment with atmospheric phenomena, (vi) travel inside earth, and (vii) study a model of a solar system. In GAIA, each microworld is designed according to specific educational scenarios, which encapsulate both the educational material that is to be presented, as well as the functionalities needed for each specific scenario. To this end, scenarios are constructed through a combination of different information, representation and interaction elements, and are designed to allow the educators to organise predefined activities that are presented to the students *work sheets*". Each activity serves certain cognitive, learning, methodological and/or problem-solving goals, and is enriched with the techniques and guidelines, which can assist the activity's integration into the educational practice of the school curriculum.

Exploratory Nature and Multiple Representations

GAIA aims to realise a constructivist learning environment, which facilitates active learning through experience. Throughout the learning process, the use of the exploratory software promotes experimentation and testing of multiple methods and techniques for the solution of a given problem. Thus, the software does not restrict the students to a unique and sequential path of problem solving steps, but promotes exploratory learning, problem solving and project-based learning (Papert 1980, DiSessa et al 1995).

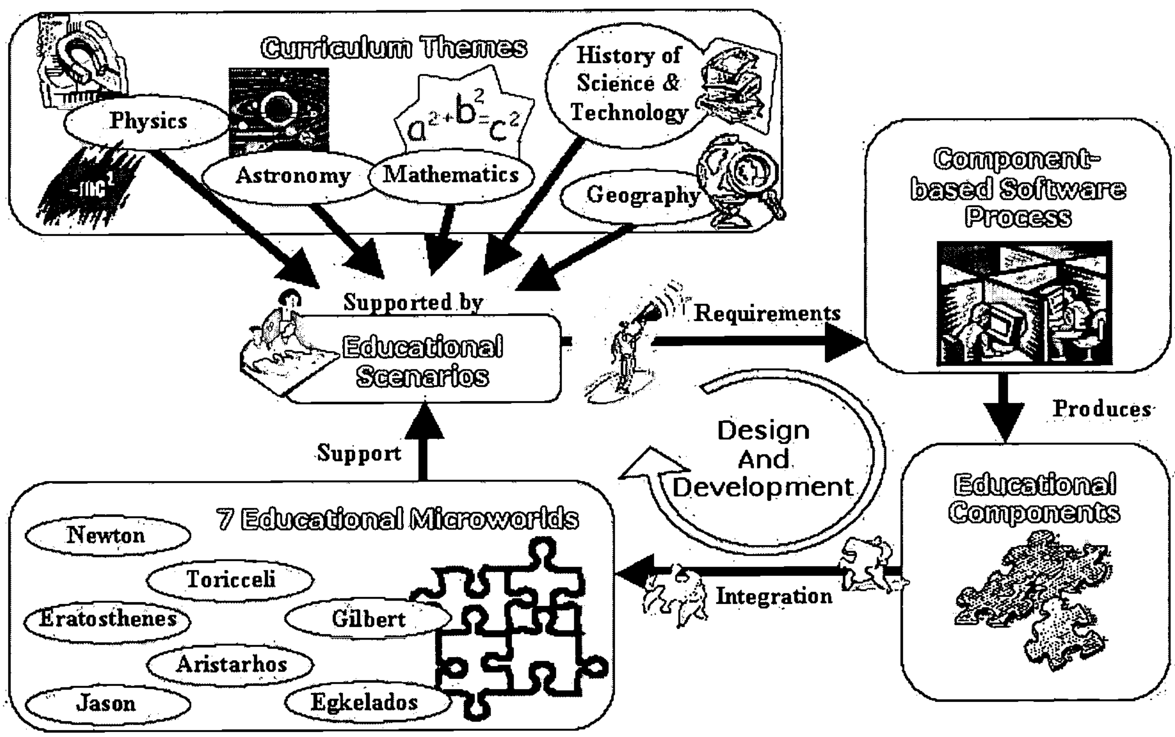
Additionally, GAIA capitalises the pedagogical approach of multiple representations. A didactic concept can be represented through multiple ways that are chosen by the student depending on his or her cognitive background, learning style and learning path. Furthermore, each representation is supplementary to the other ones and includes only the necessary, according to its type, educational material, with which the user can interact. The use of multiple representations of information improves the perception and understanding of the taught concepts.

3D Components

GAIA adopts the component-based software engineering methodology. To this end, it defines one component for each representation, which is specified by the pedagogical needs of the educational scenarios. Component-based design provides a straightforward match between software components and representations, reusability of similar components in more than one microworld, tailorability and black-box implementation.

The development of the software has adopted the approach described in (Roschelle et al, 1999). Educators, who are involved in GAIA, define the functionality specifications for each representation. These specifications form the framework for the design of the software components. This process is iteratively followed, until a fist draft of the specifications is finalised, and the components are prototyped. In addition, educators are continuously being involved in the development life-cycle, providing feedback for the educational "value" of the software components.

Furthermore, GAIA builds on recent advances in 3D technology, to provide three-dimensional representations. 3D offers a new set of advantages in representations issues and learning. The main characteristic of 3D is the ability to create "virtually real" worlds, where students can experiment in a more "na
objectives for GAIA supporting 3D representations are: (i) advanced conceptualisation of difficult scenarios, (ii) increased engagement of students, (iii) virtual experimenting, (iv) realistic view and free navigation, and (v) highly interactive environment.



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Virtual Career Guidance Provision in Education

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Abstract: Virtual career guidance – using distance education methods – can provide an educationally efficient and economically feasible way to support both students and counselors in the mutual interwoven role, thus improving the quality of careers' guidance provision. In this paper, we present a comprehensive account on educational and occupational issues pertinent to our "information technology era" and stress on the usefulness, for each student to be informed and exploit the virtual career guidance techniques, in preparing better his/her professional "route".

Introduction

Nowadays, easily accessible, up to date and reliable information, on educational and employment issues, is considered a fundamental prerequisite for successful counseling and career guidance services in education by career guidance counselors. On the other hand, counseling and career's guidance are both inseparable parts of every proper educational environment.

From the eighties (1980's) computers started to be involved in offcring career guidance. That situation might be described in the following quote: "computers and more general Information Technology are being widely recognized as a potential and dynamic factor having to offer a lot, first in improving the quality of guidance and secondly it making more accessible to those who need it" (Papas, 1988).

Computer networks provide the potential for continuous access to information from a wide variety of sources. Hence, new opportunities and conditions are created for "opening up education" such as in open and distance learning systems for life long education. The schools' career guidance services - as well as the corresponding services in universities - have to be able to use and exploit all the new opportunities based on communication technologies. That way, the information horizon of students on education and employment issues will be remarkably widened and will remain up to date.

Nowadays, the communication technologies have started creating a "path" to allow career counselors to deliver their services by distance. Career counselors – using distance education methods – can use a variety of communication technologies to deliver different programs.

Social scientists and researchcrs try to find out the shape the labor market will have in a few years. Part of their written work – mainly in the form of papers – can be now be found in different web sites. Students should be able to have access even to this kind of information in order to form their *career path* with the assistancc of their career advisors.

We consider that, in the long run, *virtual career guidance* will provide an economically feasible and efficient way to support both students and counselors in the mutual interwoven role, thus improving thc quality of career guidance.

In this paper, we present a comprehensive reference to educational and occupational issues pertinent to our "information technology era" and stress the usefulness for each student in secondary or tertiary education to be informed and exploit the virtual career guidance techniques in preparing better his/her professional "route".

Knowledge of Educational and Occupational Issues

Emphasis must be placed by educationists so that students can be aware of and become familiar with the structure and different facets of the interconnected world of education, work and even leisure provision nowadays and of for the future trends.

The rapid changes in society and technology, the mobility of students through programs which allow exchange among different schools/universities and countries, e.g. European Union Countries and the flow of the work force among countries must be taken into account by the students.

The student must be awarc that different educational experiences may be related to applied experiences in a specific field. The student must also be informed on : i) *employability skills* which are useful in seeking, finding and maintaining a job, and ii) on the existence of a wide variety of occupations that might be available to him/her.

It is wise for students to be informed that: "they can expect to change jobs about ten times and career fields three times in the course of their lives" (Employment and Education, 1989). Supporting the same view, Broughton (1996) states that: "our students will be expected to perform jobs in the future that have not been created or even conceived of today".

Instructors and guidance counselors must provide students with clear understanding of career options and pathways in various sectors of the "globalized" economy where , for example, a sudden "imbalance" in Moscow's stock exchange may affect violently and immediately stock exchanges of other countries and even more their economic situation.

Decision making and planning procedures are important components in the process of formulating a career plan consistent with students interests, skills, preferences and aptitudes. Students must be encouraged: "to develop skills in gathering materials from relevant sources both external and internal and to learn use the collected information in making informed and reasonable decisions. Another dimension considered is the concept of change, as it affects career planning" (Talavera, 1995).

Leisure time must be taken into account – by their career counselors - when students plan their *career paths.* It is wise for the student to be aware of the importance of leisure time for each individual's personal fulfillment and well-being during his/her life span. There have been people who spend their life only working and who had put aside any involvement in recreation facilities. Part–time work and other "flexible" employment now, potentially creates, more time for leisure.

New Technologies and Changes in Work - The role of the school as "the mediator" of students' career skills.

Recently, several scientists and authors have described the different facets of the *technological evolution* and of the consequent – so called – *computer revolution* which embraces and affects people, education, culture, places, systems of organization, the form of technology and the economy etc.

Nowadays, technology makes it possible to transfer almost "immediately"information, money and commercial transactions, property contracts etc through networking. Mortimore (1995) referring to *effective schools* stresses the usefulness of new technology in better learning and writes: «the ability to connect with other learners anywhere in the world, to use virtual reality to explore geographical, and historical phenomena and the opportunity to experience personal coaching through interactional multimedia packages must enhance the opportunity for better learning».

Factors of major importance in changing the nature of work and the structure of occupations is the comprehensive application, in the workplace: i) of advanced technologies, i.e., computers, microprocessors, fiber optics, satellites, etc., ii) the more sophisticated techniques in management strategies and iii) the consequent improvement in decision and policy making options.

Advanced technologies change the organization of work, its nature, the role of workers and consequently the new skills requirements to engage in work, specifically in those occupations which involve high technology or/and technology intensive processes.

At the end of the twentieth century a new «rough split» in the work force between those who can mployment conditions and those who – more or less - can not has become evident. Rifkin (1996) expresses his reservations and fears, because of this situation, and declares that: «the rapid elimination of work opportunities resulting from technical innovation and corporate globalization is causing men and women everywhere to be worried about their future. The young are beginning to vent their frustration and rage in increasingly antisocial behavior while older workers seem resigned, feeling increasingly trapped by social forces over which they have little or no control».

Knowledge and education are considered basic foundations of human resource development, economic development and the consequent better standard in the nation's competitiveness. At present and in the near future «the skills of schooling and learning and the skills of the workplace are increasingly complementary and overlapping» (Herr, 1995). This situation stresses that people with minimal training or capability of learning will face greater difficulties in finding and maintaining a job.

Many countries have started reforms and innovations in their educational system in order to make schooling more "career relevant". Thus, they introduced courses on the principles of technology to help students to understand the effects of advanced technology in work places and more generally in the occupational structure. New skills – useful for the prevailing employment conditions – have been taught to the students. Skills for conflict resolution, skills to plan and prepare for work more systematically, skills for: problem solving, information retrieval, life long learning, etc. are examples of these skills.

Career recourse centers, using computer facilities, have been established in schools (USA, Canada, etc.). Partnership contacts between schools and the larger community, where schools are located, apprenticeship schemes etc. are some "facets" that a school offers its students as "mediator" of student career skills.

Virtual career guidance for students: different techniques and modes

Despite the importance that the education system gives to career guidance provision for students, the use - till now - of *virtual career guidance* is rather limited. This kind of guidance is used and based on communication technology. Virtual career guidance is expected to make available to the students the up to date information on career paths, new professions and predictions on the probable shape of the job market. It is expected to contribute to minimizing the discrimination, among students from different locations and backgrounds, provided they are interconnected.

To cope with the need of students for accurate and updated information virtual guidance can provide continuous access to career options for each student presenting diversified levels of maturity, having different educational and occupational interests. This kind of guidance should be compatible with educational, social and psychological concerns including: *i) traditional guidance methodologies, objectives, tools and practices, ii) school dynamics and levels of interaction among staff and students, iii) relevant content and iv) needs for updated information.* Hansen (1997) writes: "besides the changing life patterns in the *Information Society*, there are also changes in knowledge systems - in what we know and how we know it; with a growing body of literature in contemporary psychology on *ways of knowing*".

Web based techniques – including search engines, data banks and multimedia applications - have been already applied by *"on – line" carrier services.* Examples of addresses of such internet sites – that may be used during carrier guidance sessions – are as follows:

- http://www.dice.com/main.html
- http://www.HeadHunter.NET
- http://public.wsj.com/careers/resources/documents
- http://www.hotmail.com
- http://www.pcrservices.com/main.html
- http://colicon.com

EURES (http://europa.eu.int/comm/dg05/elm/eures/) is a European labor market network - started in 1994 – aiming at facilitating the mobility of workers in the European Economic Area. It links more than 450 euro - advisers - specialists in employment matters – throughout Europe. The last two years, more than million citizens of the European Union have used the EURES services.

Similar techniques have been applied by Universities, see for example the Web site of Oxford Careers Guidance Service (http://www.careers.ox.ac.uk/mainpage.html). Also, other organizations offer similar services, see Prospects Web (http://www.prospects.csu.man.ac.uk). External links to other Sites relevant to Careers Guidance on the World Wide Web can be found at http://www.unn.ac.uk/academic/hswe/careers/links.html .

Different Techniques

To design a virtual career guidance technique we have to take into account: *i) users' needs (students and staff), ii) the availability of the telecommunication infrastructure, and iii) the expertise of the available staff.* The information and communication systems that support virtual career guidance provide a very good paradigm of *human - centered information systems.* We now present some *technological options* for virtual career guidance.

I. ***Special search engines:*** Special *World Wide Web (WWW)* based search engines can be developed to allow *intelligent browsing* into companies profiles, job agencies, guidance offices, job offerings, etc. Intelligent browsing means that search engines should be able to make suggestions (by providing appropriate links) according to a student's profile and the current trends in the job market. Such engines should be used with the proper assistance of a specialized counselor (s). Student access should be limited to predefined links to avoid confusion and the overload of information

II. ***Digital libraries - Data banks:*** The amount of information in digital form is growing explosively. Nowadays, libraries – mainly in a digital form – provide the necessary access for full exploitation and use of the available knowledge and information stored in the library files. So, libraries can be used - by potential users - more easily and more fully for information retrieval. In that way, information technologies provide the means for the search of information worldwide thus facilitating communication and connection among people.

III. ***Intranets - GroupWare applications using networks:*** *Business simulation games* as well as any relevant *guidance games* can be seen as examples of such GroupWare applications. They allow concurrent access to data by different students in a quick, simple and flexible way. A *relational database* (often object oriented) is "the heart" of each GroupWare application. In the case of career guidance applications they can contain *electronic career paths, digital job profiles,* etc. The counselor's advice can be provided to different student teams involved. Students can exchange information online and receive real-time feedback from the system. That way they can not only communicate with each other but also obtain automatic responses to their queries using the available data stored in the relational database. Various patterns of access to the GroupWare application are available, such as *private (accessible only to its owner), group (accessible only to specified users) and global (available to all users).*

IV. ***Virtual Guidance Rooms:*** A *Virtual Guidance Room (VGR)* can be a part of a well-organized counseling and guidance service. A VGR can use Tele - (and video) conferencing facilities as well as WWW based resources to support counselor's role. Access to videos can be gained via *a video on demand server*, while *ISDN networks* can be used to assist the guidance procedure. VGRs can then be connected through high-speed networks with a *Regional Virtual Guidance Center*. All these regional centers can be connected to a *National* one, which will be well supported with the latest available relevant resources. This structure is considered to be the most efficient – in technical and economic terms - since it will allow easy incorporation of local, regional and national educational and labor information to the existing *information sites*. These *Internet sites*, will provide easily accessible and continuously updated resources in digital form (text, audio, video). Hence they will provide, if properly managed, the latest available information on career guidance.

All the above mentioned technological options, are new methods which have not been tested or compared widely. Hence, the relative research findings on the literature are very limited.

Modes for virtual career guidance

I. ***Autonomous individual guidance:*** This is a "guide yourself" approach. The student uses a Personal Computer (PC), possibly connected to the network. That way the student aquires new skills and starts the procedure for "searching" and "information retrieval". The student can also use traditional guidance materials like books, leaflets, videos, etc. The counselor is not necessary when using this mode.

II. ***Guidance with the assistance of a counselor:*** This is a kind of semi-autonomous guidance, where the student jointly with the counselor (who can be present really or virtually) can interact with the information system. The student – counselor relation is powerful. The counselor can administer a personality test or ask the student to write an assignment. Each aspect of this relation can be enriched with the use of information and communication technology. Even though computers and communication technology will never replace the counselor, they can support some of the most crucial aspects of the student – counselor relation by providing fast and reliable access to information. Such aspects include presentations, questionnaires, access to student guides, etc.

III. ***GroupWare applications:*** This is based on advanced group communications. Individuals can interact, share material and experiences. Communication-oriented VGRs provide a characteristic technological application that supports a group-oriented counseling mode. The real challenge of this application, that is expected to be available in the near future, would be the integration of VGR operations with the functional requirements of group-based virtual guidance.

IV. ***Virtual guidance services:*** Students are allowed to participate, virtually, in career guidance sessions. Then, a student following a certain electronic path can search and exploit the available information. Options include virtual meetings with the counselors – via teleconferencing - , visits to the digital library (see case studies via video presentations, etc.) and electronic mail communication.

Concluding remarks

Any real change in society is expected to come through changes in the ways one learns and faces the different problems and situations. "To remodel a society, it is essential to influence the hearts and the Barlow and Robertson (1996) in their paper on *Homogenization of Education*.

One of the main targets, in our changing world, should be the familiarization of the new generation with the notion of *continuous* and *unpredictable change*. That way, they can act and operate as good "navigators", in any "weather" and as reasonable decision makers use and rely on a set of relevant informations so they have access to through *information retrieval techniques*.

Nowadays, we have great progress in new information technologies and in their accelerated use within the educational system but mainly outside it. The new generation is the "favorable" and more dynamic learner, user and "explorer" of any kind of information through the worldwide networking – without "suffering" from any "barriers" that the formal education system might impose.

It is wise and efficient for the educational system to offer its students the means and modes for the exploitation and use of the new technologies in shaping better their future educational and occupational career route. This students' expertise, acquired by means of the educational system, provides them with the knowledge on how they can be more efficient "shapers" of their future careers.

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Requirements and Management of IT Resources in Education

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Abstract: Information Systems used in Education must take into account educational as well as technical aspects. Using educational information systems we must choose a balanced approach where: social, educational and technical aspects must participate in the "right mix", so that to meet the set requirement of the system in the prospect of having a positive summative evaluation.

Introduction

The accelerating use of *Information Systems* and more generally of *Information Technology (IT)*, in each level and sector of education and training system - nowadays and in the future – reveals the need for development and use of optimization procedures. These are leading to improvement and positive exploitation of available modes and means and ultimately lead to the need for efficient management of the available recourses to be used. A set of properties that must characterize an Information System, used in a specific environment, e.g. educational, creates a scientific interest to the end of revealing and tracing out the best "mixture", between *requirements* and *management* of recourses so that an expectation of a better "fitting" is considered an attainable target.

Requirements Engineering

Requirements are properties that an information system should have in order to succeed in the organizational environment in which it will be used. *In brief, requirements say what a system should do.* According to Jirotka and Goguen (1994): "anecdotal evidence suggests that errors in requirements may amount for something like 50% of the total cost of debugging". Requirements capture and analysis specify the services that the system should provide and the constraints under which it must operate. It has been suggested by researchers that proper systems' requirements elicitation techniques should incorporate *research methods from social sciences as well as methods which lie within the traditional computer science domain* (J.F. Dumont & P. Stefaneas, 1996).

According to Davis (1990): "Requirements Engineering (RE) is the analysis, documentation and ongoing evolution of both: user needs and the external behavior of the system to be built". Requirements engineering is currently an active research field in the area of Information Systems. It is concerned to find out the future stage of the Information System and how the current one may change. It has to do with the proper prediction of Information Systems behavior. The main problem of Requirements engineer is to satisfy, at the same time, the needs of systems' designer and those of the user(s). Requirements engineer has first to gather information, then to consider various solutions and finally to suggest what kind of system should be designed in order to satisfy users' needs. All these stages are depended upon the available recourses and the given technology. Efficient use of recourses is considered to be taken into account in each stage of the requirements engineering procedure.

Educational research – according to Travers (1969) - is "an activity directed toward the development of an organized body of scientific knowledge about the events with which educators are concerned". Its aim is to discover general principles or interpretations of behavior that can be used to explain, control and predict events in educational situations; that is to create scientific theory. Research methods refer to the general strategy followed in collecting, manipulating and analyzing the data necessary for answering a specific question in an area of study. In general, four categories are used for classifying educational research. These are: *experimental, ex post facto, descriptive and historical*. Users' participation in RE process is considered to be absolutely crucial for its success. Various theoretical models have been suggested in the area of RE (see Eman, et. al., 1996).

Management of Resourses

The degree expressing of how successful is an introducing procedure of a new information system in an educational setting (environment) is measured in terms of its usability, students and teachers satisfaction meeting learning objectives and cost incurred, not only in economic terms. Systems of course are developed and used taking into account the available resources, in the specific environment. The "scarcity" problem of recourses is considered to be one of the major issues to be taken into account and it consists of the so called "Project Manager's Dilemma" (Chatzoglou and Macaulay, 1995). Project Manager must develop the system in the domain of the available resources. The following three characteristics are considered vital and interrelated "components" in educational management: (1) *Development and maintaining quality in procedure and outcomes,* (2) *Use of available recourses effectively, and (3) Establishing a strategic plan and an implementation schedule for the operation of the organization (institution).*

Strategic planning is perhaps the most traditional view of how strategic decisions are made in organisations. The perspective indicates that strategy formulation is a distinctly intentional process involving a logical, rational, planned approach to the organisation and its environment. Further it implies that through the application of appropriate analytical and systematic techniques the "right" decision can be taken.

Information Systems in Education

Introducing a new information system in Education is a form of an organizational change. To overcome possible resistance and "inertia", to such change is useful to "activate" and involve the potential users in, as many stages of development and introduction of the new system, as possible. The RE processes involves many stakeholder groups: policy makers, managers, educators, psychologists, students, etc. Each of those have their own viewpoints representing a particular perspective. So, it is necessary each type of requirements to be expressed and each viewpoint to be related to the other (Mullery, 1996).

A very important question, to be taken into account, is to which extend a system, an organization or more generally an environment can restrict or guide the requirements process and hence the whole systems' development life cycle. Another important question refers on dissemination of Information Systems within an organization and how this fits users' needs.

Requirements Engineering Techniques in Defining Requirements for Information Systems in Education

Information Systems used in Education must take into account educational as well as technical aspects. Using educational information systems we must choose a balanced approach where: social, educational and technical aspects must participate in the "right mix", so that to meet the set requirement of the system in the prospect of having a positive summative evaluation.

For such applications requirements must take into account theories of learning and cognition, the education system infrastructure, aims and objectives to be met and cost - benefits analysis aspects. The definition of the properties that an educational information system should have in order to succeed is considered crucial for the development of its life-cycle and the consequent applications.

Epilogue

Requirements Engineering – as we have seen – is concerned with needs (in the area of their interest), either of the "customer" (e.g student) or/and of the designer trying to use the available recourses as efficiently as possible. As, Macaulay (1996) writes: ...."RE is concerned with gathering information and considering possible options, and with identifying what should be designed in order to meet some perceived future need. Current systems will never be quite adequate for the future situation that the change will bring". So, a "balanced interwoven mix" taking into account: I) information system technology, ii) care for good management of available resources, iii) Deep knowledge of education – as a content and procedure – is expected to contribute to successful operation of the "system" in our case the most efficient use of Information Systems in Education.

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Cooperative Interpretation of Technical Papers

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Support systems for learning through cooperative activities are becoming very popular, perhaps due to the growing need to form people with abilities to learn and work in group. In learning settings, it is more and more necessary to share the form with that others see the knowledge, be it to obtain new knowledge, be it to observe the limits of a particular vision. Besides that, the construction of the knowledge possesses a strong social component.

A process of cooperative interpretation of technical papers in educational contexts is focused. Such a process has as educational goal the development of argument ability, the improvement of the capacity of interpreting technical papers and the meaningful learning of a paper content. However, without the aid of a support software, this process is subject to loss or misunderstanding of information, as well as to problems related to social aspects of the cooperative work.

Application of Virtual Reality to the periodic table for chemistry education

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Abstract: We developed the VR program to be used to learn the periodic table in chemistry education. It is discussed how to develop the VR periodic table and what to learn through that. The VR program is developed using the 3D Webmaster program of Superscape. The students can receive the feedback according their action on the VR world. There are some chemical knowledge such as chemical elements, atomic radius, electron affinity, and ionization energy etc. The students could study interestedly and cooperatively the periodic table.

Introduction

As the computer is popularized in individual and society, it is using a many of area. In particular, there are many materials to learn a science knowledge using multimedia through computer. Many of them are web-based learning materials, which are developed by Java or Flash. Since the technology of the representation, storage, computation and communication in computer make progress, the environment of education is also developed.
Virtual Reality (VR) referred to 'immersive Virtual Reality.' In immersive VR, the user becomes fully immersed in an artificial, three-dimensional world that is completely generated by a computer (Steuer, 1992). It is also possible to define VR in terms of human experience, 'a real or simulated environment in which a perceiver experiences telepresence,' where telepresence can be described as the 'experience of presence in an environment by means of a communication medium.' (Riva, 1999). A key feature of VR is real-time interactivity, in that the computer is able to detect student input and instantaneously modify the virtual world (Seth 1999, Wylmarie, Robert 1999).
It is reported that using the VR simulation in chemistry education can increase student engagement in class, promote understanding of basic chemical principles, and augment laboratory experience (Christine 1996).
In this research, we develop the VR periodic table to grow up the attendance and interest of students in learning chemistry.

VR Periodic Table

The 3D models and objects are presented in the VR periodic table that is developed by 3D-Webmaster of Superscape, therefore the students easily recognize that. There are 4 push buttons on the left-down side in the screen (fig 1). Each of them is the electron affinity, ionization energy, atomic radius and reset. When the students push electron affinity button (fig 2), they can see the periodicity of electron affinity immediately. The knowledge of main elements is also displayed as pushing those elements in periodic table and the discoverer, character, structure are presented on the other frame.

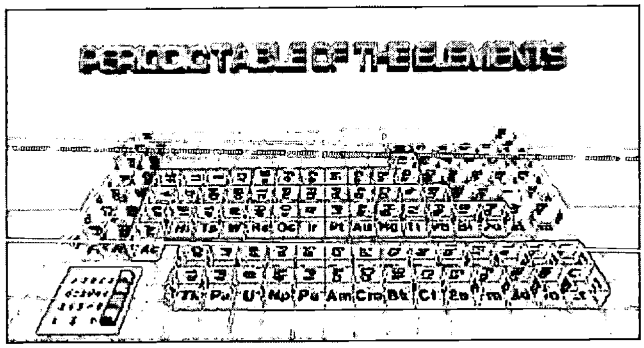

Figure 1. Opening screen

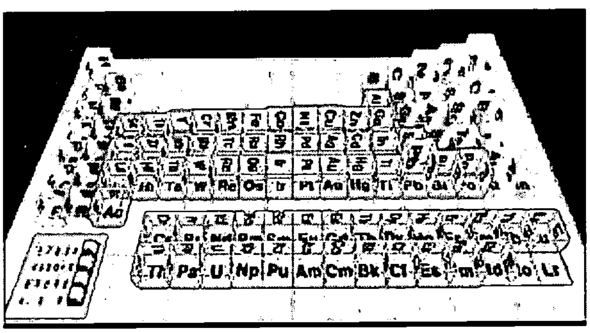

Figure 2. Periodicity of the electron affinity

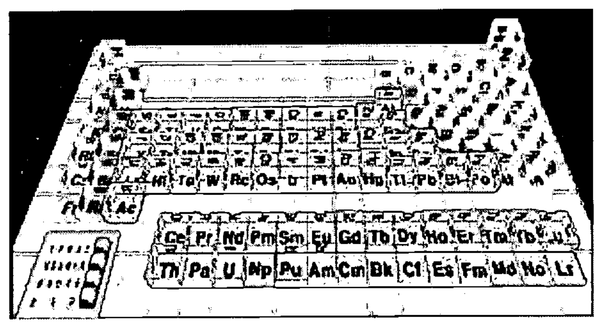

Figure 3. Periodicity of the ionization energy

What To Learn

Students in the level of middle or high school could learn chemical knowledge such as chemical elements, atomic radius, electron affinity, and ionization energy etc. through VR periodic table. Moreover, since the 3D models or objects are used in learning of chemical concepts, the students can feel the interest, and learn independently or cooperatively in learning situation.

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Coupling IP-videoconference with web-based learning environment

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RUBIS Videoconferencing module adds high-quality interactive real-time audio and video communication possibilities to TELSIpro, a multilingual web-based learning environment. User interface is simple and integrated to other RUBIS modules, so that the user can make a connection to another user or multipoint conference by simply clicking a link in TELSIpro. Videoconferencing and other tools can be used simultaneously without extra effort on controlling the videoconference.

Application of Cooperative Learning Environment in Developing Students' Environmental Decision-Making Skills

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Abstract: The aim of the present research was to study the role of the individual and shared mental models in the process of forming students' competent environmental decisions in synchronous CSCLE. An environmental role-play was carried out in the CVW learning environment with 12 groups of secondary school students. Their decision-making process was supported by additional web materials and a learning protocol. 27 science teachers conducted the formative evaluation of the teaching method and additional recourses. The content analysis of log-files and students' post-questionnaire were used to investigate the role of individual and shared types of the mental models in forming competent decisions. Two different patterns of making group decisions in synchronous CSCLE were observed. It appeared that the decisions that formed on the basis of the shared mental model during students' discussion were more competent than the summation of decisions.

Introduction

During the process of making environmental judgements the decision-maker has to consider scientific knowledge, the aspects of legislation and economy but also ethical and moral issues to make competent decisions (Zandbergen & Petersen, 1995). A large amount of low-structured information available from different sources and a lack of experience inhibit the decision-making process of novice decision-makers. Competency in making environmental judgements is affected by the limitation of short-term memory that the decision-maker is capable to use actively during the different phases of the decision-making process. According to the phases of decision-making (Huitt, 1992; Ratcliffe, 1996) the decision-maker will initially generate a mental model of the problem, which is an abstract body of organized information, constructed using knowledge activated from long-term memory (Barker & Scraik, 1999; Jonassen, 1995). Secondly, different sources of information should be evaluated and an alternative problem scheme should be generated and compared with the initial mental model. The decision-maker has to judge the alternative schemes and make the decision. This process is affected by limited memory space. The short-term memory is described as having storage capacity of seven plus or minus two chunks of information for a relatively brief duration (Tulving, 1970; Hewett, 1995).

The memory-space of an individual decision-maker can be enlarged supporting it with the shared memory-space that forms during the collaborative decision-making activity. Collaborative team can form a shared mental model that is an average correlation among team members about how much each person knows (Kraut et al., 1999). Relying on the team members' different mental models a bigger number of relevant alternatives can be generated from the initial information. The shared memory-space would also help individual decision-makers to keep information in the short-term memory by peers' approval or disapproval of arguments. Therefore, collaborative team can evaluate alternative solutions more effectively than individual members and make a competent decision in a shorter time.

As a prediction of the present work it was supposed that environmental decision-making skills could be effectively taught by active learning methods in the synchronous computer supported collaborative learning environment (CSCLE). During collaborative learning the process of formation of shared mental model is recorded in the log files that support the visual rehearsal of information. The decision-making process can be scaffolded with additional materials on web pages, collaborative document-generating tools and learning protocols.

The Study

The aim of the present research was to develop an effective method promoting students' environmental decision-making skills in synchronous CSCLE. According to our hypothesis an environmental role-play in virtual environment as a teaching method could be applicable. The method of role-play has to be supported by different kind of scaffolding: the instructional scaffolding (learning protocols for the tutor) and the information-embedded scaffolding (web-based materials guiding different roles). The role of the individual and shared mental models and the role of different aspects of information in the process of formation of competent environmental decisions were investigated.

The study was carried out in the CVW environment (http://cvw.sourceforge.net/) that is applicable in collaborative activities in a distributed meeting situation. During a role-play the groups of users worked together in the different rooms of environment discussing the problem and jointly editing decision documents. Their learning was supported by additional web-materials and a learning protocol following the phases of decision-making (Huitt, 1992) that had to guide the chat-facilitator in tutoring the process of making environmental judgements.

A pilot study for the formative evaluation of the role-play was conducted with 27 science teachers as a part of an advanced in-service course on the usage of information technology in science classes. During the hands-on workshop they had an opportunity to participate in the role-play in CVW environment. A post-questionnaire and a semi-structured group interview were used to get teachers' opinions about the method. Their activities during the role-play were analyzed on the basis of log-files.

The application of collaborative role-play in CVW for teaching and investigating the mechanism of environmental decision-making process was carried out with 12 different classes of secondary school students (10-25 in each group). To study the role of the individual and shared mental models in forming competent decisions the content analysis of log-files (the comparison of decisions made in the different phases of decision making process) and the students' post-questionnaires were used. The consideration of information about different aspects of the problem (scientific, ethical, juridical and economical) was studied.

The aim of the environmental role-play activity was to oppose the role-groups representing different environmental knowledge, attitudes and values and to initiate the discussion for generating ideas, evaluating alternatives and implementing solutions. Supposedly this kind of role-play had to lead to the more competent environmental decisions compared with the individual viewpoints. The scheme of the collaborative role-play consisted of the following phases:

i) Students were divided into four role-groups that met in different rooms of the CVW. According to the learning protocol, the tutor introduced the tasks to students. In each room there was a link to the brief survey of the problem. Next, each student had to generate a note of his initial decision (an initial mental model), which could be used as a rehearsal material during the decision-making process when short-term memory might be overloaded.

ii) In the next phase of the activity each group was acquainted with their role and worked together in the separate virtual rooms using supplementary web-material about one certain aspect of the problem. According to the role of each group a limited amount of additional information was offered for making the initial judgement, because only some aspects of the problem were important from a specific viewpoint of the role. It enhanced the decision-making process of the role-groups. During small group discussion the learners of the same role had a possibility to restructure additional information. An expert decision of this role was formulated on the basis of the shared mental model of the group. They followed the instructions of the tutor and jointly edited a decision-document. The documents created by the role-groups were stored in their rooms and were available for all the group-members.

iii) Subsequently, the members of different role-groups moved to the different expert-rooms to discuss their preliminary judgements as experts and to find controversial issues in their previous decisions. Using the documents generated in the role-rooms they discussed and evaluated the role decisions and made a final decision. The final documents were stored in the expert rooms.

iv) The evaluation phase of final decisions was jointly carried out in the conference-room, comparing and commenting on the final decisions of different expert-groups guided by the tutor.

Findings

The teachers' group interview and the post-questionnaires and the students' questionnaires exposed some factors that influenced the decision-making process in the synchronous CSCLE. The participants referred to the need to organize the leadership in teams and also difficulties in following the discussion while writing their opinions or creating the decision-document. The latter was one of the constraints that could have affected the teams' decision-making process.

The analysis of the log files allowed to investigate the influence of additional materials to the decision-making process. It appeared that groups followed role-descriptions, examined additional materials and the presented information was taken into account while making decisions.

The content analysis of the log-files according to the types of students' responses and the comparison of decisions in different steps of the role-play revealed two different patterns in making group decisions. Groups that concentrated on the discussion expressed a bigger number of arguments and decisions than the groups that organized their decision-making process plainly on comparing each other's decision-documents. Due to the discussion a shared mental model for solving the problem was constructed in the former groups and the team-members were capable of drawing the final conclusion according to the decisions that were supported most of all. Conversely the teams that used the pattern of comparing each other's decision-documents did not succeed in generating the shared mental model and forced their leader to make the final decision. Therefore, their group-decisions were strongly affected by the judgements supported by the leader.

These findings indicated the need to study the mechanisms that direct the teams in choosing one or another decision-making strategy to favor the pattern of discussion where a shared mental model is generated. During the discussion the team-members can develop wider and deeper mental models in shorter time than compared with an individual model. The decisions that formed on the basis of the shared mental model during the discussion were more competent than the summation of the individual decisions.

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Issues of the Online Program Planning Process

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Abstract: Educators who are responsible for the creation, management, and administration of educational programs are central to the planning process. Research suggests that program planning is not driven by theoretical constructs, but rather by the personal experiences and beliefs of individual planners. This study explores how individuals who plan online programs perceive their roles. Planners' perceptions of their work are important because their perceptions direct their activities, and their activities guide a rapidly expanding segment of educational programs which are impacting a growing learner population. In order to study the perceptions of a geographically diverse group of individuals, this study observed the exchanges of the participants in an international online forum, the Distance Education Online Symposium (DEOS) during a 30-day period in 2000. The 286 messages exchanged in DEOS during the study's period were analyzed using the Constant Comparative Method. This analysis produced an organizational scheme which grouped the respondents perceptions into four categories.

Introduction

Online education is still in its beginning stages, and research describing what those who design, develop, teach, and administer online programs actually do is only beginning to emerge in the literature. Therefore, it may be useful to draw upon theory from related fields. This study utilized theories from traditional adult education program planning and models of adoption to compare and describe the perceptions online educators have about their work. The framework developed may be used as a basis of comparison for other populations of online educators, as a way of thinking about the professional development needs of those who work with online programs, and as a basis for future research.

A Review of the Literature

A number of authors in the field of adult education program planning argue that the actions of individuals who plan programs are guided not by theoretical models, but rather by their personal skills, interests, experience, and educational philosophy (Brookfiled, 1986; Cervero, 1991; Darkenwald, 1982; Wilson, 1995). In the absence of research-based models of online program planning or evidence to suggest those who plan online programs work from theoretical constructs, this study begins with the assumption that the actions of online program planners are guided by the planner's personal framework. Therefore, an investigation of planners' activities through examining planners' perceptions about their role and the work they perform is necessary.

While research from the field of adult education program planning suggests that investigation into the actual practice of online program planning needs to begin by examining the perceptions planners have about their work, models describing adoption of innovations provide a foundation for comparing the results of this study. While there are several models describing the adoption process (such as the Paradoxical Disjunction Model (Cravener, 1999); the Model of Diffusion (Dooley, 1995); the Concerns-Based Adoption Model (Hall, Wallace, and Dossett, 1973) and (Hord, Rutherford, Huling-Austin, and Hall, 1987); and the Technology Acceptance Model (Wolski and Jackson, 1999)), most adoption models have their roots in Rogers (1962, 1965), work on adoption theory.

Roger's (1962) classic work on diffusion theory argues that adoption of an innovation is distributed along a normal, bell-shaped curve if plotted over time on a frequency basis. The first group to adopt an innovation is the "innovators," and they are followed closely by the "early adopters". The next group is the "early majority," which is followed by the "late majority". Finally, the "laggards" are the last group to adopt an innovation (for a variety of reasons). The innovator group --those who are first to adopt a new technology --are described as intrinsically motivated, self-taught, experimenters (Wertheimer and Zinga, 1997), who are comfortable with change, and attracted to challenges and risks (Hadley and Sheingold, 1993). When all or most of the members of the innovator category (those first to adopt a new technology) have adopted the innovation, it is referred to as the saturation point; and Geoghegan (1994) suggests that the saturation has been reached for innovators of instructional technology.

Building on Rogers (1962) work is Hord, Rutherford, Huling-Austin, and Hall's (1987) Concerns-Based Adoption Model (CBAM). When confronted with a new challenge, technology, or process, CBAM argues that individuals undergoing change are focused on their own awareness (of the issue/need), desire for information, and personal concerns. That is, people undergoing change are going to be more concerned about gaining information about how the change will impact them personally. Once individuals have gained some experience with the innovation, they move away from the intense need for information and into stages focused on consequence, collaboration, and refocusing. How an individual perceives the innovation will determine how quickly the individual moves from initial inquiry to adoption.

Theories of program planning and adoption of innovations intersect at their mutual focus on the individual's personal perspective. How individuals perceive their program planning process has a direct impact on the resulting program. As program planners adopt the innovation of online technology, how they perceive these innovations influence their rate of adoption. As such, the design of this study focused on the perceptions of individuals responsible for planning online education programs in order to develop a framework to guide future inquiry. This design is briefly described in the following section.

Research Design

Two main issues shaped the design of this study. First, if one accepts the premise that program planners' actions are guided not by theoretical models but rather by their personal framework, then one should examine the actual practice of planners in order to discover the issues planners attend to. Second, as this study is concerned more with planners and less with the actual tasks of the planning process, one needs an unvarnished view of how planners perceive their work. Contributing to these issues is Rogers' (1995) position that innovators tend not to cluster around geographic centers but rather around others with similar interests. Therefore, an online community of practitioners was selected as the population for this study. Observation of an online group allowed the data to be collected without the respondents being influenced by the presence of a researcher, or what Goetz called the "Observer Effect" (1984). The population selected for this study was the participants of the Distance Education Online Symposium (DEOS), created in 1991 by Pennsylvania State University.

Data were collected during January 2000 and were analyzed using the Constant Comparative Method (CCM). As first described by Glaser (1967), CCM was applied in a rhythmic fashion which produced four themes or categories. These categories describe the issues the DEOS participants raised during the time period the study was conducted. These themes were compared to adoption models to produce an organizational scheme that describes the issues the members of DEOS addressed during January 2000. While the results of this study should not be generalized and applied to other populations or circumstances, they can serve as a basis of comparison for future research. A brief description of the findings as well as a discussion of how they relate to adoption models is addressed in the following section.

Findings and Discussion

The analysis of the data produced an organizational scheme which grouped respondents' perceptions into four themes. Those groupings are: Comparison (between the online environment and the traditional classroom), Impact (of the online environment on the individual planner), Application (of the online environment to the individual planner's discipline), and Improvement (how the planner can improve his/her discipline using online technology).

Comparison

The comparison theme is reflected in DEOS members' messages which center on comparing familiar concepts and elements to the online environment. Data corresponding to this theme describe the online environment by comparing it to the traditional classroom, learners, and process. This is the largest theme, accounting for 34.8% of the entire dataset.

Building on Rogers' (1962) work is Hord, et al's (1987) Concerns-Based Adoption Model (CBAM), which argues that individuals will begin the adoption process by first becoming aware of alternatives and then gathering information about alternatives when confronted with a new challenge, technology, or process. This initial questioning stage is consistent with the theme of comparison in that the individual confronting a change will usually begin by gathering information --in this case, by comparing the online environment to a known environment. While the design of this study sought only to categorize the DEOS participants' responses, comparing adoption models to these findings suggests this may be the first phase program planners would move through as they move their practice to an online environment.

Impact

Messages in this theme reflect a concern the respondent had about how the topic (of the message) would impact them on a personal level. This theme is the second-largest one, comprising 26.1% of the total dataset. While the messages in this theme address a range of topics, many of them reflect the respondent's concern about the time involved, or required by, the topic of discussion. In other words, the messages in this theme reflect the respondents addressing how the topic of discussion would impact them personally by focusing on how much time was required to engage in a particular task.

The theme of how the online environment impacts the program planner personally is tied to Rogers' (1995) work on diffusion models, and is not unusual when one sees this process through the lens of the program planner moving their practice into a new environment. Cravener (1999) explains this behavior, in part, through the Paradoxical Disjunction Model: "Paradoxically, the faculty rarely are interested in new technologies to support teaching and learning. The faculty are predominantly focused on psychosocial factors: personal affective issues and their need to meet institutional requirements for tenure" (p. 1). This idea can be seen in the respondents' discussion of how the online environment impacts them as individuals.

Application

This theme is reflected in messages that explore the application of online programming in an individual's professional practice. In other words, messages in this theme address the question, "How can I apply (the message topic) to my own practice?" Messages in this theme address a broad range of issues from topics dealing with organizational concerns to topics of professional development of an individual.

The application theme illustrates the environmental context --from the broadest organizational perspective, to the more narrow personal perspective, that shapes a program planner's activities. Fullan (1991) describes the process of incorporating educational technology into practice as complex and multidimensional. Fullan writes that this sort of change requires the use of new or revised materials (curriculum, resources), the possibility of having to use new approaches to teaching (teaching strategies, approaches), and the possible alteration of beliefs (pedagogical assumptions and theories and underlying methods). These types of changes cut across the organizational environment and the individual's personal beliefs and past experience. The theme of application is seen again in the Concerns-Based Adoption Model (CBAM). Hord et al. (1987), showed that as individuals gain experience with an innovation, they move away from an intense need for information and into stages of consequence, collaboration, and refocusing. Individuals in these stages are focused on integrating the innovation into their personal practice. As individuals develop sufficient mastery of the innovation, they begin to expand their vision to address issues of improving their larger field of practice, which is reflected in the final theme of improvement.

Improvement

This theme is reflected in messages that explore how to expand or improve distance education as a discipline. Much of the discussion in this theme addressed broad issues, such as industry trends, purpose of distance education, and organizational change. Once program planners have successfully integrated online programming into their practice, they began to consider the larger context of their field. This need to share ideas and connect to a larger context is explained, in part, by Schein (1992), who writes:

> Once we have developed an integrated set of such assumptions, which might be called a thought world or mental map, we will be maximally comfortable with others who share the same set of assumptions and very uncomfortable and vulnerable in situations where different assumptions operate because we will not understand what is going on. (pgs. 22-23)

In other words, we are more comfortable with those who share our ideas and beliefs. Program planners who have integrated online programming into their practice will likely seek out these others by gravitating to groups who hold similar beliefs or work to educate their existing reference group.

Recommendations

Because the purpose of the study was to identify planners' perceptions of their work, it did not test for relationships between the four themes of the organizational scheme. As such, future research should investigate not only the validity of the organizational scheme but the relationship between the themes as well. A comparison of this study's findings with literature on models of innovation adoption suggests that online program planners may progress through the four themes as their practice evolves—a hypothesis for which there is little evidence to affirm or deny.

Additionally, a review of the literature related to planning adult education programs suggests the environment in which a program is created has a great deal of influence over its design and conduct. The concept of situated cognition states that learning is not just influenced by the environment but that learning is in fact shaped and defined by the context in which it occurs. Brown, Collins, and Duguid (1989) wrote that the learning situation "co-produces" knowledge, meaning that what is learned can not be neatly dissected from the context in which it was learned and how that knowledge is applied (1989, p. 32). The impact of the environment is similarly addressed in discussions of the planning process. Wilson and Cervero (1996) address the influence of the politics of power in the planning environment writing: "Any account of program planning must address both power and responsibility in order to be of any practical help in the every day world" (p. 9). Pennington and Green's (1976) comparative analysis of 52 continuing education program planners found that the planner's perspective and the environment in which they work had a much greater influence on the program produced than any theoretical construct. "Planning continuing professional education programs is a highly individualistic activity as the planner moves through the development process," they write. "The decisions planners make to keep the program development process moving involve consideration of the environment in which they are operating, internal and external constraints and resources, and the possible outcome of any decisions" (p. 23). A review of adult education literature regarding the influence of the environment on the planning process suggests there is an interaction between a planner's perception and the planing environment. However, as with a comparison to adoption models, there is no evidence to support or reject this hypothesis; thus further research needs to investigate the possibility of a connection between a planner's perception and their environment.

This study began from the premise that discussions of online learning typically focus more on the learners and their experiences and less on the educators who create and work with the programs. As such, this study took the position that educators' issues are the ones that have broader impact and greater implications. This is not to suggest that questions related to online learning are not important –they are critical. However, it was well beyond the scope of this study to consider the entire dynamic of the educator and online learner. Considering which part of the educator-learner dynamic to address, one part of the equation has to be considered first. Obviously, additional research needs to address the perceptions online learners have of their experience and how their perceptions influence their performance.

This study represents only one small step towards understanding the process of creating online programs. As the number of online programs grows, it becomes increasingly important to understand the process of creating, implementing, and administering these programs. How educators perceive their roles as online program planners is critical, as they are creating an ever-expanding number of online programs which are influencing a growing group of learners. Understanding more about the education process is critical because education changes people's lives.

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FAIRWIS Usage for Virtual Learning in Student Micro Enterprises

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Abstract: Laboratory micro enterprises of students are running in thc Young Enterprise Europe educational program. This brief paper discusses how the results of the on-going FAIRWIS project can be used to improve the efficiency of these lab-enterprises and better accomplish their educational objectives. An example usage scenario of a student virtual fair and the architecture of the 3D information visualization module of FAIRWIS are introduced.

Web-based learning by doing for micro enterprises

A critical success factor for an industrialized country is to teach students the complexity of the economical world, by introducing them to entrepreneurial activities, hence to develop the future generation of managers. IGstudents Foundation (IGF) is the Italian member of Young Enterprise Europe (YEE), the organization that promotes managerial education in 19 European countries with over 600,000 participating students every year (see www.igstudents.it and www.young-enterprise-europe.com). IGF considers the enterprise as a means to improve the co-operation between educational and working environments, and to promote professional experiences to increase business know-how of young students. This mission is carried out through the creation and management of "laboratory" enterprises of students running in a protected environment, according to the "learning by doing" method. A lab-enterprise operates for a single year, develops (new or traditional) products/services, and grows within the global market, identifying actual development perspectives, internal management control systems and efficient communication techniques. Students manage their lab-enterprises in a realistic fashion: nominate a Board of Directors, study strategies to locate new markets and to sell products, keep books, draw up financial statements, and even pay taxes to IGF. Lab-enterprises are exhibitors in trade fairs and participate to competitions, these events allow the products promotion, and students compare themselves with other enterprises. The most important events are National Competitions, among winner labs selected in Local Competitions, national winners attend a European Competition. Several fairs are planned this year, located in dedicated areas of commercial centers, during these events the students show and sell products to visitors, that visit their stands mainly because are in the commercial center. Due to the increasing number of lab-enterprises this learning by doing approach is going to become very expensive and difficult to be implemented. This suggests a larger usage of ICT and Web-based educational modules (Pauselli, D'Atri, 2001). Preliminary experiences were specialized web sites and training sessions by videoconferencing systems. A second step, that is now under investigation, is the usage of virtual trade fair environments for remote training of IGF students in an interactive, synchronous and real time way.

Virtual trade fair environments for student training

FAIRWIS, an acronym for Trade Fair Web-based Information Services, is an on-going European research project (www.fairwis.net) that is developing a system to support real trade fair events and to promote virtual ones, by offering on-line services to organizers as well as a very large number of (local or remote) exhibitors and visitors. FAIRWIS services can be used for student virtual fairs, thus improving the efficiency of lab-enterprises by means of an integrated (virtual and real) exhibition marketplace (D'Atri, Pauselli, 2001). In fact an exhibitor of a student fair could virtually attend a related national real fair event, by showing products and services via a kiosk located in this venue, which simultaneously runs several remote student exhibitions. These virtual exhibitions could also be available on the Web, and be visible everywhere in the world, for longer period with respect to the student events. The visit to major national and international real trade fair events will also be possible. Hence, these fairs will be learning and meeting opportunities and could evolve into stronger and effective relationships. In fact, a student may act both as visitor and as exhibitor, and can strongly increase and improve business contacts and knowledge about new related products/services. One of the main differences between FAIRWIS and similar services currently available on Web sites is that the latter have static data that it are difficult to update and to put on line in an appropriate format. FAIRWIS has a real time connection with an underlying database to guarantee coherence of data and up-to-date status. The presence of the database also give the possibilities to IGF students of easily generating new examples of Web fairs, by modifying the database contents and customizing a few data in the overall system, whose user interface is then automatically generated. However, presenting data on the Web in an understandable way requires a lot of work when they change dynamically, in particular it is difficult to modify the graphical layout without disorienting the users. An innovative feature of FAIRWIS refers to the generation of 2D/3D visualizations that are exploited to facilitate human-computer interaction. In the following we briefly illustrate the module that generates a database-driven 3D visualization environment based on VRML (ISO/IEC, 1997) and a RDBMS. The concepts that can define a formal basis for the implementation of such an architectural framework and its components are described in detail in (FAIRWIS, 2001).

Example scenario

Let us suppose users want to browse through a visually rich 3D virtual trade fair environment (compare to virtual gallery environment as described in Muller et Al., 1999) filled with, from their subjective point of view, more or less interesting stalls of various exhibitors. They want to look for a product or just review information about some exhibitors. They enter the system, and through an appropriate interface, provide the "search criteria" to the system for locating exhibitors and/or products. A 3D visually interactive presentation of a trade fair hall is then generated in an area of the screen. The selection of the exhibitors is based on the users' search criteria. In the displayed architectural topology of the trade fair, grounds and buildings are structured hierarchically and are therefore easy to navigate by selecting areas related to the different exhibitors, business sectors, and product categories. As the users move around in this virtual trade fair environment, they orient themselves with the help of so called "landmarks" and "signposts" inside the 3D environment. After a short spatial navigation, a trade hall entrance is reached. A label describes that the exhibitors located in this hall match a couple of search criteria defined earlier in the form based query construction dialogue by the user (e.g., a certain exhibitor and his products). Through the entrance, users proceed in the hall that contains only the exhibitors expected in this section of the trade fair. As the users navigate into the hall, they take their time to study the exhibitors positioned along the alleys of the trade fair hall. By clicking on one of the exhibitor stalls in the 3D environment, all information about the exhibitors stored in the database is displayed on a separate area of the screen together with a more detailed high-quality image of products and further meta-information like, e.g., pricing and sales conditions.

Architectural model for a database driven 3D visualization environment

The application aspects and the users' experience described above demand a set of different interactive information visualization functions to be supported by an overall technical architecture.

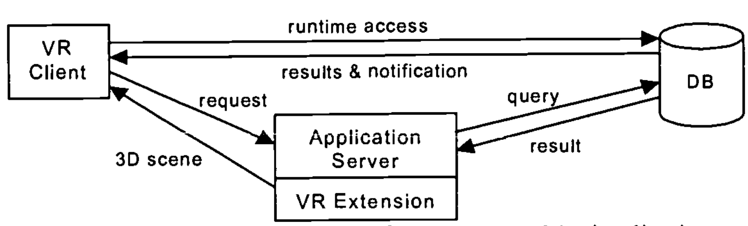

Figure 1. The general architectural model of a data driven 3D visualization application

As shown in the figure (Fig. n 1) the general architectural model of the Virtual Reality (VR) visualization of the virtual trade fair consists of a browsing client, an application server, and a persistent storage system supporting the information object database. Since the communication between the components (depicted by arrows) can potentially take place over a networked connection, the single components can be arbitrarily assigned to hardware platforms. The left side of the diagram displays the users' VR-capable browsing client. After entering the application, the VR client displays the user interface with all its components like, for example, a form-based user interface component, which can be used to enter search criteria describing the users' request. When an information request is submitted to the application server, the server recognizes that an appropriate 3D scene has to be delivered back to the client. In order to produce the actual data that matches the users' request, the server translates user requests into a query to the database. The database system processes the query and returns the result. Now, the application server can use the retrieved data to construct the 3D scene with the help of some special server extension. The 3D scene is then sent to the VR browsing client and displayed properly. As the dynamically constructed 3D scene is interactively browsed (Hemmje, 1999), users can interact with certain objects of the surrounding environment, which, in turn, may need to get additional data from the database storage mechanism. If, for example, the user enters an area in which the data about exhibited products have not been incorporated yet, they have to be retrieved, downloaded, and integrated into the scene via the client runtime access mechanism. Furthermore, as soon as any data manipulation action is performed on the database storage mechanism, which effects the data visualized in the running 3D scene, an immediate notification of the client has to be performed to which the clients 3D environment can, in turn, react. The runtime communication and notification mechanisms do not necessarily have to go directly from the client system to the storage system. It is possible (and in many cases appropriate) to handle the communication through an additional middleware layer. The technical details of the system implementation are described in (FAIRWIS Consortium Deliverable2, 2001).

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An Architecture of an Electronic Education Market Using XML-Standards

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Abstract: In this paper, we describe the conceptual architecture of an Electronic Education Market based on XML standard specifications for business processes and educational processes. This architecture supports the interoperability and portability of processes for educational companies and institutions, acting on the global marketplace of the WWW. The architecture is divided in two levels: Level 1 covers general trading transactions, whereas Level 2 covers specific educational transactions. We show how development and learning processes are supported, increasing the productivity of actors in educational processes.

Electronic Markets for Education

The *Electronic Education Market (EEM)* describes the interorganizational information systems for educational purposes (see Hämäläinen, Whinston, & Vishik, 1996). Business transactions and educational processes are supported on different levels. On the one hand, trading processes for educational resources are supported. This includes the trade of educational products and services, such as courses, trainings, or information services. On the other hand, the design and development of educational materials are supported. The term *Educational Mall* is used synonymously to EEM.

An Architecture for Electronic Education Markets

In this section, we describe the architecture for an Electronic Education Market on two levels. First of all, we describe the use of general E-Commerce standards for the trade of products and services. These standards support general trade transactions, such as procurement, shipping, or billing. These trade functions can be used by E-Markets in general and were not specifically designed for educational purposes. Secondly, we show how educational transactions are supported. Examples of specific educational transactions are: concurrent design of educational resources, course retrieval, or handling of virtual courses.

EEM Architecture: Trade transactions

E-Markets in general cover both, the requirements of suppliers and their customer. Our example focuses on the negotiations between customer and supplier. These negotiations include the payment, terms of delivery, and product specifications. E-Markets add a different aspect to the traditional concepts as they have to incorporate the demands of Internet services. Especially the identification of trading partners and the security of Internet payment need more attention due to the anonymity of the medium Internet. Figure 1 shows a Use Case diagram with the processes involved in Level 1 of the architecture. This document focuses on the negotiations of payment and services between Educational Malls, its suppliers, and its customers. The main processes, exchanging data through standardized XML-documents, are registration, catalog handling, negotiations, ordering, and payment. Those transactions are performed using Electronic Business XML (ebXML), Electronic Commerce Modelling Language (ECML), and eCatalog XML (eCX) for the implementation of this layer. For further information see (EbXML, 2001, ECML, 1999).

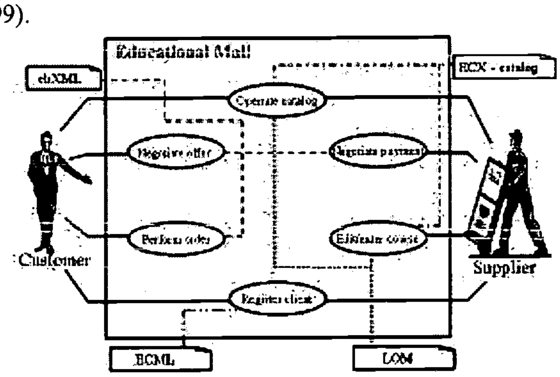

Figure 1: Trading processes for an Electronic Education Market (Level 1)

EEM Architecture: Educational transactions

The second level (Level 2) of our architecture covers educational transactions. For developers, teachers, and learners the interoperability of learning environments and learning management systems is a critical success factor in the future. The trading processes are covered by level 1 of our architecture, on level 2 the following transactions are supported by the following standards:

Learning Object Metadata (LOM) is a standard by the IEEE Learning Technology Standardization Committee (LTSC) to describe computer supported learning resources, such as courses, tools, multimedia objects (IEEE LTSC, 2001). *Computer Managed Instruction (CMI)* supports the interoperability of learning management systems. Different course types are administrated, steered, and used by a central system. In our case, the administration is performed by a system provided by the EEM. The standard *Public and Private Information for Learners (PAPI)* contains information about actors in educational processes, such as personal data, user characteristics, or performance information. In our architecture, the learner model is controlled by the user who authorizes the use by the EEM and other systems. *Content Packaging* provides methods for the description, implementation and packaging of learning materials used independently of authoring system, platform, or system. *Question and Test Interoperability (QTI)* is a format for description , implementation, and transfer of performance monitoring of the learner (see IMS, 2001). The *Enterprise* specification provides an exchange format between learning systems and other information systems, such as HR systems. Finally, a *Quality Standard* defines the management and operative procedures in order to ensure the quality of learning systems used in the EEM. In our system, we use a standard based on ISO 9000:2000. The use of those standards for both, development and learning processes, is summarized in Figure 2.

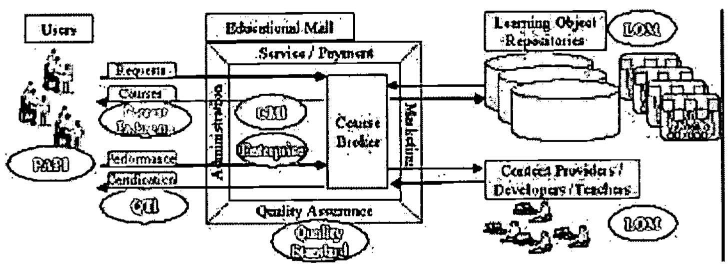

Figure 2: Educational processes for an Electronic Education Market (Level 2)

Summary

In this paper, we presented an architecture of an Electronic Education Mall using XML-bindings of standard specifications. Our approach allows the integration of business functions by using standardized XML formats for data exchange between participating systems. This approach enables participants to significantly reduce transaction cost by the integration of their systems. For further information about this approach see (Pawlowski, Adelsberger, 2001).

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Developing More Effective Access to Higher Education for People With Disabilities:
A Case Study in the Design of Accessible Online Courseware

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Abstract: Universities are under increasing pressure to recognise the rights to effective access of people with disabilities. The use of web based courses and resources presents an opportunity to broaden participation by offering flexible learning and independence, but also presents an additional challenge for the course developer when designing programs and developing courses. This paper discusses an evaluation of an online learning environment (WebCT) in practice at the University of New South Wales. Issues considered included compatibility with assistive technologies; structure, presentation and organisation of content and navigational elements; and the provision of alternative information for people with sensory, cognitive or physical disabilities. The results show that many barriers to accessibility can be overcome through the employment of learner centred design principles, and by taking advantage of the features provided by the learning environment. This paper will discuss the results of the evaluation, issues raised and potential solutions.

Introduction

In an atmosphere of growing demand for flexible provision to meet the educational needs of an increasingly diverse population, technology is now widely used in the provision of courses and resources. Online Learning Environments (OLEs) present the opportunity to exploit technology to create educational materials which are flexible, informative and accessible to individuals who may not otherwise be able to participate in Higher Education.

Institutions worldwide are adopting tools to enable academics themselves, rather than specialist technologists to develop courseware for use online. It is essential to encourage and empower academics to produce courseware which is accessible pedagogically, structurally and to users of adaptive technologies. The rationale for this project is to present a case study of best practice in the development of online courseware, which is accessible to people with a wide range of special needs. The particular package on which the study is based is WebCT.

Evaluation Methodology

To identify the issues and possible problems, an evaluation was carried out, with the consent of the designers concerned, of WebCT courses developed at UNSW. The process took a combined approach based upon:

- Extensive analysis by the researcher (Elaine Pearson) of WebCT courses at UNSW
- Discussion with and survey of WebCT Designers

- Interviews with students and practical evaluation by students of the accessibility of courses using Assistive technologies

The evaluation was based on the guidelines provided by W3C "Web Content Accessibility Guidelines 1.0" and analysis of the courses using the Bobby (http://www.cast.org/bobby/) validation tool. In addition, evaluation of a learning environment which takes account of the requirements of those with sensory and learning disabilities requires analysis of the structure, presentation, content and navigational aspects. For this the principles of learner centred courseware design were employed. A model of courseware design that combines content design, navigational design and visual design, and is informed at all stages by the learner model (Pearson and Green , 1999) is the one on which this evaluation is based.

Evaluation Results

The results of the evaluation can be divided into generic issues relating to the design of the courseware and issues relating specifically to the WebCT learning environment itself. The major problems encountered in courseware design included inconsistent and inappropriate use of icons or graphics; no text equivalents for graphics, figures or other illustrations; poor organisation of content which was originally intended for face to face delivery; the widespread use of PDF and other read only file formats for the presentation of text documents; text, abbreviations and unusual characters may not be correctly or accurately interpreted by screen reading software ; the inappropriate use of tables; poor interface design and poor use of colours.

Whilst it is WebCT's stated aim to be compliant with the W3C accessibility guidelines, some problems remain. There does not appear to be a text equivalent for some icons, headers and titles; the inappropriate use of tables; the overuse of frames; and the use of Applets and Java for the implementation of some of the interactive elements of WebCT, including chat windows, discussion groups and email.

Conclusion

The increasing use of the Web for teaching and learning provides an opportunity for inclusion of people with disabilities who may otherwise be prevented from full participation. However, it is important for developers of online courses to be aware of the difficulties that people with disabilities may face within such an environment. The danger is that the technologies designed to increase flexibility and participation could become a barrier in themselves. The adoption by UNSW of WebCT for the development of online courses has facilitated an analysis of accessibility problems within an active academic community and the development of a practical strategy for the design and development of online courses.

A blueprint for the design of accessible courseware has been produced that will enable academics developing online courses in WebCT to take account of the needs of students with particular needs. This in itself will result in learner centred courseware that is more accessible and more effective for all students. The move to online learning prompts academics to reconsider teaching and learning practices for all students, and although one cannot expect to meet the needs of all learners at all times, reasonable steps can be taken to ensure inclusive practice.

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Technology at the Cutting Edge: A Large Scale Evaluation of the Effectiveness of Educational Resources

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Abstract: The perceived effectiveness of traditional and computer-based educational resources, within the context of a single course in first year biology, was investigated within an action-research paradigm. The study examined the dynamic state of perceptions towards these resources by the major stakeholders involved (students, teaching staff and technical staff). A major focus of the research was the extent to which the computer-based resources were utilised, and the students' perceptions of the usefulness of these resources to their learning. The majority of students found the resources to be of use for their learning but some did not use them at all, even though they had access to the Internet, suggesting that the provision of on-line resources will not necessarily generate value-added learning.

Introduction

At The University of Sydney courses are still campus-based and students attend lectures and laboratory sessions in most weeks of the semester. In first year biology the development of educational multimedia to address the diversity of student characteristics, the ethnic/cultural sensitivities to animal dissections and specific learning difficulties has led to a focus on the use of computers in the learning process. This in turn has led to the development of an on-line virtual learning environment (http://fybio.bio.usyd.edu.au/vle/L1/) enabling the students to access our resources any where/any time. The development of this resource is discussed in Peat, (2000). The current study examined one of the first year courses, Human Biology, which integrates a range of computer-based learning modules, on-line materials and communications strategies with more traditional learning resources such as lectures and practical sessions, designed to cater for a variety of learning styles. The purpose of this study was to provide both a reflective and analytical assessment of a broad range of learning resources integrated through web-based technology and determine their impact on student learning. A major focus of the evaluation was the extent to which the computer-based resources (educational multimedia and information technologies) made available to the students were utilised and the students' perception of their usefulness to their learning. To achieve this, an action research model was implemented with all stakeholders contributing to the collection of data to enable assessment of the learning environment from all perspectives.

Methodology

The research model adopted the Eclectic-Mixed-Methods-Pragmatic Paradigm (Phillips, *et al.*, 2000) considered more capable of handling the complexity of modern society and technology with a focus on practical problems rather that on issues, whilst acknowledging the weakness of current evaluation tools. The overall study was based on the dynamic state of the perceptions of the major stakeholders involved in the course, whilst this paper focuses on the students' perceptions of their use of educational multimedia and communications technologies within an integrated curriculum. The stakeholders included students (n=up to 800), lecturers (n=5), laboratory teaching staff (n=20), technical staff (n=3), and courseware developers (n=2). The target population of students is typically recent high school leavers enrolled in science-based degree programs. The student body has become increasingly diverse over the years, with respect to culture, academic achievements, literacy and science backgrounds as well as extra-curricular activities such as paid employment. The overall data collections involved all stakeholders and data were collected at four separate intervals, using surveys, interviews and/or focus groups. Data from the preceding survey were used to design the subsequent instruments.

Results and Discussion

The results to be described in the conference presentation will focus on the major factors emerging from the research process and examine each of the following aspects:

- student use and perceptions of the Internet, access to on-line materials and views of communications technologies;
- student perceptions about using on-line tutorials in general; and
- student use (specifically) of virtual dissections versus real dissections.

Nearly all students in this course (99.5%) have access to a computer, with 98.5% of all students indicating access to the Internet (84% access at home), however there appears to be competition within the home for access to the Internet line (36.5% of students indicating competition from siblings or parents). Whilst general access to computers and the Internet is good, there is some concern within the student body about access to the biology resources for this course on the Internet due to technological reasons. It appears we can provide the resources but we need to be careful that we match them with student technological abilities and experiences.

The data show that 20% (200 in the cohort) of the students are not using the Internet as a resource for this course but of those that do use it 55% indicate it is useful but not extremely useful. The overall student use of email was high, with 97% of all students surveyed indicating some use (mostly non-course related), however only 10% of the entire cohort found email useful in supporting student learning in this course. Only 75% of students made use of the computer-based tutorials provided to support their learning, but the majority (91%) of those students that did use the materials found them useful. This reinforces the idea that within the student cohort there is a variety of learning styles, which require the provision of a diverse range of learning resources, both on-line and off-line. Oliver & Omari (2001) reported a similar lack of uptake of web-based teaching with 20% of students not comfortable with using the web as their learning environment. The reason for this lack of uptake needs to be investigated before putting a large proportion of teaching and learning resources on the web. From a curriculum development viewpoint it was important to gain an understanding on the relative usefulness of animal dissections and virtual dissections to student learning outcomes which would help inform the debate about the replacement of animal cadavers in student laboratories. Many of the students remarked on the usefulness of both the cadaver and the virtual dissection, indicating that the former was probably more useful for understanding structure and the latter for function, illustrating how different media can be used for different inputs/outcomes. The data, however, indicate that there is little difference between the two types of instruction.

Initial data from this study indicate that there are students who embrace educational multimedia and information and communications technologies and who will find these learning experiences valuable. However, there remains the issue that some students do not find them useful and this reinforces the need to offer a variety of materials on offer. It reminds us that we cannot use on-line as a replacement but we can use it effectively in the teaching program. It is important to remember that the student body requires a variety of learning experiences that not only include the new technologies in teaching and learning but also the more traditional resources. The outcomes reinforce the need to offer a variety of learning experiences that target different learning styles and enable a mix of off-campus and on-campus opportunities.

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TELEADAPT-SOCINF: Continuous training for SMEs employers and employees in Catilla y Leon and Berlin

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TELEADAPT-SOCINF was an ADAPT project starting in January 1999 and finishing in October 2000, and co-funded by the European Social Fund, the regional government of Castilla y León and the Centre for the Telecommunication Development in Castilla y León (CEDETEL). In this project CEDETEL collaborated with the Institut für Technische Weiterbildung (ITW) and the Fachhochschule für Technik und Wirtschaft (FHTW).

The objective was to offer continuous training to the Small and Medium Sized Enterprises in the areas of Castilla y León in Spain and Berlin in Germany.

For this purpose we implemented a virtual learning space and several CDROM-supported hypermedias. The interdisciplinary group that worked in this project included technology experts, graphical designers, pedagogues, etc.

During nearly four months we run different groups of students, which gave us the opportunity to evaluate the materials and the telelearning experience itself. Most of the participants appreciated the advantages of this new methodology.

HURAA: An Interactive Web-Based Agent That Optimizes Information Retrieval in a Multi-media Environment

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Abstract: The Computational Discourse Technologies Group is developing the Human Use Regulatory Affairs Advisor (HURAA). HURAA is a web-based information delivery and retrieval system that includes an animated agent that guides the user through six distinct learning trajectories. HURAA exhibits different patterns of interactions depending upon the trajectory the user selects. The knowledge base of the HURAA includes various documents on Institutional Review Boards taken from federal, civilian, and military sources. After a brief introduction and overview of the system, the six learning trajectories are described. The learning trajectories are as follows: (1) Historical Overview, (2) Lessons, (3) Explore Issues, (4) Explore Cases, (5) Making a Decision, and (6) Query Documents. Additional sections of the paper describe the other major components in the HURAA system.

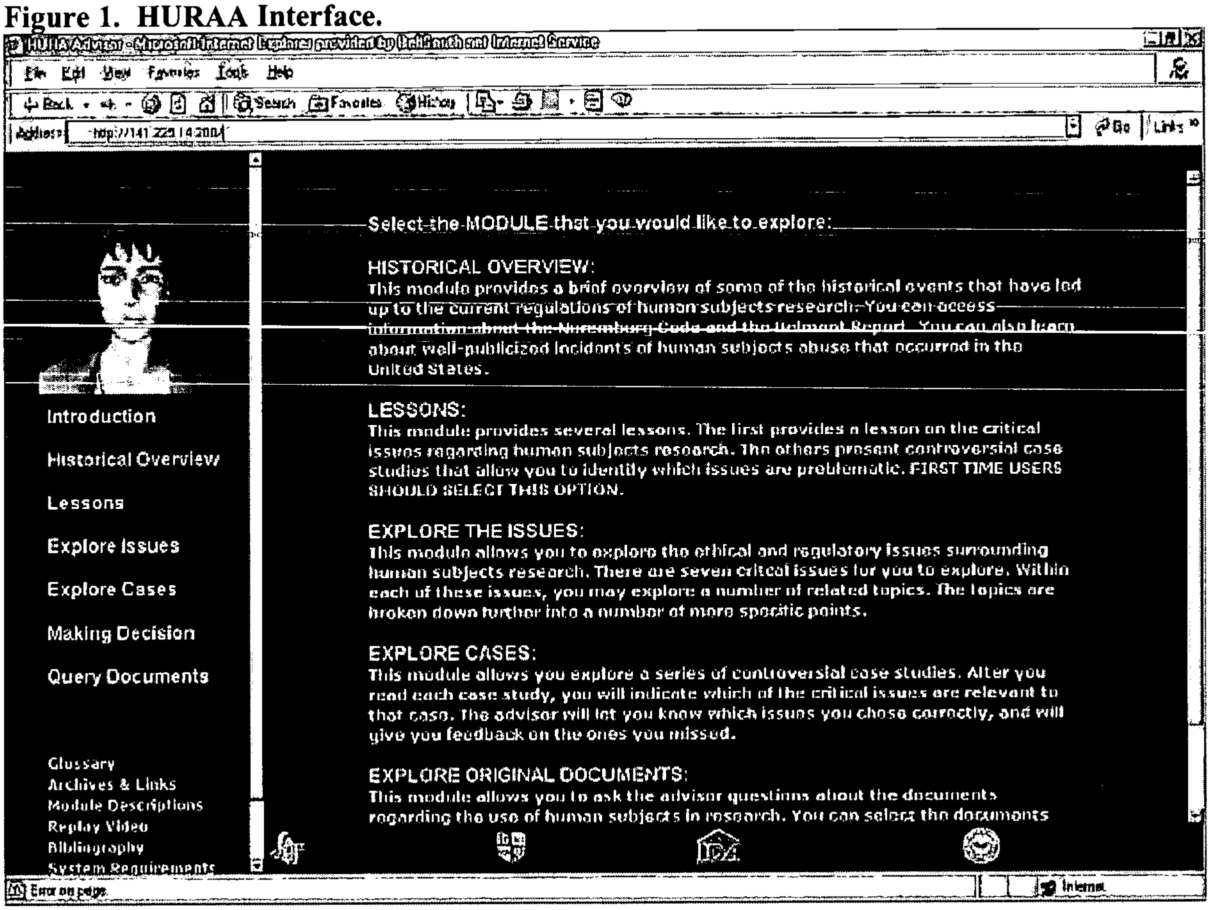
Introduction

The Human Use Regulatory Affairs Advisor (HURAA) is being developed by an interdisciplinary team of cognitive psychologists, computer scientists, and engineers, who are affiliated with the Computational Discourse Technologies Group. HURAA is designed to help users learn the policies and regulations that pertain to using human subjects in research that is funded by the U. S. Department of Defense. The major components in HURAA include a multi-media interface, Dialog Advancer Networks, Learning Trajectories, Latent Semantic Analysis, and Sharable Courseware Object Reference Model (SCORM). The information in the HURAA database includes numerous military and historical documents that provide guidance about current polices to researchers, decision makers, military personnel, and civilian members of Institutional Review Boards (IRBs). Given that numerous persons must review a research protocol prior to its approval (e.g., DoD personnel, battalion commanders, or civilian IRB members), users are asked to specify their jurisdiction prior to the beginning of the interactive session.

Overview of HURAA

Once at the HURAA website, the user provides a user-name and password, and then selects from a list of user profile categories and purpose-of-visit options. Next the user views a brief Flash movie introduction that provides some historical information and describes the importance of the Belmont principles of beneficence, justice, and respect for persons participating in research. Some of history's worst cases of human subject abuse, such as the Tuskegee syphilis study, the Willowbrook study, and Nazi concentration-camp research, are also highlighted in the introduction. After the introduction, the HURAA agent appears and describes how to navigate the interface and how to explore the various learning trajectories. The agent and the learning trajectory home page are presented in Figure 1. The six learning trajectories that users may choose to explore are as follows: (1) Historical Overview, (2) Lessons, (3) Explore Issues, (4) Explore Cases, (5) Making a Decision, and (6) Query Documents. Once the user selects a particular trajectory, the agent provides navigational guidance via synthesized speech and simple head movements. The user is free to switch learning trajectories at any time during the session. The interface also includes eight additional navigational and informational options that users can utilize at any time during the session (see Figure 1, Note: to view all eight options the user must use the scroll bar). Some of these options are a glossary search, links to other relevant websites, and a bibliography link.

Figure 1. HURAA Interface.



The Components of HURAA

Dialog Advancer Networks

A Dialog Advancer Network (DAN) is a mechanism that manages the interactions that occur between a user and HURAA. A DAN allows the agent to micro-adapt each dialog move to the user's navigational choices. HURAA contains several DANs that include customized (i.e., trajectory-sensitive) pathways that are tailored to each of the six learning trajectories. A DAN includes a large number of potential pathways that terminate in a particular Advancer State. The Advancer States prevent navigational uncertainty of the user by including dialog moves that instruct the user what to do next. In earlier research, we found that conversation management is a particularly difficult task in automated tutoring sessions in the absence of a DAN (Person, Bautista, Kreuz, Graesser, & TRG, 2000).

Before the user selects a learning trajectory to explore, the agent relies on a *generic* DAN to help the user make choices. Specifically, the generic DAN provides the user with brief descriptions of the learning trajectories and navigational options when the user mouses over a particular option on the interface. For example, when the user mouses over the "Glossary" option (see Figure 1), the agent says, "Find the definition of a word." It should be noted that the agent, the learning trajectory options, and the other navigational options are constant features on the interface, and the user can select any of these options at any time.

Most of learning trajectories have distinct ways of presenting information to users; therefore, it was necessary to create several *trajectory-sensitive* DANs in order to provide the user maximal navigational guidance (e.g., Johnson, Rickel, & Lester, 2000). The generic DAN encourages the user to select one of the learning trajectory options, and once the user makes a selection, one of the trajectory-sensitive DANs takes over.

For the most part, the trajectory-sensitive DANs contain dialog moves that help the user navigate the information that is included on each page of a learning trajectory. For example, the agent may say something like, "To learn more about a particular issue, click on the corresponding bullet" or "You can search an original document by selecting the 'Ask Question' option on the bottom of the screen" or "You can review a relevant case study by selecting the 'Show Case' option." The system currently has approximately 700 pages through which the user can navigate.

The Six Learning Trajectories

Historical Overview. The first learning trajectory located directly under the agent is the Historical Overview trajectory (Note: The Introduction option is not a learning trajectory; this option allows users to here the Flash movie introduction again). When the user selects Historical Overview, a bulleted list of historical documents and information appears (e.g., the Nuremburg Code, the Declaration of Helsinki, and the Belmont Report). The DAN for this trajectory contains dialog moves delivered by the agent that inform the user as to what to do next. For example, the agent might say, "Learn more about the Belmont Report by clicking here." This trajectory is primarily an information delivery trajectory that helps the user learn about the historical events that led to the development of current polices and regulations regarding human subjects use.

Lessons. First-time users are encouraged to work through the Lessons trajectory first. This trajectory introduces the user to seven critical issues that are derived from the three major principles in the Belmont Report (Emanuel, Wendler, & Grady, 2000). When the user enters this trajectory, the agent tells the user to select Lesson 1. In Lesson 1, the user is introduced to the seven critical issues that all persons involved in human subjects research must know. After the user reads the seven critical issues, the agent instructs the user to select a specific historical case (i.e., Tuskegee Syphilis Study) to read. After the user reads the case, the user is presented information about how the seven critical issues were violated in the historical case. The agent then instructs the user to select the next lesson (Lesson 2). The user then reads about a particular case study and must identify which of the seven issues are problematic in the case. HURAA then provides the user with feedback on the issues that the user has selected or has failed to select. The Lessons trajectory contains two more lessons that continue in this manner: the user reads a case, the user selects the issues that are problematic, and the Advisor provides feedback to the user.

Explore Issues. When the user selects the Explore Issues option, HURAA presents a page containing bullets that correspond to the seven major issues discussed in the previous section. The information in the Explore Issues trajectory is presented to the user in a three-leveled hierarchy. The seven critical issues are presented at Level 1. Level 2 includes specific "Topics" related to each of the seven issues. Level 3 contains very specific "Points" related to the Level 2 "topics." The agent guides the user's navigation through the three information levels. In this trajectory, the user has options to view relevant case studies at Levels 1 and 2. The agent will remind the user of the "Show Case" option when an issue-related case is available. The agent also reminds the user of an "Ask Question" option by saying something like, "You can enter a question and search an original document at any time."

Explore Cases. When the Explore Cases option is selected, bullets that correspond to ten controversial case studies are presented in the content window to the user. The agent instructs the user to, "Select a case study to read, and then test your knowledge of the seven critical issues by selecting the 'Test Your Knowledge' button at the end of the case." On the "Test Your Knowledge" page, the seven critical issues (see "Explore Issues" section) are presented to the user. The agent instructs the user to select the problematic issues for the case that the user just finished reading. Once the user makes the issue selections, HURAA provides feedback on the user's selections. Correct responses are denoted with exclamation marks, and incorrect responses are highlighted in red and denoted with question marks. When users make errors (i.e., misses and false alarms), HURAA provides additional feedback when the user mouses over a particular problematic issue.

Making a Decision. This learning trajectory is designed to help users who need to make a decision about a particular research protocol. Once the user selects this trajectory, a bulleted list of nine distinct research areas appears in the content window. The nine research areas included in this trajectory are General Consequences, Basic Biomedical Research, Drug and Vaccine Trials, Radioactive Materials and X-rays, HIV/AIDS Studies, Human Genetic Research, Drug and Alcohol Studies, Behavioral and Epidemiological Research, and Training and Weapons

Development. The agent instructs the user to select the research area that most closely resembles the protocol under consideration. Users are then encouraged to explore the content related to the selected research area.

Query Documents. The final learning trajectory in the current version of HURAA is Query Documents. When this option is selected, the user is presented with a number of specific types of documents that are related to human subject use in research (e.g., the IRB Guidebook, Army regulations, Codes of Federal Regulations). The agent tells the user, "You can search any of these documents by clicking the box next to the document." The user can search one and any combination of documents by entering a question in English. Once the search is completed, the agent says, "Look below the dialog box for the results of the search."

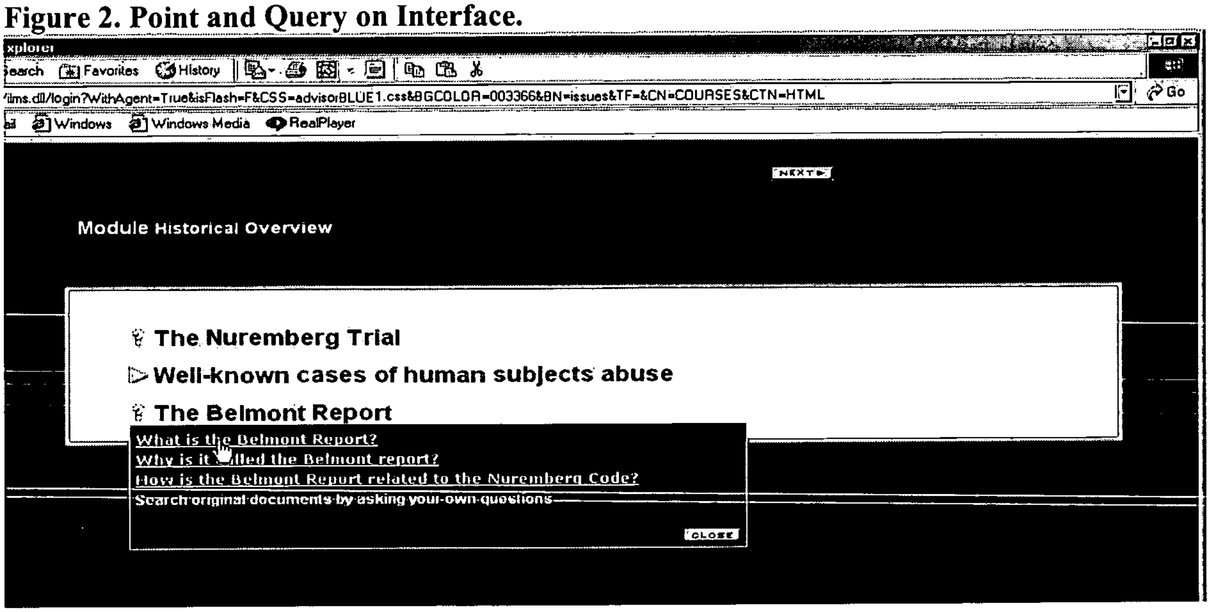
The Multi-Media Interface

The Flash Introduction. Before the interactive session begins, the user views a Macromedia Flash Movie introduction. The Flash introduction is designed to accomplish the following: (1) reduce the volume of text the user has to read, (2) drive home the purpose of visiting the HURAA site, and (3) grab the user's attention with an engaging presentation of historical information. It is delivered documentary style with striking graphics, bold text highlights, and a professional voice-over. Actual case photographs are used when available along with supplementary conceptual photos to create a dramatic effect.

The Animated Agent. Animated agents are beginning to appear on a number of websites and in web-based learning environments. The animated agent in HURAA is a female persona that remains on the screen throughout the interactive session. The agent was created in Curious Labs Poser 4.0 and is controlled by Microsoft Agent.

Point and Query. Within the Historical Overview and Explore Issues trajectories, a Point and Query (P & Q) option is available for most bullet options. By clicking on a question mark next to the bullet options, users are presented with a list of one to five questions that reiterate and expand upon the information available in the trajectories (see figure 2). The user clicks on any of the questions, and an answer for that question appears at the bottom of the screen. The P & Q option allows the user to quickly and easily ask the system sophisticated questions and receive accurate answers to those questions. Previous research (e.g., Graesser, Langston, & Baggett, 1993; Langston & Graesser, 1993) demonstrates that such interfaces are very usable and are very effective.

Figure 2. Point and Query on Interface.



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The Interactive Options. As mentioned earlier, there are six learning trajectory options on the interface and eight other informational options that are always available to the user (see Figure 1). Some of the learning trajectories are designed specifically to get users to actively engage with the content (i.e., Lessons and Explore Cases). Other learning trajectories present the user with hierarchically structured text, and users are encouraged by the agent to "drill down" through the content of the information. In addition, the agent frequently reminds the user of other exploration options. For example, the agent may remind the user to submit a question about the content or review a case study relevant to the issue or topic at hand.

The other eight informational options are provided directly below the six learning trajectory options on the interface. These options are as follows: (1) Glossary (2) Archives and Links, (3) Module Descriptions, (4) Replay Video, (5) Bibliography, (6) Systems Requirements, (7) Help, and (8) Log Out. When the user mouses over these options, the agent provides the user with brief descriptions. Users are free to select these options at any time during the session.

The remainder of the interface, basically the center and right side of the screen, is the content area. This is where all of the content-sensitive information is presented to the user when one of the six trajectory options is selected. There are two navigational options that are always available on this part of the interface, "Next," and "Previous." These options take the user to the next page or to the previous one; such buttons are standard on most web browsers.

Latent Semantic Analysis (LSA)

At any point during a learning session, the user may ask a natural language question about Institutional Review Board practices and procedures and DoD guidelines. This knowledge in HURAA is represented by LSA (Hu, Graesser, & TRG, 1998; Landuaer, 1999; Landauer & Dumais, 1997; Landauer, Foltz, & Laham, 1998). LSA is a statistical procedure that compresses many text sources into a space of approximately 100 to 500 dimensions. The LSA text space in HURAA includes the texts from a variety of government, military, and civilian documents, plus a corpus of approximately 15,000 question-answer pairs. In most applications of LSA, a geometric cosine is computed to assess the conceptual similarity between any two sources of text. These cosine values range between 0 and 1 with higher values indicating more conceptual similarity. In HURAA, one text source is the user's input (e.g., a specific issue, case, and/or a natural language query). The other text source is the LSA text space mentioned above. For example, when a user submits a question to HURAA, LSA is used to locate text segments from the particular documents that the user specifies (e.g., the IRB Guidebook, Army Regulations, etc.) that are most relevant to the user's question. The five text segments with the highest conceptual overlap (LSA cosine value) are displayed for the user.

Sharable Courseware Object Reference Model (SCORM)

The information content in HURAA is organized to meet the requirements specified by the Sharable Content Object Reference Model (SCORM). SCORM is an attempt by the DoD's Advanced Distributed Learning (ADL) Initiative to develop a standard model for representing on-line information that can be utilized by various information technologies. It is proposed that SCORM will transform education and training in the military. The goal of the ADL Initiative is to provide a reference model that will enable developers to reuse courseware materials and instructional components in multiple applications and environments, regardless of the tools used to create them. Minimally, this requires that the instructional content be separated from context-specific run-time constraints so that the material can be incorporated into other applications. SCORM defines a common interface and data schemes for reusable content units (see URL adlnet.org). In order for SCORM to work successfully, there must be a standard way to depict content and a standard way for content to communicate with a learning management system (LMS).

Currently, SCORM consists of three main specification sets. One is an XML-based specification set for representing content structures. This permits course content to be moved from one server/LMS to another. The second is a set of specifications relating to the run-time environment, including an API, content-to-LMS data model, and a content launch specification. The third is a specification for creating meta-data records for courses, contents, and raw media elements.

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Using interactive comics for energy -education through the web

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Abstract: This article introduces Energy!, which is a hypermedia based open learning environment accessible through thc computer networks. Energy! is a product of a pilot project called Energy for Schools. The pilot project was organised in 2000 by the Hypermedia Laboratory of the Digital Media Institute, Tampere University of Technology. The target group of Energy! are the learners aged 13-18 studying energy issues. This article firstly describes the background to the Energy for Schools pilot. Secondly it presents the technical platform, A&O, which was used in Energy! The article goes on to introduce the Energy! learning environment; its pedagogical background, and its various content materials. Finally, the article reports the learning experiment and its main results. In conclusion an evaluation of the role of technology -based learning environments in energy-education is presented.

Background of the Energy for Schools pilot project

Energy for Schools was one of the pilot projects of the Open Learning Environment (OLE) project, organized by the Hypermedia Laboratory of the Digital Media Institute, Tampere University of Technology in Tampere, Finland. The OLE project is part of the national User-Oriented Information Technology USIX programme (1999-2002), and is principally funded by the National Technology Agency (TEKES) and a number of Finnish enterprises.

One central purpose in the OLE project is to produce a pedagogically sound and technically functional learning environment, called A&O. A&O supports user authentification and offers tools for data management facilities, hence the content material of Energy! was located there. A&O provided to the use of Energy! the communication and collaboration tools, and also user-friendly tools for producing hypermedia material. The content material of Energy was produced in a team. This consisted mainly of teachers and learners on the Degree Programme in Environmental Management. The graphic figures of the comics were drawn by a 16 year old learner.

Energy! is a product of co-operation between some teachers of the Tampere Region, representatives of the Tampere Energy Agency and researchers of the Hypermedia Laboratory. The Energy for Schools pilot project was funded by the Tampere Technology Centre Ltd and TEKES. The pilot project was finished at the end of January 2001, but the content material made during the pilot project is available on the web-pages of the Tampere Energy Agency at the address <http://www.hermia.fi/energia/energiaa/>.

A&O, the technical platform of Energy!

A&O <http://ao.tut.fi/demo> is an open learning environment accessible via computer networks, especially over the Internet. Thus A&O offers the learner an opportunity to study independent of time and place. It supports both self-paced and collaborative learning. A&O is open not only to various learners in schools and in universities but also to public and private organisations. It can be used in education with young as well as with mature learners, moreover A&O is an exploitable open learning environment for different content materials. It has been tested with content materials of advanced environmental and energy education, with matrix algebra at the University of Technology and with adults in the seamless service chain in health care. (Pesonen 2000, Pohjolainen et al. 2000.)

The main goal of the A&O leanrning environment is to be both pedagogically appropriate and technically functional. It has been designed on the basis of modern learning theories that emphasize the construction of new knowledge on the basis of previous knowledge, when the learners' active role and collaboration with other learners are essential in the learning process. In addition to these, the learners' intentions, meaningful learning context and transfer play an essential role in A&O. (Pohjolainen et al. 2000.) Constructivism is the central pedagogical idea of Energy!. Learners' active role, construction of new knowledge, meaningful learning context and the transferrability of matters learned were the essential aspects in the process of developing content material for Energy!.

Energy! an interactive, open learning environment

The purpose of Energy!

The fundamental aim of the Energy for Schools pilot was to produce a web-based learning environment. The aim was increase learners' awareness in energy matters. Another essential aim was to motivate learners to save energy in their daily routines. The aim was not only to enhance learners' knowledge but also to encourage them to action. The studying atmosphere in the Energy! learning environment was to be positive and inspirational, not judgemental.

The format of the content material in the Energy! learning environment is comics, because they are closely connected to everyday situations and can therefore reach young people better than, for example, books. Gravett 1990 came to the conclusion that 40-50 % of young people aged between 16 and 20 rarely read a book, but the majority of them read comics (Shelwood & Irwing 1999, xiii). Energy matters are complex and multidimensional. They are a combination of values, beliefs, attitudes and choices. Therefore the dialogues between the comic figures are an excellent way to illustrate the different aspects and opinions in the energy matters in narrated comics. The greatest challenge in creating Energy! was to enable learners' active role when studying energy matters. The dilemma was solved by creating an interactive learning environment in which learners could participate by considering, debating and making choices in energy matters. The choices the learners made directly influenced the continuation of the content material.

The pedagogical background

The pedagogical background of the Energy! learning environment is a combination of three ideas: learning with technology, comics in education and problem-based learning (PBL). This synthesis constitutes a context for interactive technology-based comics, and offers the learner an active role. The theories of learning with technology and problem-based learning emphasize the learner's active role in the learning process. Thus these theories provide the most extensive pedagogical background for the Energy! learning environment. In general comics in education are criticized for putting a reader in the passive and uncritical role, but technology-based interactive comics can refute these critics. The technology-based interactive comics offer the learner an active role when using the content material. The learner is open to influences when he/she reads the comics, because there is always something between two panels, and the reader fills them with his/her imagination. This is the case in all reading, not even texts have only one correct interpretation. (Selwood & Irwing 1999.)

Learning with technology

"Students learn from thinking... Technologies can foster and support learning...if they are used as tools and intellectual partners that help learners to think." Jonassen et.al. (1999,2) describe the role of the technology in the learning process. Learning with technology, not from technology, was the main idea in designing the Energy! -learning environment. Learners construct knowledge themselves in their learning processes, but technology can be very a useful tool to support those processes. Learning with technology is based on constructivism, which emphasises the activity of the learner in the learning process.

Learning with technology offers an opportunity to ascertain the different needs and interests of the learners. The technology-based learning environments open up the possibility to differentiate the content material to different users needs. Learners try to find the substance of the matter during the process of learning. Every learner structures knowledge on his/her personal experiences, which are not automatically replaced or transformed. Thus gaining the substantial knowledge from the information is a personal process. Therefore there are as many perspectives on the matter as there are persons considering it.

With the technology it is possible to simulate the real environment of the matter at hand in the learning situation. The simulated, familiar context motivates the learner and facilitates the adoption of new knowledge in the learning process. The transferrability of the learned knowledge is easier when the context of learning is familiar. Understanding the substantial knowledge has an affiliation to the learner's wider social context in various ways. These aspects in learning with technology should help learners not only to recognize and solve the problems but should also guide them to critical thinking. (Jonassen et.al 1999, Kotilainen & Hankala 1999.) Understanding critical thinking helps learners to realize that there are various aspects to problems and not necessarily only one right answer.

Learning with technology empowers the interaction for the learner in various levels, which enables learners' interaction with peers, teachers, experts, tutors, mentors, computers etc. In the Energy! learning environment the technology offer learners more personal perspectives on content material with narrated comics. To be more precise the choices the learner makes in the material direct the following information in content material.

Comics in Education

Comics are visual storytelling; where texts and effects are added to bring more meaning to the visual story (Packalén & Odoi 1999, 8). The story plays the central role in comics, but the context must also be taken into account. The comics visualize the culture and wider social context of their audience, otherwise they may cause confusion for the reader. For example, energy education in Africa or in Scandinavia differ greatly from each other. On the other hand the comics from strange cultures can provoke readers'curiosity, for example school children are very enthusiastic about getting information on other cultures through comics as Packalén and Odoi (1999, 15) state. (Harrison 1981.)

Comics have been used effectively in education for decades. Already in 1913 "Mr Block" taught workers the message of industrial unionism (Selwood 1993, 41). In the classrooms comics are used to teach learners writing skills, awareness of value system, health education, relationships etc. The effectiveness of comics was compared to text, illustrated text and text with photos in educating preventive maintenance during the Second World War by the US Government. The best understanding was attained with comics. Much of the effectiveness of comics appears to ride on emotion. (Selwood 1993, 41.) Comics are an excellent way to visualize the communication and different aspects and attitudes. Comics connected to technology offer new possibilities; learners' affective, cognitive and psychomotor capacities can be supported by creating the learning environment with technology. (Alamäki 1999, 78).

Based on the facts precented on comics in education, narrated comics offer an excellent way to introduce different aspects of energy matters. In the comics the texts of the dialogues are short and thus excellent content material for technology-assisted learning. In addition dialogues offer more than the formal information and can therefore simultaneously include information about emotions and feelings.

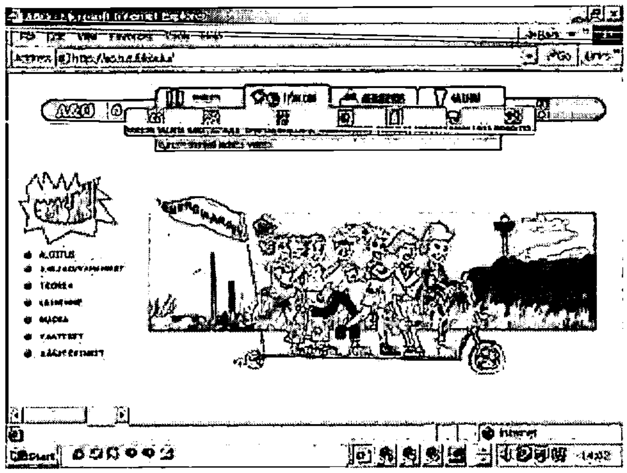
Problem-based Learning (PBL)

Problem-based learning (PBL) is a way to think about knowledge, understanding and learning. Problem based learning supports the pedagogical idea of constructivism and especially the active learner with his/her ideas and perspectives. It supports the construction of knowledge from the learners own perspective. Problems and personally needed answers govern the construction process of the content material. Problem, disagreement or dissonance between new and previous knowledge in a certain context fasilitates the process of problem solving. The primary idea of PBL is to find and use the core, essential information for problem solving. Problem-based learning supports the integration of disciplines in the problem solving processes, and thus presents a different aspect in processing the information if compared to many other learning theories. For example, when studying the greenhouse effect with PBL, studying is not limited to the facts of biology. Chemistry, geography etc. are integrated into the learning process. According to problem-based learning the process of studying should be investigative, critical, reflective and active. (Boud & Feletti et al. 1997.)

The Energy! learning environment includes the applied ideas of PBL. In it learners may independently retrieve the information needed through the link-words and get to know the theory of the themes. The construction of the content material originates in the target group's interests.

The content material of the Energy! learning environment

The content material of the Energy! web-based learning environment consists of five different areas: beginning, narrated comics, knowledge forum, hints for energy saving and conclusion. The style and the meaning of these areas differ greatly from each other.



Picture 1. First page of Energy! showing the comic figures acting in the narrated comics.

Picture 1 introduces the front page of the Energy!- learning environment. The left side of the page introduces the areas of Energy! and is also for navigation. The picture on the front page illustrates the characters in the narrated comics. Every figure has different knowledge and attitude towards energy matters: One is very enlightened in energy matters, another is definitely not, one knows something but does not act like that, someone acts energy-friendly through being poor, someone wants to act better in energy matters, but does not now how. These aspects are represented in the dialogues of the narrated comics.

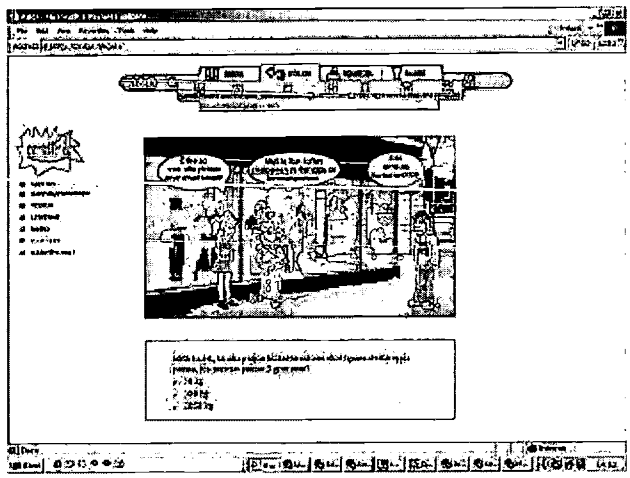
The beginning

At the beginning the learners are motivated to use the Energy! –learning environment by testing their energy attitudes and behaviour with a ten-point scale. As a result of the test learners are stereotyped to one of the six comic figures. When the learner has finished the test he/she is informed with a portrait of his/her comic figure with the comment: "Your energy choices are closest to my choices!". Learners may read more about their figures if they are interested.

After the beginning using the Energy! learning environment may be guided precisely (by the teacher or the curriculum) or by the learners' own interests, which guide their learning processes. After the beginning the available content material consists of: knowledge forum, narrated comics on four topics and energy saving hints.

The narrated comics

The learners are guided to the energy issues by the dialogues of the narrated comics. In the dialogues six comic figures discuss energy matters, attitudes etc. The figures have different attitudes towards energy consumption. The narrated comics are about: clothing, food, leisure and traffic. All of them include: dialogues of the topic and link-words with more detailed information about the matter. Between the pages of the narrated comics there are the questions concerning learner's knowledge and attitudes to energy matters (see Picture 2). After the answer the learner receives the reaction and the infobox with the specific information about the theme question. Studying with the comics requires activity on its part of the learner, because before getting information or progressing in the comics, he/she has to make choices, complete groupworks etc. In the comics every theme is followed by the gallows game with which learners can test what they have learned about a certain topic. The gallows consist of the prompts of currently studied themes, terms and an area for the right answer.



Picture 2. The page in narrated comics. At the end of the page there is a question which demands answer before the user can go forward.

The knowledge forum, hints for saving energy and conclusion

The knowledge forum of Energy! includes interesting background information on energy issues. It is divided into six levels: solar system, globe, society, individual, organic and miscellaneous level. All except the miscellaneous level, are on the aspects of a certain discipline. The miscellaneous level is an integration of the different disciplines. The style of the text in the knowledge forum is humorous and colloquial. At the end of every theory level there are some practical questions about the content of the level, but primarily the knowledge forum has the traditional text format.

The hints for saving energy is the most practical part of Energy!. Through the picture of the storehouse the learner can be given energy saving hints in different areas of life. The learner may choose the hints of interest by clicking the mouse on a picture. Finally, the learner finishes his/her studying with Energy! by testing his/her knowledge of energy matters in the conclusion. There is a ten-point test, but the questions put more emphasis on knowledge and its application than at the beginning.

The learning experiment of the Energy! –learning environment

The Energy! learning environment was tested with its audience during the national energy saving week October 9.-15. 2000 at schools in Tampere Rcgion, Finland. The idea of the learning experiment was to find out how suitable the Energy! learning environment is for studying energy issues for learners 13 to 18 years of age. The main purpose of the learning experiment was to find answers to the following questions: How effective are the narrated comics in energy-education and how did the learners evaluate the material of the different themes in the Energy! environment. Would they use the same kind of learning environment for their studies also in the future. At the time the learning experiment was carried out the conclusion and the narrated comic about the leisure were under production, and are thus not evaluated in this article.

The learning experiment was organized in two secondary schools; Tammerkoski school in Tampere and in Moisio school in Ylöjärvi. There were three teachers in each school who tested the Energy! learning environment with their students. The Ylöjärvi teachers have had a very active role in the designing the Energy! learning environment. Data from the learning experiment were gathered mainly with semstructured questionnaires completed by the learners after the experiment. The experiences of the teachers were gathered with open questionnaires, and by informal interviews made by the researcher. The researchers' participant observation also gave some understanding of the theme. (Borg & Gall 1989.)

Main results of the learning experiment

The Energy! learning environment was tested with 185 learners. The feedback of 167 learners is taken into account in the results. The learning experiment was carried out primarily during the national energy saving week, inclusive of some lessons during the following week. The time used for the learning experiment varied between the classes from one to five hours. The most common period for studying with Energy! was two or three hours. 60 % of the learners in the learning experiment were girls. Almost all the learners were 13-15 years of age. As background knowledge the learners evaluated their awareness of energy matters to be quite poor, and they were not very interested in them.

After the learning experiment the learners evaluated the different parts of the Energy! learning environment with the same grades by which they are normally assessed by the teachers (scale 4-10). Highest grades (mean between 8.1-8.28) were given to the interactive comics; clothing, food and traffic. The interactive comics were liked mostly because of their questions and reactions to the answers.

"I wasn't interested in the theme [traffic], but the questions sort of tempted me to the comics."

"Using it [Energy!] is fun! I can test my knowledge and learn new things from the answers."

Learners both liked and disliked strongly the beginning of Energy!. Positive feedback was given because it connected students better to comics by giving them their "own figure". The beginning was criticized mainly of the technical problems in the use of it. The small number of alternative comic figures was cricized by the learners.

"Interesting. It was cool to get to know who am I like, but for a boy it's not nice to be Ritu [the female character]."

The greatest need for improvement in Energy! was reported to be in the knowledge forum and in the hints for energy saving. Those were criticized for the passive role of the learner in them. In the knowledge forum there were only a few questions for learners after the theory levels and the energy saving hints were only for reading. A very typical comment on the knowledge forum was for example:

"Quite interesting, but there were not many possibilities to influence it [the form of the theory]."

The energy saving hints were improved after the learning experiment. The hints area introduced in this article is the improved version. The tested version of the energy saving hints included the same hints, but the style of the hints was plain text not a interactive picture as it is at present.

More than 85 % of the learners who took part in the learning experiment evaluated Energy! to be suitable or very suitable for learning about energy issues. 70 % of the learners estimated that they had learnt something about energy issues through the Energy! learning environment. 20 % of the respondents learnt a lot or very much indeed about energy issues through Energy! in their own opinions. Learners estimated (80 % of them) that the level of the information in the environment tested is appropriate for the users at their age.

Interactive comics as a form of the learning material were evaluated to be an excellent way to inform learners about energy saving. This was the opinion of 60 % of the learners who took part to the learning experiment. 40 % of the learners thought that the comics were adequate for explaining energy issues. Despite all the technical problems which appeared during the learning experiment three out of four learners would also like to use Energy! or the same kind on learning environments for their studies in the future.

The teachers explained their interest in using Energy! with their students with the integrational aspect to different disciplines and with the aspect of sustainable development in Energy!. Teachers felt that the use of the technology based learning environment changed the role of the teacher more to the role of expert, but also to the role of technical guide. They appreciated the variety of the themes, because they enabled learners to learn themes they were interested in. Teachers hoped for most improvement to the technical usability and to the instructions of Energy!

Conclusion

This article presented the Energy! learning environment, which was tested with the learning experiment described here. The results of the experiment and the researchers' experiences show that interactive comics are a very appropriate form for material of the energy education. The technology-based learning environment

provided an opportunity for personal differentiation in the learning material. This supports different learners and different learning styles. The personal feedback which is offered to the learners in the interactive comics motivates and guides their learning processes, but there is still need for the learners' own activity. Learners need active processing of the information and the activity depends mostly on the learners themselves. A very rational comment was given by a 14 year old learner about the Energy! learning environment:
"As a whole it's OK, but it [Energy!] is more suitable for those who are really interested in these themes. "

Thus even if learning with technology deals with the problem of differentiating the education, how can we solve the problem between active and capable learners and those who are not motivated and thus manage under their level all the time? If the learners liked most the questions and their own chance to act and to influence the future of the environment, how can the authors of learning environments and content materials respond to the challenges? How can the games and learning environments be differentiated from each other in the future, or do they have to be differentiated at all? Are we moving faster towards edutainment, where the fundamental idea is that education should be fun?

Energy issues are a very challenging topic. They are closely connected to the values, beliefs and attitudes and therefore elicit strong opinions. The interactive comics provide a frame for the dialogue on energy issues, but the dialogue should be widened from the technology-based learning environment to real conversation and interaction between learners and other participants of the learning environment.

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Online Education Practice: a Dual-Track Balancing Act

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Abstract: Technikon Natal is a higher education contact institution in Durban, South Africa. In the last six years the Online Learning Centre has evolved bottom-up, driven by the contagious creative spirit of champion lecturers. Activities have grown to such an extent that it has become necessary for the institution's management to develop an institutional vision and model for online education.

This paper reflects upon trends and developments in this environment, from 1994 to 2000. It speaks of experiences and lessons learnt by online learning practitioners. It weighs up various issues in order to suggest a sustainable model for an institution that faces constraints commonly experienced by most higher education institutions in the developing world.

Introduction

Technikon Natal is a higher education contact institution in Durban, South Africa. In the last seven years online education has evolved bottom-up, driven by the contagious creative spirit of champion lecturers. By the end of the year 2000, activities had expanded organically to such an extent that it has become a priority for the organisation's management to take ownership of the practice. This ownership will allow a more clearly defined focus, enabling Technikon Natal to collaborate and compete with other institutions, in the context of preparing students for an e-commerce driven workplace.

This paper reflects upon trends and developments in the Online Learning Centre, from 1994 to 2000. It speaks of experiences and lessons learnt by online education practitioners. It weighs up various issues in order to suggest a sustainable model for an institution that faces constraints commonly experienced by all educational institutions in the developing world.

History of Technikon Natal and South African Education: 1994 – 2000

Technikon Natal is regarded a historically white institution. The transformation of the institution commenced during a transformation forum in 1994, the year of the country's first democratic elections. As a result of this process, 21% of the student population is presently white and the remaining 79 % black.

During the time of transformation, the trend of academic development in the mainstream became prominent. Mainstreamed academic development implies a focus on the learner through academic staff development and curriculum development. Lecturers are taught to adapt their teaching techniques and the curriculum to suit a diverse student population. This approach is opposed to the voluntary, add-on, remedial student support model that existed previously during the apartheid years, where the curriculum and teaching techniques remained intact and "struggling" students were required to attend "extra" lessons conducted by tutors, outside of a course's time table.

Since South Africa became a democracy, the country's educational policies have evolved towards a system of outcomes-based education (OBE), emphasising access, learner-centeredness and flexibility. All of these are facilitated with greater ease through the use of computer technologies.

Initial Implementation of Online Education through Ready-Made Courseware

During 1994 a pre-designed computer-assisted learning (CAL) system was purchased for the Education Development Centre (EDC), a student support department awkwardly placed *outside* the academic ambit of the institution. One staff member was appointed to install the PLATO online tutorial system in mathematics, physics, chemistry and English and to recruit users for the use of ready-made software.

Although there was no institutional vision for online education and no broad guidelines for implementation at the time, the CAL Centre's own long-term goal was to develop ways of introducing online learning in a *sustainable* way and to become a central academic support service for all faculties - the guiding consideration being, "how to extend the scope of involvement in the pedagogical use of online learning from the margins towards the centre of institutional practices" (Taylor 1998).

The challenges that the marginalized EDC faced when the CAL Centre became one of its subunits were: being a voluntary, add-on service (not timetabled); surviving on donor money; being placed outside the academic ambit; and carrying the stigma of "remedial education". In spite of these challenges, the CAL Centre currently functions as an independent unit known as the Online Learning Centre (OLC). It is centrally placed in the academic ambit, offering a range of services, has access to the institution's budget, and comprises of two academic staff members plus an administrator and a technician. In the main these successes can be ascribed to the systematic, research-based approach of a handful of adventurous, tenacious, lone-ranging practitioners.

Online education at the institution has now reached a point where top-down meets bottom-up: as mentioned previously, at the end of 2000 the academic management team showed an interest in making an institutional commitment in order to support lecturers in their practice. This point will be elaborated on at the end of the paper. However, at this point some guiding principles that have been used by this unit that has operated in the absence of an institutional vision for online education will be discussed:

From the start, the institutional climate posed challenges far greater than making the technology work. In the beginning stages lecturers' "remedial" approach to students with learning difficulties was still at the order of the day. It often occurred that lecturers sent individual students away to the EDC to get "extra help" in the student's "free time" for a particular academic problem. Single students would then work in isolation online, not knowing how to select relevant materials from a host of options, and losing motivation quickly.

Therefore it was necessary to keep a firm stance on implementation in the mainstream curriculum. This approach required a focus on working with lecturers and academic departments rather than with individual students. Lecturers have been required to be *involved*, following the process of online content review and selection (to customise various programmes suited to a variety of courses and learner needs); time-tabling sessions as part of students' formal programme; appointing subject facilitators to assist during these sessions; developing ancillary printed materials to link tutorials to lecture content; and giving credits for work completed to boost motivation.

As a result of this work method, the PLATO system is now extensively used for first year courses on campus. Student numbers have increased from an initial group of forty to close to two thousand. This proves that it is not only the *design* of educational software that determines quality of learning, but equally important is *the way in which it is implemented.*

The underlying pedagogy of the PLATO tutorials is mastery learning, which is particularly effective for the reinforcement of basic sub-skills, e.g. practising to do a chemistry titration or calculating vectors in physics (Bloom 1986). During 1994 we conducted a study with electronic engineering first year students who used PLATO maths. Results indicated that the PLATO intervention helped students to achieve outcomes that require the mastery of basic sub-skills. However, PLATO did *not* improve students' ability to solve problems that require the use of higher order thinking skills. Interviews with students revealed their need for balancing individual online tutorial work with constructivist-type activities such as follow-up group discussions, in order to make PLATO tutorials more relevant to lecture content.

The quotes below underline that first year students with no previous exposure to technology are empowered (and not alienated), if a learner-centred approach is used:

"PLATO doesn't become tired of explaining."
"It is that I am not afraid to do anything."
"I could never do calculations alone. PLATO gui

Although our DOS-based version of PLATO is now "old technology", it is still heavily in use after seven years.

In-House Courseware Development with a Focus on Staff Development

Since the initial implementation of commercially available educational software in 1994 at the institution, the need has arisen for the development of software in-house, in areas that are either not commercially available, or available but not quite fitting Technikon Natal's syllabus, or commercially available but not affordable. In order for two educational technologists to support fifty-five academic departments, a model of in-house courseware development *with a focus on staff development* has evolved.

As the unit has been a "lone ranging department" (Taylor 1998), staff has had to keep a focus in the absence of managerial input. This has had positive as well as negative implications. On the one hand we have had free reign to experiment and learn, pushing the boundaries of development and technology in our efforts to support lone ranging practitioners' innovations. On the other hand this has caused a scattered focus and an overloaded infrastructure, the unit being inundated with requests for involvement. Therefore, in grappling to regain focus and to find a suitable and sustainable model for online education, the OLC observed trends at other higher education institutions. The two main models that emerged seemed to be staff development and production.

Below is a summary of some of the benefits and drawbacks of both models.

STAFF DEVELOPMENT UNIT	PRODUCTION UNIT
Lecturers are empowered if their skills are developed – it is a personal investment.	Good short-term solution (specialist developers can get something up and running quickly).
The lecturer is in control of the environment and owns process in the long run.	Specialist developers can develop sophisticated learning materials.
Long-term updates are more feasible.	
The support department can function with skeleton staff, in the absence of managerial support.	

Table 1: Benefits of staff development and production models

STAFF DEVELOPMENT UNIT	PRODUCTION UNIT
Time constraints of lecturers to do development	A production unit requires a big infrastructure in order to develop projects for a range of departments.
If lecturers themselves do the development, it is not likely to be done on a sophisticated level (time constraints).	Cannot function in the absence of managerial support.
	In the long term the lecturer is not in control of the environment – unable to take care of upgrades and updates.
	Impractical for a production person to drop current projects to take care of updates a year or two down the line

Table 1: Drawbacks of staff development and production models

In hindsight it seems that keeping the focus on staff development and continually redirecting ownership to the lecturer since the early "PLATO" days of implementation, has been crucial for the creation of a sustainable climate. The greatest challenge has been developing software in collaboration with academics and, in the process, enabling them to *remain in control of the process.*

Orwig (1999) emphasises the importance of providing online practitioners (lecturers) with incentives and resources in order to get them involved, and rewards for successful practice. One of the most positive offshoots of the staff development model is that by gaining technological skills, a lecturer becomes more marketable. This personal investment is at least one incentive for getting involved, even if no formal institutional forms of recognition exist.

Another important focus in an attempt to cultivate a sustainable climate, has been to work with champions and to give these champions every opportunity to succeed, and to promote their work on and off campus. As a result, these champions become role models, mentors and, even, coaches to others further down the line.

Academic Staff Development Workshops

Since 1998 the centre has offered staff development workshops to all academic staff on campus. Web pedagogy has formed an important foundation for all workshops. Some topics at the time of writing are virtual classroom development, facilitation and management; website development and management; multimedia authoring and electronic presentations.

The quote below is a response commonly given by lecturers during feedback:

"Thank you for the relaxed, non-threatening environment in which this course is presented. It gave me the confidence to use the Net effectively and to apply its advantages to the classroom setting."

Lecturers are on the one hand keen to get involved, yet on the other hand many are hesitant since they have probably been intimidated somewhere along the line by those who claim to own the technology. Therefore we focus strongly during workshops on demystifying technology.

The following quote also indicates a common response:

"Many doors opened, but we need to step through now."

Once lecturers realise that they can master the technology, there is the realisation that stepping into practice is hard work, takes commitment and requires real support.

Development Tools

During training we have not focused so much on high-end bells and whistles, but rather on template-driven, "low-end" technologies that make it more feasible for lecturers to do the development (e.g. Toolbook Assistant; Microsoft Word and Microsoft Front Page for website development). As lecturers are able to create materials relatively quickly, there is more time to explore pedagogical issues, for example learning how to select media and development tools appropriately for a specific target group. Another important pedagogical skill is to learn how to facilitate actively online once electronic materials are developed, in order to prevent students from getting lost in cyberspace and to sustain online interaction and ensure that learning takes place.

Projects

The importance of faculty support of a lecturer's project cannot be over-emphasised. Projects have stalled in spite of the enthusiasm and commitment of lecturers. Not only is this a waste of valuable resources, it is also extremely demoralising for everyone who has poured time and energy into a project. We have therefore introduced detailed inter-departmental agreements, and in order to cope with the demand and to prioritise projects, only support subsidy-generating courses.

Below follow examples from the range of past and current online learning projects at the OLC:

The Pharmacology Project of the Community Nursing department is a CD ROM-based distance education multimedia project for registered nurses and midwives who are unable to travel to Technikon Natal. Through this project Fregona, Harris and Kruger (1999) have explored the provision of pharmacology training for rural community nurses and midwives in KwaZulu Natal.

The Operating Systems IV virtual classroom of the Computer Studies department is an example of constructivist learning on the World Wide Web. Fourth year learners construct a rich online resource every year through individual and collaborative projects. In this project the power structures of traditional education, including roles of lecturers and learners, are challenged (Pete & Khalili 1998).

The End-User Computing intranet site of the Computer Studies department is used to develop web browser literacy and information literacy amongst first year students, in preparation for projects such as Operating Systems IV (Khalili & Pete 2000).

The Thekwini Project of the Languages and Communication department is a virtual classroom on the World Wide Web that uses innovative techniques such as scavenger hunts to develop academic literacy skills and increase the motivation levels of second language students (McKenna 2000).

Online Open Learning for Contact Teaching

The range of projects listed above all fit in somewhere along the continuum of open learning. Online learning does not only belong to distance education. Where it is implemented in a previously traditionally taught contact course, open learning comes into play. For many of the courses above, lecturers have retained contact sessions with students. However, where these courses previously consisted of traditional transmission mode lectures only, there is now a balance of lectures, tutorials to touch base and make logistical arrangements and online sessions (that include access to materials and contact with lecturers and peers).

Conclusion: a Top-Down, Bottom-Up, Dual-Track Balancing Act

Taylor (1998) elaborates on Morrison's (1996) idea that if thirty percent of lecturers in a given institution teach online, this indicates the critical mass that is required to extend online education towards the centre of institutional practice:

> "...then the institution would undergo a paradigm change in its educational practices".

In order to reach the critical mass, he proposes a dual-track approach, namely balancing innovation and appropriation – examining innovative lone ranging lecturers' work methods and adapting and applying these to other courses. In this way an additional ten percent of "early adopters" can be gained. The challenge is to gain the last ten percent to achieve this critical mass:

> "Institutions have to engage the attention of the unconverted rather than continue to focus on the easily or already converted. This identifies the target." (Taylor 1998)

For the last seven years at the Online Learning Centre we have followed a dual-track approach, continuously balancing various aspects in order to gain and sustain the participation of the pioneers and the early adopters.

The recent commitment of our academic management team will enable the development of an institutional vision and a coordinated strategy. Issues that will be addressed by the newly founded Online Learning Committee include a survey to pool institutional resources; providing incentives, resources and rewards to motivate lecturers to practise, and a discussion of the existing intellectual property policy. It is hoped that these debates will shift online education from the margins towards the centre of Technikon Natal's educational practice.

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Instructional Strategies for the World Wide Web: Outline of a Taxonomy

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Abstract. *Based on a review of the current instructional use of the WWW we outline a taxonomy that classifies web-based instructional strategies according to three categories: knowledge mode (from passive viewing of information to active construction of meaning), presentation mode (from text to virtual reality) and collaboration mode (from individual to open collaboration). We offer suggestions as to how this taxonomy can be used by instructional designers in order to evaluate existing online learning environments or to develop new instructional strategies that take advantage of the unique characteristics of the WWW.*

With the introduction of a new medium, the question of how it can be used for instructional purposes is often very enthusiastically answered with claims that it will solve many of the existing problems of the educational system. Just as other media before it, the World Wide Web (WWW) has spawned great expectations of its potential for instructional use. In this paper, we briefly review currently used instructional strategies for the World Wide Web, using examples from the literature as well as a case example, a web-based graduate course on Instructional Systems Design (ISD). Based on this review of the instructional use of the WWW and rooted in a media attribute approach, we outline a taxonomy that classifies instructional strategies according to three categories: *Knowledge Mode*, *Presentation Mode* and *Collaboration Mode*. We offer suggestions as to how this taxonomy can be used by instructional designers in order to evaluate existing online learning environments and to develop new instructional strategies that take advantage of the unique characteristics of the WWW.

Instructional Strategies for the Internet and the World Wide Web

An instructional strategy can be seen as any method, application or adaptation of knowledge designed to serve the function of learning. Instructional strategies can range from the artistic or craft-based to highly systematic and structured approaches. For an instructional strategy to be regarded as effective, it is usually supported by an epistemology, a psychological or theoretical framework which endorses a certain approach to successful instruction, and by a structured design methodology which helps to guide the instructional designer through the creative process.

The Internet offers a range of services and tools that have been readily adapted for instructional purposes. Aside from 'first-generation' Internet tools such as FTP and Telnet, Finger and Gopher, the Internet is now an umbrella for a range of popular services such as newsgroups, BBS, chat, e-mail, and more recently, the World Wide Web. Each of these services has come to have instructional applications, although in some cases the instructional theory underlying their use is underspecified.

For example, instructional uses of the Internet include *Newsgroups & Bulletin Board Systems,* electronic message systems which allow users to leave their own messages and to review messages left by others. In instructional settings, they can be used to exchange information or as a collaborative tool for group study projects (Wiebe, Slovacek, Semrau, & Doyle-Nichols, 1993). *Chat* is real-time text-based communication between two or more users that can be used to exchange information and to provide a format for discussion of curriculum-related topics or conduct group work. *Email* is perhaps the most popular application used on the Internet and its original purpose was to provide basic communication, information exchange and collaborative research services. In an instructional context, it allows learners and educators to exchange information and references, obtain assignments, receive guidance or counseling from instructors or peers, share documents, participate in quizzes or asynchronous discussion on curriculum-related topics, and even make excuses about missed homework or absence (Poling, 1994; Monahan & Dharm, 1995). In addition, *listservs* can be used to broadcast e-mail messages to large groups of people, e.g. a class, school or an entire institution in an instant.

These applications and services can be described as instances of first-generation text-based Internet communication tools. Although their use began as early as the 1960's, wider acceptance did not begin in earnest until the mid-80's. A second generation of Internet usage involving hypermedia content – combining still and moving images integrated with audio and text-based information – became available for instructional purposes more recently and continues to grow at a rapid rate.

Since the introduction of the *Web Browser* in 1993, researchers have suggested strategies for the instructional use of the WWW. For example, Hackbarth (1997), in a review of a collection of papers by Judi Harris, describes options for the integration of web-based learning into the curriculum, emphasizing the value of interpersonal exchanges, information collection, and problem-solving activities. By contrast, Bannan-Ritland, Harvey and Milheim (1998) offered a hierarchical framework of instructional activity types, listing the kinds of activities which the WWW can support: Simple 'one-way' information delivery, where a webpage is viewed; appended information delivery, with the use of supporting materials, media, resources, references, etc.; information delivery with synchronous or asynchronous online interaction and/or collaboration; structured information delivery such as integrated learning modules; the creation and manipulation of original information such as WWW sites; and immersive interaction in media-rich information spaces, perhaps with collaborative partners.

Three elements permeate across this hierarchy. First, knowledge representations are being formed, organized, presented, and structured in varying degrees of sophistication, usually to suit a given instructional objective. Second, the degree of activity and interactivity, the modes of presentation, can vary according to the way the Web is configured for a given instructional task. Thirdly, the affordances for collaboration and group communication are essential, in accordance with the software and tools available and the objectives in a given educational environment.

In a different example, Bonk and Reynolds (1996) outline a strategy to encourage "Learner-Centered Web Instruction for Higher-Order Thinking, Teamwork and Apprenticeship." This three-prong strategy emphasizes the "Creative, Critical and Cooperative" aspects of learning. The authors list 10 kinds of activities, from online brainstorming, to role playing, creative writing, simulations and semantic webbing, to concept mapping, summarizing, case-based reasoning and categorization schemes, to various partner-based activities, conferencing, group investigations and gallery tours. Although the authors offer an open and flexible schema, we can notice three distinct elements: first, knowledge representation (what we refer to as the *Knowledge Mode)* are used to create, organize, and structure materials; second, differing *Modes of Presentation* are described to support access to and manipulation of information and media; and third, *Collaboration Modes* and communication brings learners together and allows them to exchange ideas in a variety of ways.

By contrast, Mioduser et al. (1999, 2000) outlined a 100-element taxonomy for classifying the structure and functionality of web-based learning environments, (1) including *general descriptive elements*, (2) elements addressing the *underlying pedagogical-instructional model* of the environment, (3) elements characterizing the *knowledge and representation structure*, and (4) elements to classify the *types of communication* which could take place there. The first category could be described as elementary metadata about the surveyed Websites, but the second category includes details about the instructional *configuration* of the Website (resources and their links), the instructional *model* (e.g. directed vs. open-ended), the instructional *means* (e.g., hypermedia, VR, modeling), the interaction *type* (browsing, interacting), as well as the cognitive processes elicited, locus of control, feedback, help functions and learning resources. The third category addresses the representational structure and means utilized by the site, and the type of knowledge and the navigation tools being used. The fourth category includes the types and means of communication tools used.

In this scheme, we find again that the elements fall into one or another of the three-dimensions outlined above. *Knowledge* is being represented in a specific mode, organized and created in varying degrees of complexity with various types of cognitive and organizational templates underlying it. *Presentation Modes* are used to provide access and exchange functions required by a given educational Website (for example hypermedia database access, VR exploration, complex information retrieval and processing or thematic index navigation). Finally, *Collaboration* and communication tools have an essential role in bringing learners together, be it for group tele-manipulation or synchronous chat.

Outline of a Taxonomy of Instructional Strategies for the WWW

The WWW is a medium where instructors can provide curriculum-integrated learning materials for students to engage in a wide variety of media-rich information discovery and collection, interpersonal exchange and complex problem solving. Nevertheless, some researchers have questioned the currently established theoretical basis and pedagogical use of the WWW as a medium (Windshitl, 1998; Doherty, 1998; Trilling & Hood, 1999; Mioduser, Nachmias, Lahav, & Oren, 2000) and have argued that future development of web-based instruction will require more clearly formulated strategies founded on firmer instructional-theory background. What is needed is a theoretical approach to instructional strategies for the WWW that includes a mechanism for its practical application and assessment. In the following section, we situate instructional strategies in the context of Salmon's *media attribute theory* and outline a taxonomy of instructional strategies for the WWW that aims to address some of these unresolved issues.

Following media attribute theory as described by Salomon (1979), four classes of attributes have the potential of affecting learning with media: contents, symbol systems, technologies and social settings and situations. The content that a medium typically conveys does not seem to lend itself as a useful distinguishing factor for instructional strategies using the World Wide Web considering its seemingly unlimited breadth of information. The available symbol systems of the World Wide Web, on the other hand, describing the modes of appearance of information using sets of elements interrelated by syntax, combine the symbol systems of many other media and allow the representation of information in modes from text-based to multimedia to virtual reality immersion. Technological attributes are responsible for the availability and accessibility of information and the way learners can manipulate and interact with it. In this context, the World Wide Web combines the processing capabilities of the computer with the inherent communication capabilities of the Internet. Social settings and situations describe the social context of the medium's typical use but are usually only partially associated with the use of the medium. In the case of the World Wide Web, however, the social setting of its use can be described as individual, collaborative within a closed community, or collaborative within an open group of learners.

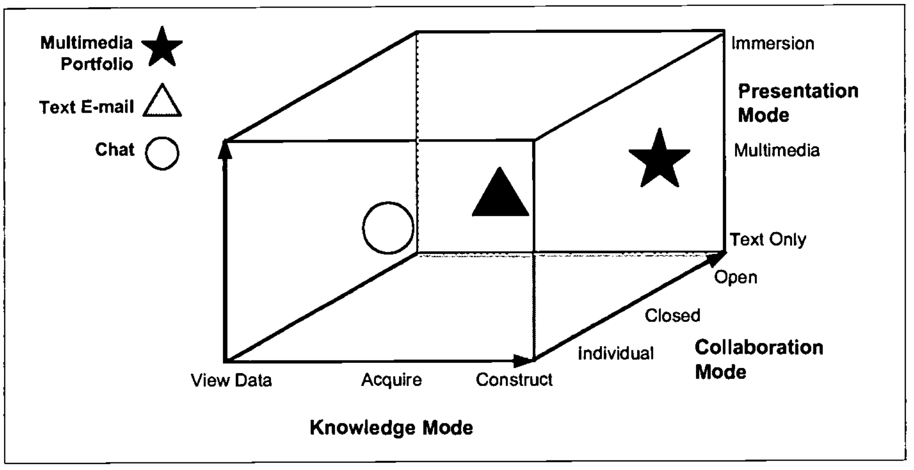

Figure 1. The three dimensions of instructional strategies for the WWW, comparing text-based e-mail, student-created multimedia-rich portfolios and simple synchronous chat.

In our review of the research literature on instructional strategies for the WWW, three dimensions emerge into which applications and adaptations of the WWW for instruction can be usefully categorized. These dimensions correspond very closely to the classes of media attributes described above. The first dimension relates to the epistemological approach taken to knowing and learning by describing how learning materials are organized, manipulated and created, see Fig. 1. This *Knowledge Mode* corresponds to the *content* and *technology* categories of media attributes, and describes the spectrum reaching from viewing information to the construction of meaning. The second dimension relates to the nature and complexity of the *Presentation Mode* that is used to represent information, from text-only to immersion in a virtual environment, which corresponds to the *symbol system* category of media attributes. The third dimension, *Collaboration Mode,* situates the instruction in a social setting and describes the level of interaction with other learners, such as individual work or collaboration, corresponding to the *social settings and situations* class of media attributes. In the following section, we demonstrate how this taxonomy can be applied to a case example.

Case Example

The case example for this paper is an online graduate course in Instructional Systems Design (ISD) developed by a team led by the first author at a large research university. The course had traditionally been delivered as classroom-based face-to-face instruction, but an increasing demand by students who had a long commute to the university or lived out-of-state prompted the discussion of offering an online section in addition to the classroom section. The course was developed using the Instructional Design Process as described, for instance, by Rothwell & Kazanas (1997) with some modifications to accommodate the WWW as delivery platform. The design of the online instruction for the ISD course is based on a combined constructivist and cognitive approach. The constructivist perspective was expressed in the idea that meaningful and relevant authentic situations and settings help learners construct their own meaning. The cognitive perspective included the ideas that learners differ in the way they perceive and process information and how they interact with their environments and with other learners, and that these processes and interactions need to be understood and supported in order to facilitate learning. The features of the course can be described in two tightly related categories: Instruction and Communication.

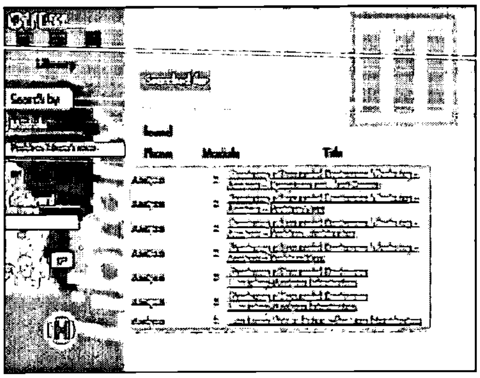

Figure 2. Online course: Case Library

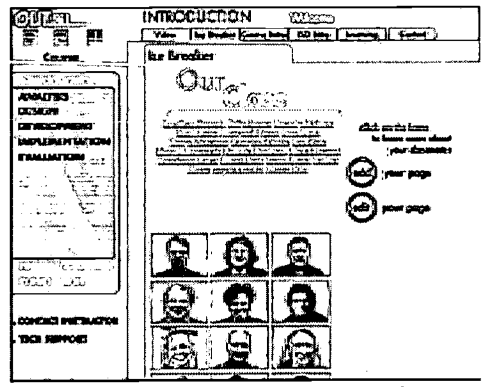

Figure 3. Online course: Ice Breaker

Instruction. Instructional strategies of the ISD course include features outlining the objectives, the visualization of the design process that is being taught, and brief video-based advance organizer lectures by the instructor, discussing the context of the materials covered in each module and how they connect to other modules.

To illustrate the course content with a practical example, a case study was employed that allowed learners to make the connection between the theoretical concepts discussed in the course and their practical application in a real-life situation. In addition, as a form of cognitive flexibility hypertext, students have access to a library of mini-cases that includes cases with different contexts for each of the phases described in the case study, see Fig. 2. These mini-cases allow learners to access materials that are relevant to their own life experience and that relate to the class projects they were working on. This feature also allows adding new cases to the library, enabling students to contribute to the learning process by submitting their own class projects as cases, thus sharing them with others.

Instructional Strategy	Knowledge	Media	Social Setting
Provide Instructional Goals	Acquire	Text/Animation	Individual
Visualize Process	Acquire	Text/Animation	Individual
Introduction/Lectures	Acquire/Construct	Text/Video	Individual
Library of Mini Cases	Construct	Text	Closed Collaboration
Email Correspondence	Acquire/Construct	Text	Open Collaboration
Bulletin Board Discussions	Acquire/Construct	Text	Open Collaboration
Ice Breaker	Acquire/Construct	Text/Image	Closed Collaboration
Vidco Conference Discussions	Acquire/Construct	Text/Video	Closed Collaboration
Chat Discussions	Acquire/Construct	Text	Closed Collaboration
Exercises w/ Feedback	Acquire/Construct	Text	Individual
Progress Feedback	Acquire/Construct	Text	Individual
Class Project	Construct	Text/Visuals	Individual

Figure 4. Instructional Strategies of Online ISD Course with Taxonomy applied

Communication. The communication component, integrated with the course materials, allows for various forms of synchronous and asynchronous interaction among students, between students and instructor, and between students and the course materials. The telecommunications applications used for asynchronous interaction are email correspondence, a bulletin board with threaded discussions, a feature to upload assignments to the instructor, and an ice breaker activity to let students get to know one another in the beginning of the course, see Fig. 3. In addition, synchronous meetings were held throughout the semester, using desktop video conferencing and chat.

The interaction with the course materials includes features of individualized content for each student. For example, exercises with immediate feedback give students an opportunity to see if they have understood certain key concepts covered in the course. Another feature showed students how much progress they had made in working through the course modules, and which assignments they needed to submit and when. The instructional strategies used in this course and their categorization following the proposed taxonomy are shown in Fig. 4.

While the categories of the proposed taxonomy are value-differentiated, i.e., neither end of the spectrum is generally of a higher instructional value than the other, they do allow for a critical evaluation of the balance of the presentation modes, types of knowledge and social settings used in the application, with respect to the stated outcome of the instruction. In this case example, we notice that the strategies are well balanced in the knowledge dimension, providing instructional strategies that emphasize the acquisition of knowledge as well as facilitate the construction of meaning. The media dimension, however, shows an imbalance with a tendency to use text to convey the information for an instructional strategy. Research in individual differences in learners and their effect on multimedia learning has shown that different individuals prefer to learn with different modes of representing information (Plass, Chun, Mayer, & Leutner, 1998), and this should be reflected in this course web site. The social setting dimension shows a combination of individual activities and open as well as closed collaborations. In other words, the instructional strategies of the site combine individual learning with collaboration in various forms.

Discussion and Conclusion

The objective for this three-dimensional taxonomy for instructional strategies was to help instructional designers evaluate instructional strategies for existing sites and develop new instructional strategies that take advantage of the particular characteristics of the WWW. For the evaluation of the conceptual design of an instructional environment, one might find that a media-rich virtual environment that facilitates constructivist learning could be restricted to a single user, for example when trainee engineers use immersive VR to learn about the installation or functioning of a new technical component. On the other hand, one could design a discussion board that may fulfill basic collaboration and knowledge creation objectives with textual information only. It is therefore not implied either end of each of the dimensions of the taxonomy would lead to more effective instruction in a web environment. Instead, each dimension of the taxonomy can be individually, partially or fully reflected to varying degrees, as befits the instructional objectives. The taxonomy does allow, however, to identify if such objectives or requirements as the availability of collaboration features, the support of learners with different presentation modes of information, or the design of a constructivist learning environment, were indeed conceptually met.

Another use of the taxonomy is that an instructional designer can design a course based on instructional objectives by selecting, based on the taxonomy, the web-based application or service to facilitate an instructional strategy that supports the objective. Here, the taxonomy would allow defining, based on the instructional objectives and the learning theory informing the design of the environment, the characteristics of the instructional strategies to be used to facilitate the objectives with respect to the three dimensions of the taxonomy. Once these characteristics are defined, the actual instructional strategy that reflects these characteristics can be chosen. In fact, based on this taxonomy, new instructional strategies could be conceived that are unique to the WWW as delivery medium and that have not been used for other media before. Indeed, the taxonomy can be applied independently of the ever-evolving network infrastructure, so that further research could include, for instance, the use of broader bandwidth networks and more advanced computer hardware.

Windschitl (1998) has suggested new paths towards researching the social setting for web-based learning, including assessing the effects of collaboration and interaction in web-based learning. In terms of the other two elements of the taxonomy outlined above, relevant questions for further research relate to *how* online media and knowledge manipulation tools can best be used for instruction, how learners utilize them and how teachers can exploit them in learning environments and evaluate their use too. This could help to give the model a more practical application.

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Facilitating the Mental Integration of Multiple Sources of Information in Multimedia Learning Environments

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Abstract: If multimedia learning is to be successfull, different sources of information need to be integrated into coherent mental representations. In many cases, however, the presentation and use of different sources of information does not result in the construction of appropriate mental representations. Starting from various potentials and problems of multimedia learning, the theory of structure-mapping is proposed as a framework which can be taken advantage of to design multimedia learning environments which systematically encourage and support the mental integration of multiple sources of information. A multimedia learning environment for statistics is described which has been implemented according to the design principles proposed.

Introduction

Multimedia learning environments commonly comprise different sources of information such as various linguistic as well as static and dynamic pictorial representations. In this context, it is frequently assumed that the (simultaneous) presentation of different and possibly complementary sources of information improves learning. During the last 10 years, however, psychological and educational research have collected extensive evidence that the presentation of different sources of information in multimedia learning environments might not only not improve but even impede learning. In many cases, the „obvious" benefits of multimedia learning environments vanish in the moment serious evaluation takes place.

In current psychological and educational theories it is hypothesized that different sources of information are processed by different mental systems (e.g., Mayer, 1997; Paivio, 1986; Schnotz & Bannert, 1999). It is proposed that linguistic information is processed by a verbal system and pictorial information is processed by a visual system. The theories differ in their assumptions about the connections between the verbal and visual system.

According to Paivio's (1986) dual coding theory, the construction of mental representations of linguistic information only takes place in the verbal system. The construction of mental representations of pictorial information, in contrast, takes place in the visual as well as in the verbal system. Mayer (1997) assumes that mental representations constructed by the verbal system are mapped to mental representations constructed by the visual system as well as the other way round. Schnotz and Bannert (1999) propose that mental representations of linguistic and pictorial information are integrated into a single mental model which corresponds to an analogous and modality-unspecific mental structure.

According to the theories of Mayer (1997) and Schnotz and Bannert (1999), successful learning in multimedia learning environments aims at the integration of linguistic and pictorial information into coherent mental representations. However, the presentation and use of different sources of information frequently does not result in the construction of appropriate mental representations. Up until now, it has remained an open question how the construction of coherent mental representations can adequately be supported in multimedia learning.
In the following, various potentials and problems of learning with different sources of information are summarized. Afterwards, the theory of structure-mapping is proposed as a framework which can be taken advantage of to design multimedia learning environments which encourage and support the mental integration of multiple sources of information and to construct coherent mental representations. Finally, the multimedia learning environment VISUALSTAT for statistics is described. This learning environment has been implemented according to the design principles proposed.

Potentials and Problems of Learning with Multiple Sources of Information

Potentially, multiple sources of information may improve learning in multimedia learning environments in various ways. For instance, different sources of information may be complementary, resulting in the construction of more complete mental representations of an application domain than a single source of information (e.g., Ainsworth, 1999). Furthermore, multiple sources of information may realize different conceptual perspectives on an application domain leading to the construction of multiple mental representations which can flexibly be used during problem solving, for example (e.g., Spiro & Jehng, 1990).
During the last 10 years, however, psychological as well as educational research demonstrated that the presentation of different sources of information in multimedia learning environments poses various problems to the students. Each source of information may rely on notations which are not familiar to the students. For instance, in many cases students are not able to identify visual and spatial structures in pictorial representations which would allow them to understand an application domain (e.g., Lowe, 1998). In other cases, students do not interpret the perceived visual and spatial structures conceptually (e.g., Weidenmann, 1994). Very often, such a lack of visual literacy is accompanied with illusions of understanding (e.g., Salomon, 1994).
The need to process different sources of information poses additional challenges to the students. For example, the students have to process larger amounts of information and to direct their attention simultaneously to different information (e.g., Lowe, 1998). Very often, these requirements overburden the students' cognitive capabilities resulting in only little learning (e.g., Sweller, 1993, 1994).
One of the most severe problems, however, may be the finding that students frequently do not systematically relate different sources of information to each other (e.g., Ainsworth, Bibby & Wood, 1996; Anzai, 1991; Kozma et al., 1996; Lowe, 1998; Peeck, 1993). As a consequence, these students fail to integrate the information into coherent mental representations. Their mental representations about an application domain remain fragmentary and - especially - disjointed. During problem solving, for instance, these students very often switch back and forth between different mental representations of a posed problem without being able to determine which representation contributes in which ways to the problem's solution (e.g., Anzai, 1991).
Although the use of multiple sources of information has the potential to deepen understanding, their coordination and integration does not take place on its own.

Facilitating the Integration of Multiple Sources of Information by Structure Mapping

We propose the theory of structure-mapping as a framework which can be taken advantage of to design multimedia learning environments which encourage and support the mental integration of different sources of information. Initially, Gentner (1983) modeled the construction of analogies between two application domains by means of structure-mapping. A structure is made up of objects and their attributes as well as relations between objects. According to Gentner's (1983) model, an analogy is constructed by (partially) mapping the mental structure which represents the familiar domain, named the base, onto the mental structure which represents the unfamiliar domain, named the target. In recent years, Gentner and Markman (1997) demonstrated how structure-mapping can be used to model how similarities among different objects are established.
We apply the model of structure-mapping as a means in order to encourage and support students to (1) externally relate different sources of information to each other and - as a consequence - to (2) mentally integrate the different

sources of information. In many cases, different sources of information in multimedia learning environments delineate structures which are (partially) related to each other. Because students rarely identify relevant structures and establish relations between them spontaneously, the model of structure-mapping can serve as a framework in order to guide the implementation of mechanisms into a multimedia learning environment which interactively and systematically (1) encourage the identification of structures relevant to an application domain and (2) support the construction of relations between the identified structures by (partially) mapping one structure onto the other.
In earlier research it has been demonstrated that students who actively relate different sources of information to each other construct more complete and more coherent mental representations of the application domain under scrutiny than students who do not (e.g., White, 1993). To know the relations between different sources of information also allows one to flexibly switch between them on the one hand and to integratively make use of them on the other hand during problem solving, for example (e.g., Anzai, 1991). Structure-mapping forms one means to guide the construction of such relations.

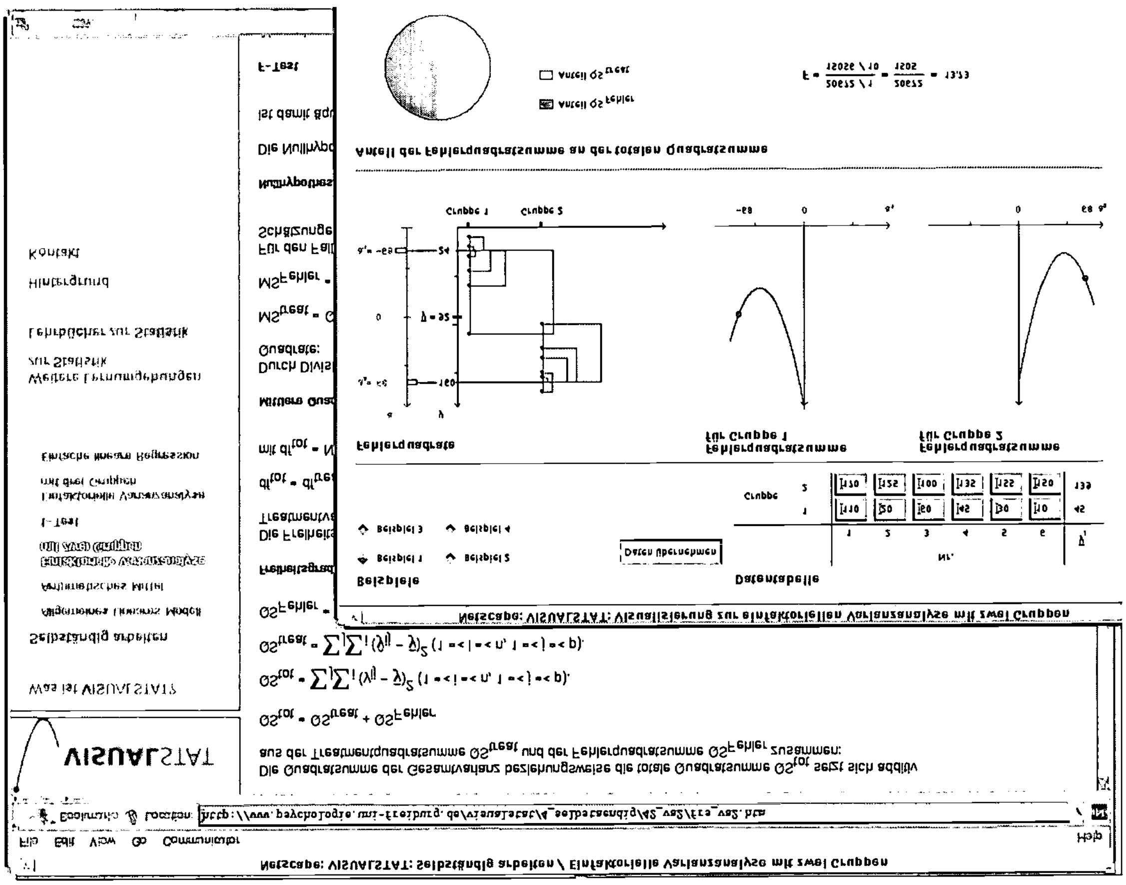

Figure 1. Different sources of information about the model and the methods underlying the one-way analysis of variance with two groups.

Supporting the Integration of Multiple Sources of Information in VISUALSTAT

VISUALSTAT is a multimedia learning environment for statistics for the social sciences in the World Wide Web (www.psychologie.uni-freiburg.de/visualstat/). It comprises different sources of information about various models and methods of statistics such as the general linear model, the method of least squares and the partition of the sum of squares. These models and methods underlie frequently applied procedures in statistics such as the t-test, the (one-way) analysis of variance and the (simple) linear regression (e.g., Hays, 1994). VISUALSTAT does not make up a complete and self-contained learning environment which is intended to be used instead of a textbook. It rather complements a textbook. While textbooks describe the considered models and methods almost always exclusively by means of text and algebraic equations, VISUALSTAT additionally visualizes them dynamically and interactively (see Figure 1). The dynamic and interactive visualizations draw a student's attention to properties of the considered models and methods which frequently remain unrecognized or misunderstood in traditional statistics courses.

VISUALSTAT can be used in two different modes: (1) self-guided and (2) guided learning. The mode of self-guided learning aims at students who are already familiar with the dynamic and interactive visualizations in VISUALSTAT. These students are encouraged to take advantage of the different sources of information according to their own learning objectives and information needs.

The mode of guided learning aims at students who are unfamiliar with the dynamic and interactive visualizations. These students receive guidance according to the design principles described above. Firstly, in order to avoid cognitive overload, one visualization after the other is presented to the students.

Secondly, the students are encouraged to interactively and systematically map step by step components of the (familiar) textual and algebraic representations to components of the (unfamiliar) graphical representations in order to learn (see Figure 2): (1) which components make up the visualizations, (2) how the text, the algebraic equations and the visualizations are related to each other as well as (3) how the different visualizations are related to each other.

Every time a mapping is completed, the students are informed about the correctness of their mapping. If students repeatedly construct an incorrect mapping, the correct one is explained to them.

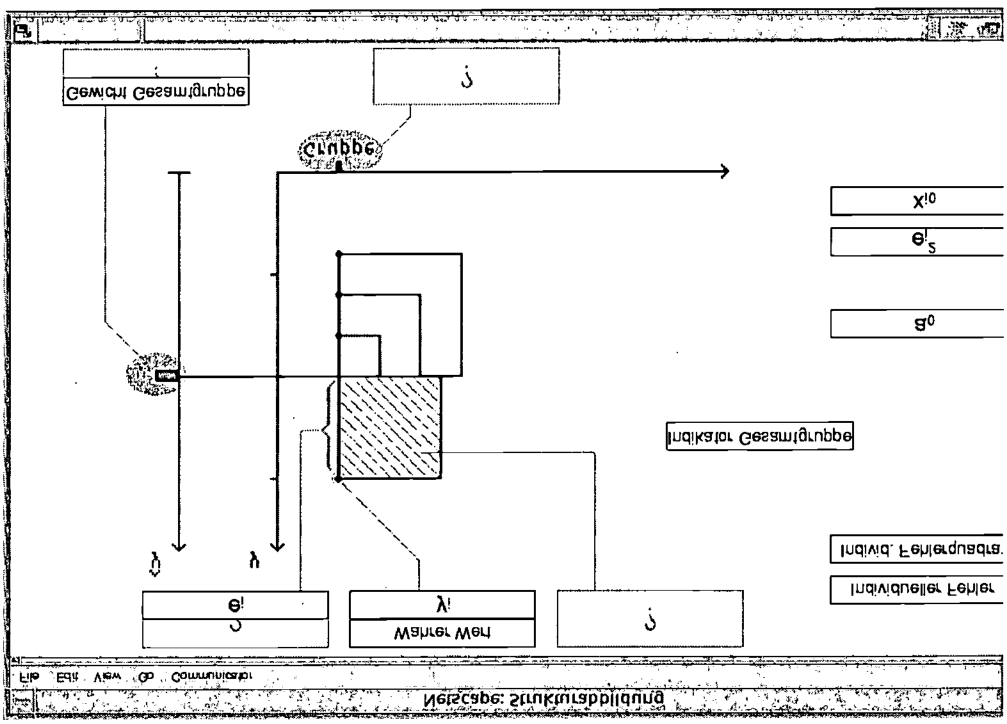

Figure 2. Interactive mapping of components of textual and algebraic representations to components of graphical representations underlying the mean.

Discussion

Although multimedia learning environments potentially may improve students' learning in various ways, they also may impede learning. For instance, students frequently do not systematically relate different sources of information to each other in multimedia learning. As a consequence, their mental representations about an application domain remain fragmentary and disjointed.

In empirical studies which revealed these problems it is very often concluded that learning in multimedia learning environments needs to be supported (e.g., Ainsworth, Wood & Bibby, 1996; Peeck, 1993). However, until now, only a few measures have been proposed to support multimedia learning (e.g., Mayer, 1997; Sweller, 1993, 1994). The measures which have been proposed keep the students in perceptive and rather passive roles. They focus on how different sources of information should be presented to the students in oder to facilitate the students' learning (e.g., Mayer, 1997; Sweller, 1993, 1994).

In this paper, we proposed a form of support which places the students in active roles. It focuses on how the students' mental processing of the presented information can systematically be encouraged and supported. Our proposal was based on the theory of structure-mapping (cf. Gentner, 1993). According this theory, two sources of information can be related to each other by (partially) mapping structures from one source of information onto structures in another source of information.

The multimedia environment VISUALSTAT was equipped with mechanisms which implement the proposed principles. In VISUALSTAT, the students are guided to relate different sources of information to each other by (1) identifying the relevant structures in the information presented and (2) constructing mappings between the identified structures. We are convinced that the activity of systematically relating different sources of information to each other will result in the construction of more complete and more coherent mental representations. Currently, we are designing an experimental study which will be conducted in order to formally evaluate the learning effects of the support mechanisms implemented in VISUALSTAT.

Acknowledgments

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Changing Role of Teachers and Learners in Web-based Education

"**Abstract**:" The objective of this paper is to address the question of the changing conception of knowledge at present and the need for institutions of higher learning and educators to reconceptualize the notion of knowledge and learning in order to keep in line with the changes in the society. Furthermore, I will argue that it is necessary to develop teaching methodology that can function effectively in the new technologically-grounded paradigm that is evolving in the realm of the social and the economical on a global scale today. This paper is based on my experience in developing, designing and delivering a web-based Spanish Civilization course at the University of Arizona, Tucson.

Learning Environment

The Spanish Culture and Civilization course, Spanish 430 was taught during Summer Session I, 2000 at the University of Arizona, Tucson. It was unique in that it gave students the freedom to access class resources at any time, from any internet-connected computer in the world. Indeed, while many students in the Tucson area used the Web to read class materials, many others took part in class discussions and completed their assignments from Phoenix, Flagstaff, and Nogales, Arizona, San Diego and Los Angeles, California, and even from as far away as Spain and Italy. The course lessons were divided into three broad categories: *La Tierra* y *El Pueblo*, *Poetas*, and *Pintores* (The Land and People, Poets, and Painters, respectively). Each of these categories was divided into subsections where class readings, practice quizzes, and discussion topics could be found. All class readings included images, photos, maps, audio and video materials along with text, and a dictionary feature that instantaneously provided word definitions at the click of a mouse.

One of the most innovative features of the course was a collaborative project. Students were required to form groups of three and read Spanish newspapers during the five-week period of the class, paying close attention to a particular news story and the manner it was presented in the Spanish news media. At the end of the course the groups presented their observations in the form of essays.

Student participation was facilitated principally through a section of the course called *Mesa Redonda*, but also through available chat rooms and e-mail. *Mesa Redonda* was a virtual round table where students were required to both post their thoughts on class lessons and read the postings of their classmates. During the five weeks of this course, there were over 500 postings. Students also had the option to use chat rooms to ask specific questions about class materials during the professor's virtual office hours, or were able to have their technical questions addressed by the Technology Preceptor of the course. Chat rooms also provided for students who were in different areas of the world a means by which class readings and projects could be discussed in real-time. Students also made use of both the class e-mail system and their own e-mail accounts to discuss class topics and have their questions answered.

The designing, developing and delivering this experimental course presented me with several challenges and made me think about teaching and learning in the age of technology.

Technology and teaching

Technological innovation, the demands of global economy and the drive towards a cost-effective education are forcing educators, administrators and students alike to incorporate new and innovative technologies into education. Consequently, the virtual-classroom has emerged as an alternative to the traditional classroom as well as conventional distance learning courses. However, the virtual-classroom is yet to realize its full potential. Teaching and learning in a virtual-classroom cannot be conceived as a simple enhancement of the delivery of customary text-based materials, nor should it be thought only as freedom on the part of learners to access materials outside the confines of physical classroom and text. Technologically-oriented education in its present state continues to rely on traditional pedagogy. This approach will be unable to cope with the new paradigm that is redefining the society in hitherto unknown ways. The challenge for educators is to evolve new methodologies wherein the concept of teaching and learning has to be thought anew.

Knowledge in Information Age

The technological innovations and societal changes over the last fifty years have profoundly transformed the concept and utility of knowledge. Jean-François Lyotard in his book *The Postmodern Condition: A Report on Knowledge* characterizes knowledge in the postindustrial age as "payment knowledge" and "investment knowledge" (Lyotard, 1984, p. 6). While the "payment knowledge" is "units of knowledge exchanged in daily maintenance" the "investment knowledge" is "dedicated to optimizing the performance of a project" (Lyotard, 1984, p. 6). However the educational institutions-unaffected by changes in half a century—conceive knowledge as an end in itself. The academics envision the universities as places for pursuing whole body of human knowledge, therefore "research and the spread of learning are not justified by invoking a principle of usefulness" (Lyotard, 1984, p. 34). These two forms of conceptualizing knowledge today are the undercurrent of conflict witnessed between the communities and legislatures who demand greater accountability from academics on the one hand, and the universities that defend their freedom on the other. Wedding Internet technology and education as solution for this conflict is a losing preposition because these two groups views of knowledge are radically different. The possible resolution lies in institutions of higher learning reconceptualizing their idea of knowledge and its pursuit.

Teaching in classroom

Teaching in a traditional classroom takes place in a narrative framework: sender, receiver and referent. The teacher is the sender who stands before a class and transmits information during sixty minutes. The receivers are students who patiently wait for sixty minutes to pass, and the textbook, a bound volume of knowledge, is the referent. This narrative model does not have an inbuilt mechanism to foster teacher creativity and learner involvement. They are left largely to the personal initiative of senders and receivers. The anecdotal experience of most of those who went through colleges and universities demonstrates that they have had one or two teachers who inspired them to learn and one or two courses where they really learned.

The dissonance teachers experience between teaching and learning in the classroom is the reflection of the conflict between the two notions of knowledge I referred to earlier. The student body that enters academia is drawn from a society affected by the technological changes. They are exposed to a different form of information mapping and they process that information in a different way. Television and videogames, major sources of information and interaction, are episodic in nature, task-oriented and use-determined. However the narrative models of teaching and learning ensue an accumulation of large body of knowledge whose goals and utility may or may not be realized at a later date.

Challenges of a virtual-classroom

The Internet, so far, is the maximum achievement of the technological revolution. If web technologies are to be used in education, the concept of knowledge, how it is presented and for what purposes it is used has to be rethought. Without this reconceptualization of knowledge, publishing lessons and class notes on web with few added features such as note taking, search and visuals will be a mere translation of narrative model to Internet. Using the web as a delivery mechanism of traditional classes will be counterproductive because research has shown that students have not taken to reading on screens. Moreover, web learning eliminates the many benefits of live interaction in a classroom.

In a fixed classroom an innovative teacher responds immediately to evolving dynamics of the course through interaction with students and by evaluating students' responses to the material and teaching style. However in the web-delivery such spontaneity is missing. The course cannot be redesigned or reoriented at such short notice. One potential solution is to incorporate as many scenarios as possible into course design and use the multimedia interactions. The teacher in a virtual-classroom has to forgo his or her role as transmitter of knowledge and become facilitator of learning. For this to occur the students have to be trained to play a new role, that is of active learner instead of passive listeners. My experience has taught me that both, the role of teacher and student have to be rethought and reengineered in adopting technology in education and creating virtual-classrooms.

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A COLLABORATIVE ENVIRONMENT FOR VISUAL REPRESENTATION OF THE KNOWLEDGE ON THE WEB - VEDA

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Abstract: This article presents the advance of an inquiry project whose objective is the development of new cognitive tools that make possible the handling question of communication and cooperation on the Internet universe, where the pupil can be considered as an agent who can learn from the interaction with objects of the domain or other situated agents in remote points. The environment integrates collaborative learning, distance education and conceptual graphs, resulting in a tool that is actual been implemented.

1. Introduction

The collaborative learning on the basis of the distribution cognition theory, suggests that the knowledge is not an object acquired and possessed for the individuals, but it is inlaid in the social relations, in the identity of the apprentices, in the social conversations and speeches (Jonassen, 2000). The new applied technologies for distance education has taken the process of learning beyond the limits of the classroom. The Internet has been showed as a basic factor in the dimension processes of distance education, promoting the creation of computational communities directed to learning. In this context, of collaborative learning and distance education, is inserted the VEDA environment, a visual tool (graphical) for organizing and indexing the knowledge, based on conceptual graphs (semantic networks). Professors and pupils build the knowledge of a course domain, identifying concepts, constructing relations (connecting links between concepts), organizing ideas, reflecting the learning process and evaluating strong points (better assimilation) and weak (deficiencies) of the learning. The activities are carried through synchronous and/or asynchronous conferences, where the actions are visualized by all, identifying the author. They allow discusses about the domain on a collaborative form (argument, negotiation and explanation) objectifying the construction of the knowledge.

2. Indexing with Conceptual Graphs and Hypertext

The conceptual graphs (Sowa, 1984) provide a form to represent knowledge through the ontology (application domain) and logic (logical first-class). Following its formalism, we can represent graphical form in linear form and create a computational model. This computational model together with the features of hypertext, allows indexing the knowledge in HTML format. With canonical graphs it is possible to standardize the creation of conceptual graphs. Thus, we must follow the described steps in Table 1, for create activities:

Step	Task	Module (Architecture)	Properties
Step 1	Creation of an Ontology of concepts and relations. Insertion of axioms.	Ontology publisher	Obligator, synchronous and asynchronous conference.
Step 2	Creation of canonical graphs	Canonical graph publisher	synchronous and asynchronous conference
Step 3	Creation of conceptual graphs	Conceptual graph publisher	synchronous and asynchronous conference
Step 4	Browser and query	Browser and query interface	Individual, synchronous conference

Tab. 1. Steps to create an activity.

We use the ontology publisher to create ontology of concepts and relations. The creation of an ontology also can be considered as an activity to be executed on the environment. Professors (specialists) and/or pupils, congregate themselves in a conference about a determined subject. The axioms are created together with the definitions of concepts and relations. The creation of canonical graphs imposes restrictions to concepts and relations. The pupils can create URL for other pages HTML from the concepts and relations, generating a Web browsing for the environment. The query environment uses canonical formation rules for expansion and restriction. Thus, we can generalize or specify the knowledge for the information retrieval.

3. Architecture VEDA

The architecture has three general properties: visual environment of the knowledge, graphical form, allows to create and remove concepts, relations and arrows; collaborative learning environment, where synchronous and asynchronous conferences occurs to the resolution of an activity; Web environment, heterogeneous platform, where the only requirement for the equipment is to provide a Web browser. The architecture is divided in four main modules: *Pre-processing*. It has the function of assisting the execution of the management modules, as conversion of pre-defined formats. Conversion from GML (Graph Modeling Language) to CGIF (Conceptual Graph Interchange Format) and conversion of conceptual graphs from linear form to CGIF. *Management*. It receives formatted data from the Interfaces and execute functions pre-defined for edition, query and browser the environment. Moreover, they manage all the data communication for the conference. Act, also, in the processes of recording documents together with the repository module. The inference machine acts inside of this set to verify if canonical graphs and conceptual graphs are compatible, if concepts and relations follow the defined axioms and execute rules for restriction and expansion of conceptual graphs. *Repository*. It stores the documents involved on the conference. All the documents have HTML format. The involved documents are: conceptual graphs, literal chat, ontology and canonical graphs. *Interface*. It acts directly with the user. It's executed in Web browsers as Netscape and Internet Explorer. It has an applet Java to graphical view the data stored in the repositories.

4. Conclusion

The environment presents a tool that integrates collaborative learning and distance education, allowing the planning and accompaniment of the activities that assist the collaborative construction of the knowledge. In such a way, beyond the direct and indirect communication (synchronous and asynchronous), modules of planning and development activities, and perception of thc participants actions are considered. The creation of conceptual graphs allows to a semantic mapping of the information, organizing the ideas. Its junction with hypertext, provides the indexing of knowledge and browsing Web pages. The use of the environment promotes the formation of a VEDA community to share knowledge.

5. Acknowledge

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Animated Agents for Language Conversation Training

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Abstract: Animated agents are cartoon-style characters that facilitate the learning process. We take an animated agent approach to improve English conversation skills of Japanese students. In particular, we use animated agents as conversational partners in interactive role-playing environments (theater, drama, and games). In order to engage the language student, animated agents feature believability-enhancing behaviors such emotional responses and social competence.

Motivation

Recent years show a growing interest in animated agents to enhance learning in computer-based interactive learning environments (Johnson et al. 2000). Lester and colleagues (1999) promote *animated pedagogical agents* for their motivational role in the learning context, in addition to the possibility of increased learning effectiveness. In this empirical study, they show the affective impact of animated agents on students' learning experiences, that revealed the so-called *persona effect*: "[...] which is that the presence of a lifelike character in an interactive learning environment [...] can have a strong positive effect on student's perception of their learning experience."

Encouraged by those results, we recently started a project with the aim to employ animated characters for the pedagogical task of language training. Specifically, the animated agent approach will be used to improve English conversation skills of native speakers of Japanese. Serving a similar purpose, *Native World* (Oki Software), a commercial software tool, allows users to practice English by interacting with native English speakers displayed in video clips. Instead of preparing video clips for all possible dialogue moves, we believe that animated characters give more flexibility without sacrificing pedagogical effectiveness. Moreover, we envision client-side execution in a web browser as the learning environment.

In a typical conversation-training situation, the user interacts with one or more characters, and plays the role, e.g., of a customer in a virtual interactive coffee shop. The programmable interface of the Microsoft agent package is used to control and display the characters involved in the conversation. The animated characters available for this package are endowed with a variety of behaviors ('animations'), speech recognition, and a text-to-speech engine. To keep the students motivated, strong emphasis is put on the *believability* of the animated characters, by giving them rudimentary personalities, emotion expression, and social role awareness.

The next section describes our language conversation training system. We will introduce two kinds of agents, AIs and scripted non-player characters. After that, we conclude the paper.

Affective Agents as Conversational Partners

So far, we implemented three role-playing scenarios. In our interactive theater, the user may take the role of Rosencrantz, the companion of Guildenstern in Tom Stoppard's famous play. Our interactive drama offers the role of a customer in a virtual coffee shop. In line with the popularity of computer games, we also developed an interactive role-playing game, the *Wumpus World*. When first starting a session, the Microsoft Agent library is automatically downloaded, the only requirement is to run Microsoft's Internet Explorer 5.0 or newer.

Similar to game developers, we distinguish between AIs and scripted non-player characters. AIs are autonomous agents that serve as dramatically interesting conversational partners for the user. Scripted non-player characters, on the other hand, are scripted agents that simply run predefined scripts.

Autonomous Agents

It is widely accepted that animated characters with believable emotional and social behavior are an important contribution to make learning environments more enjoyable and fun for users. Hence, each character involved in a role-playing interaction with the user has its own mental model, and is able to reason about its affective state and the social context.

An agent's mental model contains different kinds of entities, including world knowledge (beliefs), affective states (emotions, moods, personality traits), and goals. Our *affective reasoner* derives from the influential 'cognitive appraisal for emotions' model of Ortony, Clore, and Collins, also known as the OCC model (Ortony et al. 1988). Here, emotions are seen as valenced reactions to events, other agents' actions, and objects, qualified by the agent's goals, standards, and preferences. The OCC model groups emotion types according to cognitive eliciting conditions. In total, twenty-two classes of eliciting conditions are identified and labeled by a word or phrase, such as 'joy', -confirmed', or 'angry-at'. Emotional states, however, cannot be directly mapped to emotion expressing behavior, as emotional responses largely depend on an agent's personality and the social context in which the conversation is embedded. Thus, we place so-called *social filter programs* at the interface of the module that reasons about emotion (the affective reasoner) and the module that renders the emotional state to actual behavior. Basically, a social filter program consists of a set of rules that encode qualifying conditions for emotion expression. Emotions are then expressed in accordance with the vocal effects associated with Ekman's 'basic emotions'. E.g., if a character expresses the emotion 'happiness', its speech is typically faster, higher-pitched, and slightly louder. In effect, we achieve that characters react reasonably when interacting with the user, which makes them believable and even compelling conversational partners.

Prolog programs implement all reasoning related to conversation management and agents' mental models, i.e., affective and social reasoning. Jinni 2000 (BinNet Corp.) is used to communicate between Prolog code and the Java objects that control the agents through JavaScript code.

Scripted Agents

Some agents are not directly involved in the interaction with the user. Typically, those characters are used as 'background' characters, e.g., as visitors in a coffee shop whose conversation the language student can listen to. Scripted non-player characters possess all features of the AI characters (e.g., emotion expression) except for the reasoning component. Although conceptually easier than autonomous agents, it turned out to be very time consuming to control them with JavaScript. E.g., consider a dialogue between two characters that fulfills communicative functions related to initiation/termination of the conversation, turn-taking, and back-channel feedback. Even for a short episode, a prohibitively large number of 'requests' have to be set due to the inherently parallel nature of a conversation, e.g., one character is nodding while the other character is speaking.

Hence, we use an XML-style markup language called MPML that supports easy scripting of characters and easy integration of other media components (Ishizuka et al. 2000). MPML (Multi-modal Presentation Markup Language) was originally developed for the purpose of creating animated web-based presentations.

Conclusion

In general, we believe that animated agents offer enormous promise for interactive learning environments. Despite the early stage of animated agent research, it seems likely that this new generation of learning technologies will have a significant impact on web-based education and training. Although speech output sounds somewhat artificial and language understanding is highly restricted, animated agents behave in surprisingly lifelike ways. However, there is still a long way to go to make animated characters truly social and conversational. Also, we have to gain a better understanding of exactly which features make animated agents engaging as conversational partners or pedagogically effective as virtual tutors. We envision the animated agent approach as a new paradigm in computer-assisted (language) learning, and continuously strive to make this vision come true.

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Architectural Aspects of a Web-Based ITS for Teaching New Information Technologies

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Abstract: In this paper, we present the architecture of a Web-based Intelligent Tutoring System (ITS) for teaching new information technologies (e.g. Internet). The system is addressed to high school teachers. It contains a variety of courses starting from introductory topics addressed to beginners and scaling up to more advanced topics. Its distinctive functionality is its ability to tailor the presentation of the educational topics to the users' diverse needs. This is accomplished by using AI techniques to record each user's learning model as well as the various pedagogical decisions. The teaching process is under the control of a hybrid expert system.

1 Introduction

Numerous computer-based systems have been used in education during the last decades. The first such systems were called Computer Aided Instruction (CAI) systems. Those systems were quite effective in helping learners. A major disadvantage, however, was the fact that they did not take into account the user's knowledge level and skills. They were thus unable to adapt instruction to the individual's needs. These drawbacks gave rise to a new generation of education systems known as Intelligent Tutoring Systems (ITSs). An attractive feature of these systems is their ability to adapt the presentation of the teaching material to the needs and abilities of the individual users (Aiello et al. 1993; Woolf 1992; Vassileva 1997; Stern & Woolf 1998; Brusilovsky, Kobsa & Vassileva 1998). This is achieved by using Artificial Intelligence techniques to represent the pedagogical decisions as well as information regarding each student. For these reasons, ITSs have become extremely popular during the last years and have been shown to be quite effective at increasing their users' performance and motivation (Beck et al. 1996).

ITSs were usually developed as stand-alone systems. However, the emergence of the World Wide Web offers the potential for revolutionary changes in education at all levels. The Web gives an educational system such as an ITS, the chance to reach many real users. In this way, its functionality can be tested with numerous and diverse cases (Stern, Woolf & Kurose 1997).

In this paper, we describe the architecture of a Web-based ITS for teaching new information technologies (e.g. Internet). The system is addressed to high school teachers. It contains a number of courses starting from introductory concepts appropriate for beginners and scaling up to concepts for more advanced users. The system models the students' knowledge state and abilities. Based on this information, the appropriate pedagogical strategy for teaching each individual user is selected. Moreover, the corresponding teaching material is chosen.

This paper is organized as follows. Section 2 presents an overview of the system's architecture and afterwards describes in detail its component parts. Section 3 deals with implementation issues. Finally, Section 4 concludes.

2 System Description

During the last decade, computer technology has been introduced in many Greek high schools. A variety of computer-based systems have been used to support teaching activities, thus increasing the students' performance and motivation. Teachers are also provided with various generic tools facilitating the creation of educational applications. It is clear though that they needed some sort of training in new technologies. Teaching, however, people with quite different knowledge backgrounds may turn out to be a rather difficult task. Our Web-based system intends to cover this gap by offering a user-adapted framework for teaching new information technologies.

Conventional Web-based educational systems exhibit some special characteristics such as the following:

(i) They are addressed to people having different goals, interests and knowledge level.

(ii) The studying motives of the traditional teaching process due to the competition among the trainees and the direct contact with the tutor are missing.

(iii) The courses are static meaning that they do not adapt to the trainees' needs.

(iv) The Web imposes restrictions on the users' interaction with the system.

(v) The Web as an educational medium does not offer mechanisms of focusing the teaching process on specific pedagogical goals.

Our system is aiming to develop methods and tools dealing with the teletraining of persons with different traits and skills. The following figure (Fig. 1) depicts the basic architecture of the ITS. It consists of the following components:

(a) the domain knowledge containing the teaching material

(b) the user model which records information concerning the user

(c) the pedagogical model which encompasses knowledge regarding the various pedagogical decisions

(d) the user interface.

As shown in the figure, the domain knowledge and the pedagogical model are parts of an expert system aiming to control the teaching process. The remaining part of this section will elaborate on the system's key aspects.

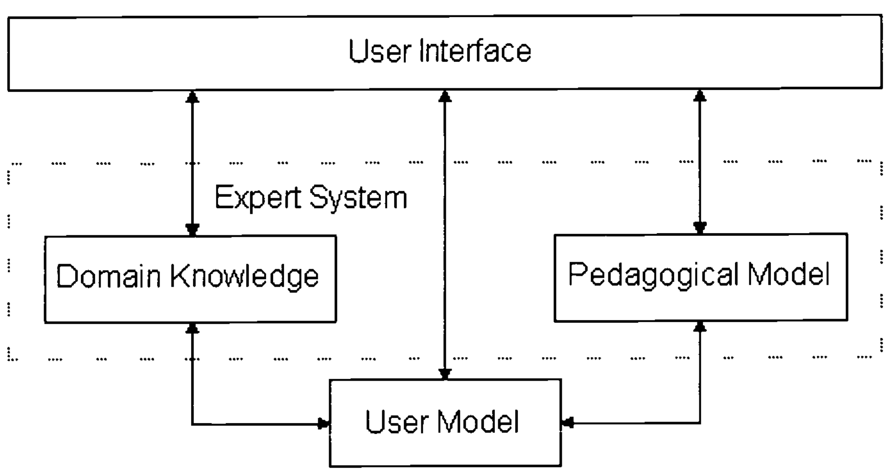

Figure 1: Architecture of the ITS

2.1 Domain Knowledge

The domain knowledge contains the teaching material presented to the system's users. The teaching material involves a variety of courses starting from introductory topics and scaling up to more advanced ones. The educational content of each course is distributed in sections, subsections and topics.

Each course unit is associated with a number of knowledge concepts. These can be either goal or prerequisite concepts. Prerequisite concepts are required to be known by the user in order to grasp the knowledge related to the goal concepts. The concepts are related to each other by describing each one's prerequisites and outcomes.

Each topic comprises a series of educational screens containing theory as well as examples. The examples assist the user in grasping the theory's key points. The number of presented examples depends on the user model. A user with high acquisition skills will be presented a small number of examples in contrast to a user with low such skills. The teaching material also contains various problems based on the examples. Each problem is associated with an explanation assisting the user in case of a wrong answer.

The course units are presented in a variety of ways, such as interactive simulations, hypertext, appropriate images and animations. This depends on the multimedia type the user prefers to interact with. These user preferences are part of the user model (section 2.2). To facilitate the selection of the material, each course unit is associated with attributes denoting which type of user preferences it corresponds to.

2.2 User Model

The user model records information concerning the user and regarding his/her knowledge state and traits (Beck et al. 1996; Anderson 1993). This information is vital for the system's operation according to the user's needs. However, such data may be difficult to gather because it is not easy to represent the user's knowledge abilities. Moreover, the nature of the Web imposes certain constraints on the system's perception of the user. For the time being, it is difficult and time-consuming to record every user action. Furthermore, it is clear that the user model should not contain unnecessary information so that the system will not be encumbered with useless interactions.

A user model used quite often in the past by other educational systems and which is used in our system is the overlay model (Carr & Goldstein 1977). In this model, the user's knowledge is considered to be a subset of the knowledge perceived by an expert in the learning field. Using this representation, the system presents the educational material to the user so that in the end his/her knowledge matches the expert's knowledge. A primary disadvantage of the overlay model is its inability to represent possible misconceptions from the user's part. For this reason, other learning models are often used such as the bug catalogue or its successor, the bug-parts-library.

The user model is based on the concepts associated with the course learning units. Further information modeled in the system concerns the user's acquisition and retention skills. Acquisition pertains to how fast a user learns new concepts. The system's response during its interaction with a user determines how high or low these skills are estimated to be. In addition, the user preferences regarding the multimedia type (e.g. text, images, and animations) of the course units is recorded. These preferences are recorded when the user obtains an account but he/she also has the option to change them during the teaching process.

Only registered users have access to the system. In this way, the system is able to record their knowledge state as well as their learning skills. A registered user identifies himself/herself to the system whenever logging on by giving a valid login name and password. An unregistered user must first submit to the system information about himself/herself (e.g. name, email address, multimedia type preferences) in order to obtain an account and access to the system's functionality.

2.3 Pedagogical Model

The pedagogical model represents the teaching process. It provides the knowledge infrastructure in order to tailor the presentation of the teaching material according to the information contained in the user model. The pedagogical model encompasses decisions involving the various teaching strategies. These strategies determine how a teaching course should be planned. Moreover, the pedagogical model possesses knowledge regarding the selection of the various course units according to the user's preferences.

2.4 Expert System

The pedagogical model and the domain knowledge are parts of an expert system controlling the teaching process. The expert system has an inference engine in order to make decisions based on the known facts. In addition, explanations concerning the solution of complex problems are provided.

Symbolic rules constitute a popular knowledge representation scheme used in the development of expert systems. The corresponding rules reflect an expert's knowledge in the field of educational software and they are elicited mainly through interviews. Rules exhibit a number of attractive features such as naturalness, modularity and ease of explanation. They are a typical approach to symbolic knowledge representation. One of their major drawbacks is that the interaction with the expert may turn out to be a bottleneck causing delays in the system's overall development.

During the last years, artificial neural networks are used quite often in the development of expert systems. Neural networks represent a totally different approach to the problem of knowledge representation known as connectionism (Gallant 1993). Some advantages of neural networks are their ability to obtain their knowledge from training examples (reducing the interaction with the experts), their high level of efficiency and their ability to represent complex and imprecise knowledge.

In our system, we adopt a hybrid approach integrating symbolic rules with neurocomputing (Hatzilygeroudis & Prentzas 2000). Our goal is to augment the corresponding advantages of these two knowledge representation formalisms and to simultaneously minimize their disadvantages. Other known hybrid approaches have proven to be quite effective (Medsker, 1994).

2.5 User Interface

The user interface is responsible for the system's interaction with the user. Due to the fact that it is a layer of the system that communicates directly with the user it should be carefully designed (Kommers, Grabinger, Dunlap 1996).

Primary aspects of the system's user interface are the following:

(a) Interactions, flow, or navigation between screens or other various parts of the system
(b) Interrelationships between messages within the system
(c) Screen designs and
(d) Messages to the user that keep him informed and grasp his/her interest. This feedback takes the following forms:
  (1) Status messages will be used to show progress of a task being performed.
  (2) Warning messages let the users know the consequences of the action to be performed.
  (3) Correctness feedback indicates whether an action or response is correct or not.
  (4) Navigational feedback shows the users where they are in the program. This is particularly important because the structure of the system will not be necessarily hierarchical.

We can distinguish two basic views as far as the users are concerned:

(i) *General view:* In the general view, the user can access all available teaching material by navigating through the sections, subsections and the topics of the application.
(ii) *Administrator view:* In the administrator view, the user can establish login names and passwords for the users of the system. Furthermore, the user can update the pedagogical model and the domain knowledge either by inserting new items or changing and removing existing ones.

Only the system's administrator has access to the administrator view. The general view is used by the trainees as well as by the administrator.

2.6 Offline Communication Among Users

The system provides an 'offline' way of communication among the system's users via an electronic bulletin board. The bulletin board is a shared location for posting and viewing electronic announcements in a simple text format. Each announcement contains its subject, its submission date, the author name and its body.

The user is able to send replies to announcements and replies to replies creating thus a chain of messages. Furthermore, he/she can sort all types of announcements according to their subject and submission date, "filter" the announcements he/she wants to view depending on their submission date. Additionally, the user sees which announcements were altered or posted later than the last time he/she logged on the system. The purpose of the bulletin board will be to increase the collaboration among the system users.

3 Implementation Aspects

The system is still under development and a prototype of it is on the way. The development of the system is based on the Microsoft Internet Information Server for Windows NT. The MS SQL Server is used to implement the databases containing the educational material and users' profiles. Active Server Pages and C CGI scripts manipulate the information stored in the databases and dynamically produce the contents of the applications presented to the users.

4 Conclusions

In this paper, we describe the design of a Web-based Intelligent Tutoring System (ITS) for teaching new information technologies. The system is addressed to high school teachers. It will offer a variety of courses starting from introductory topics addressed to beginners and scaling up to more advanced topics. The system tailors the presentation of the teaching material to the diverse needs of its users. It consists of the following four components: the domain knowledge, the user model, the pedagogical model and the user interface. The domain knowledge contains the teaching material. The user model records information concerning the user's knowledge state and preferences. The pedagogical model encompasses the various pedagogical decisions regarding the planning of the course and the selection of the course units based on the user's preferences. Finally, the user interface is responsible for the interaction with the users trained in the specific teaching subject and with the system's administrator. A hybrid expert system incorporating the domain knowledge and the pedagogical model controls the teaching process.

The system will acquaint high school teachers with modern computer technologies by enriching their knowledge in education software. Its adaptability will make some kind of teaching possible without the assistance of a tutor. The Web's universality will enable many users to gain access to the system's operations and consequently, its functionality will be tested with numerous and diverse cases. Significant conclusions regarding the system's efficiency will thus be drawn. A future goal will be to use methods of Distributed Artificial Intelligence (Solomos & Avouris 1999) to achieve communication between our system and other intelligent systems with similar subject domains such as the adaptive hypermedia system described in (Papanikolaou, Magoulas, Grigoriadou 2000).

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Students' Use of the Internet as a Help to Write Essays

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Abstract: An online survey addressing students and teachers was set up to get an insight into the use of the Internet for teaching purposes in Germany. Taking physics education as an example we are investigating students' use of the WWW and the corresponding learning outcome in a school related setting. Students aged around 17 are asked to write an essay on a topic taken from the German curriculum. The only help provided is access to the WWW and a word processing program. By analyzing both the strategies of their work with the Internet and the gained knowledge, the main aim is to find correlations. The identification and description of effective strategies will lead to a better understanding of the students' work with the WWW and hence can improve their Internet performance when using it as a help to learn.

Introduction

Supported by commercial companies, an education initiative of the German government follows the aim to get all schools in Germany connected to the WWW within the year 2001. The implementation of hard- and software is a requirement for computer assisted learning and teaching. Nevertheless didactical concepts are needed to accompany this investment. We are interested in the everyday use of the WWW for teaching physics in school and see its advantage more when used as a complementary tool than as a replacement of present learning phases. The WWW is suited to assist students' work, for example, when they are writing an essay. By looking into students' activities while working with the WWW and their gained knowledge we aim to draw conclusions that can support the practice of teaching. Our results, gained through physics education, can partially be transferred to other fields as well.

Results of the Online Survey

As a base of our main investigation an online survey was set up in 2000 addressing students and teachers who visit school related web sites (Priemer & Schön 2001). The goal was to get a first glance on their web activities. More than 300 users in eight weeks chose voluntarily a link that was set up for us on around 20 web pages to a questionnaire on our server. Knowing that this survey is not representative it gives nevertheless a helpful insight into students' and teachers' use of the Internet. Some of the results are:

1. We have many students who are novices in internet-use. In our investigation 80% of the survey participants have used the WWW 1 year or less on a regular basis. This result is confirmed by other surveys (see Feierabend & Klingler 2000). In addition, students rarely used the WWW for school related purposes but used it for entertainment.
2. Students have an uncritical confidence in the contents of web pages. Around 70% of our students completely or almost completely agreed that they take it for granted that the contents of web pages are correct no matter who the author is. Within the KIE project similar results were gathered, stating that students have the same confidence in statements of both famous scientists and anonymous persons (White 2000).
3. Orientation in the WWW seems to be no problem for students and is achieved fast. The appropriate selection of useful web sites raises problems for one third of our survey-students and teachers. Students are in general more satisfied with their Internet work than teachers. They very quickly seem to be happy with the search results they get as long as some keywords are included in the document and they more or less adapt their work to the gathered information and hence stop further investigations.

4. While students believe that the WWW by itself is a tool well suited for learning, teachers tend to rate the WWW more as a useful tool to collect material for non-computer-based teaching.
5. Students expressed their general wish that the Internet should be used in classes at school more often. Further they stated that teachers are often incompetent computer-users and do not perform teaching with the help of the Internet because of their lack of knowledge in that field. Teachers complain that they are not supported enough when using the Internet as a tool for teaching. They ask for didactical concepts, a better training, and better equipment.

Further Investigations

Based on these first results the main investigation will take a closer look into students' use of the Internet and the corresponding learning outcomes. Students of age 17 will have the task to write an essay on a topic in physics. In this school related setting the only help provided to students will be access to the WWW and word processing programs. The evaluation will focus on both the identification of "Web-Work-Strategies" of the students and different aspects of the gathered domain specific knowledge. A correlation between strategies and knowledge can lead to a description of effective WWW user skills (see Unz & Hesse 1999).
The identification of strategies will be achieved by analyzing log files and interviews. To find a measurable way of describing these strategies we will retrace the steps and web-moves of some students in case studies. By relating the content of the visited pages to the web activities, patterns or strategies can be differentiated (Choo, Detlor & Turnbull 2000). In addition a mathematical calculus based on graph theory will be set up to describe the path through the web in a more quantitative and objective way (Botafogo, Rivlin & Shneiderman 1992). The aim is to bring both approaches together in order to get an effective and efficient method of describing user activities.

Conclusions

By identifying effective strategies and knowing which strategies are likely to bring good results, we hope to gain an insight that helps students and teachers to use the WWW in an appropriate and effective way. Beside the academic interest the results can be used in three ways in practice: as an instruction for students and teachers, as a base for the optimization of web sites addressing students, and as a base for the development of a software help-tool.

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A distributed computer-based screening system for learning disabilities with centralised data processing

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Abstract: A reliable validated tool is being created to automatically screen students for learning disabilities, administered locally with minimal expert supervision, supported by a centralised data processing and evaluation system and a wide support network for students, educators, and parents. The component tasks address typical aspects of a learning disability profile. Development phases planned include software design and implementation (completed), pilot application for validation and tuning (underway), and final standardisation and widespread application in the school system. This project falls within the framework of an overarching integrated web-based environment for learning and support communities in the Greek educational system.

Learning disabilities in Greece

Despite a lack of official figures on the prevalence and characteristics of learning disabilities in Greece, a growing concern among relevant authorities has recently culminated in legislation addressing important relevant infrastructure issues within the general framework of persons with special educational needs. A significant increase in funding to support efforts in the domain of learning disabilities is anticipated in the context of the stated priorities of the Ministry of Education to combat functional illiteracy and reduce school drop-out rates. Substantial structural and material organisation will be required, including the creation of tools and materials for assessment and remediation. Currently, scant testing materials exist and most educational personnel are not adequately trained to administer or evaluate them. Moreover, regions far from urban centres are particularly disadvantaged with respect to availability of specialists.

Purpose, Scope and Context

The present project aims to develop a reliable validated tool for the automated screening of students for learning disabilities, to be administered locally with minimal expert supervision, supported by a centralised data processing and evaluation system and a wide support network for students, educators, and parents. The human network will be developed and structured over the platform developed by the Hellenic Pedagogical Institute (HPI), in the context of the project "Added Value Services in the Greek Web for Schools" (Papadopoulos et al, 2000). HPI will provide an integrated web-based environment to facilitate establishing and operating learning and support communities across Greece. The communities will bridge learning disabilities research centres (mainly in cities) to schools across the country. Interactions between special educators, teachers, and parents will help reduce social isolation related to learning disabilities. Participating teachers will be supported through web-based training courses to support efficient use of the screening tool and to found a virtual training and research centre, also introducing educators and parents to the benefits of information and communication technologies for educational needs.

Design of Test Components

The planned testing battery will apply accepted assessment methods and tasks using appropriate language-specific materials. As a first approach, for practical reasons of implementation and wide-ranging administration, the first grade of secondary education is selected for initial application and standardisation.

The motivation for the test components departs strongly from a typical diagnostic focus and instead emphasises practical screening efficiency over concerns regarding theory or comprehensiveness. The outcome of the test administration need not provide any theoretically coherent or practically comprehensive profile of the students but only a designation of status with respect to recommendation for referral to professional assessment. Therefore the implemented components address aspects of the learning disability profile likely to detect students in need of specific remedial or supplementary education. International experience (Gredler, 1999) with computerised screening tests indicates that a diversity of tested skills is common and perhaps most reliable. Relevant skills for screening purposes include aspects of the typical "dyslexic profile" for the particular linguistic setting as well as related cognitive and perceptual abilities. Practical constraints restrict the task space to tests admitting a mouse selection response, precluding oral responses. Thus many potentially useful tests, such as phonological awareness tests, cannot be considered.

In Greek the most prominent characteristics of reading disability (the most common recognised type of learning disability) include slow reading and poor spelling (Porpodas, 1999). Thus one test assesses reading speed, controlling for comprehension, via a timed reading task followed by picture matching to the text content. Another test assesses spelling ability in a selection task that requires detection and correction of misspelled words in context. A third test assesses isolated word spelling in a visual discrimination task in which the word matching a displayed picture must be selected among misspellings.

Commonly mentioned aspects of learning disability include difficulties with auditory processing (Ahissar et al, 2000). Three such tests are included: a tone detection task in a backward masking context, a pure tone frequency discrimination task, and a tone sequence reproduction task. The first test assesses temporal resolution and auditory integration intervals, the second test addresses spectral resolution with some taxing of auditory memory, and the third addresses auditory sequencing under severe time pressure.

Short-term memory (STM) is an important cognitive mechanism related to cognitive ability and linguistic abilitym and can be impaired in cases of learning disability (Swanson, 1994). This screening system includes two STM tests with a language flavour. One is a letter-span test, analogous to standard digit span tasks but with consonants instead of digits. The second is a phonological memory task presenting a pseudoword of increasing complexity to be reproduced orthographically.

Implementation Planning

System development is planned over three phases. The first, already completed, includes the design and implementation of the eight screening test components on a multimedia development platform running on personal computers commonly available in secondary schools. The second phase, currently underway, includes pilot application of the testing battery in a representative sample of Greek students. The same students will be administered conventional testing to be independently classified as learning disabled or not. Analysis of the computerised testing battery results with respect to the conventional assessment will provide indices of validity and reliability for the test components, and a first attempt at standardisation. In the third phase, only tasks and content items correlating best with expert assessment will be retained. The trimmed battery will be administered on a large representative population of students to derive psychometric standardisation and reliability validation. The final outcome will be supplemented with informational materials for the educators and parents, detailed instructions and recommendations for using the system, and the aforementioned support network by the HPI. Centralised processing and evaluation of the test data will facilitate statistical analysis and further validation, allow research questions to be addressed regarding learning disabilities in Greece, and will greatly contribute to empirical information sharing among sites of implementation and coordination, including special educators, teachers, and parents.

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On Effects of Information Technology on Learning

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Abstract: Usage of computers in school and at home does not replace each other, it together shapes individual habit of using information technology throughout persons life. It become a meaningful tool in society in relationship with knowledge, with gaining knowledge, with processing it, with expressing it and with its usefulness. In this brief paper, I will try to raise a discussion on some of the basic concepts of technology usage. Also, I will try to combine those ideas with current, omnipresent trend of life-long learning

1. Introduction

Currently, at all higher-educational institutions (and not *only* higher-educational), focus shifts towards life-long learning, in order to make natural and possible for everyone to refresh, adapt and arrange their knowledge to new circumstances, to creating new jobs, or just simply moving to another job. This rather naturally implies that information technology, with all of the advantages it brings, must play an important role in all aspects of education, regulations, curriculum or simply - in every subject in each school. Therefore, it is important that the "student" learns how to find knowledge, how to evaluate its significance and importance, how to adapt what is suitable, and how to make use of it when needed.

Although professors and their assistants are pretty much right in having an objective point in expressing their concerns about usage of information technology in schools - the fact is that computers are here to stay. They become important tools affecting lives of (almost) every subject of our society, one way or the other. Our students *are* our future, today computers and information technology in general play an important role in education, and there's simply nothing even barely indicating that this trend will change in the future society, where our students are going to live and work. Therefore, the only logical conclusion arising from these facts is that teachers *do* have obligations towards their students and the whole society to use these tools in the field of education, so that students learn how to make meaningful use of computers in their future work and life [Putnik, 2001].

2. Problems And Concerns

Nowadays, teachers are introduced to computers and their usage in classroom, in their "finished" form - with pedagogical, psychological and methodical methods built-in into the program itself. So, it's not only that the teachers are confronted with the new tools, they are also told how to change methods they have learnt and developed in their own way for years. "Programs and computers" are not asking teachers how they teach or what do they think are the best methods to enable students to learn - they are told how to teach. Even more erroneously, this is often done by computer specialists, or some other "experts" never involved in real-life teaching, those who have never taught themselves. In the best, but still refused situation, programs are created after consultation with the teachers who do not share the same opinion as to the pedagogical methods involved. In this position - it is easy to understand resistance of the teacher.

Teachers are facing more and more challenges and changes in their work - changes that many of them have not asked for and don't like, changes for which some of them have difficulties in understanding the need. They have taught their classes for years and have been thoroughly succesful, but now they are "forced" to use information technology in the classrooms. Still, huge majority of teachers are aware of one simple fact: by avoiding the use of computers in their classrooms they cannot at the same time make use of computer as an aid and a working tool. Beside, it is surely possible to recognize oneself in one of the folowing grades of information technology usage. There are at least five easily distinguished levels of "integration of information technology into the classroom" [Martin, 1997]. Those are:

- *Familiarization*: minimal usage of technology, just up to the amount of "becoming acquainted" with it;
- *Utilization*: regular, everyday usage of technology - yet , without the real "commitment";
- *Integration*: full classroom utilization. Lecturers using information technology in this manner, would certainly be badly obstructed in their teaching without it;
- *Reorientation*: at this level, teachers are re-defining and re-thinking education to "obligatory" usage of information technology;
- *Evolution:* a process, currently happening at lots of (educational) places, revolving around problems and their solutions arising in educational and instructional institutions using information technology.

Teachers avoiding the use of computers in the classroom often have valid points for their avoidance. On the other hand - teachers have to look beyond just the subject they are teaching.

3. Resume

There is an obvious and urgent need for parents to be involved with their childrens' use of Internet. Also, help of parents is needed in young people rethinking that they "know all" about computers because of their use of them at home. Those who knew themselves to be "far from knowledgeable" in the field of information technology, are fairly ready to work and learn. Yet, the others resist because they are so sure of themselves that they do not take the time to learn. Still, if we let our students to use computers *only* at their homes, with friends and parents, or just at separately and specially designed computer classes, it is much less likely that they will later have the knowledge and possibility to properly choose *when* to use computers, and *when* to favor other methods. They will not be aware of the prospects, they will be denuded of advantages of making the most of what they are doing with the help of computers. The school has the significant role of creating situations, atmosphere and surroundings for students and pupil to get access to data, information, or in general *knowledge*, in such a way that they are able to make substantial use of them. They must learn how to search for information by themselves, get it and process it so that it is useful in their lives. So - usage of computers in school *and* at home does not replace each other, but together shape individual habit of using information technology throughout their lives. It becomes a meaningful tool in society in relationship with knowledge, with *gaining* knowledge, with *processing* it, with *expressing* it and with its *usefulness*.

Still, usage of computers and information technology in the classroom can not be applied blindly. It is very important to *listen* to teachers, and to help them find tools that not only suit their subjects, but also their teaching methods [Putnik, 2000]. Information technology *will* play a role in our future society at least as important as it does now. So, the key moment for success in a constantly changing environment to which we have to adjust our students is life-long learning, especially with the usage of computers.

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The Technological Challenges In The Delivery At A Distance Of A Second Language Computer Mediated Program. What Can Technology Do For Us?

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The delivery and effective teaching of computer mediated language courses delivered at a distance is a challenge for both language teachers and technology experts. At Auckland we are trying to open widely the lines of communication.

"From DL POTS to DL PANS: The Advance Distributed Learning (ADL) Initiative"

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Abstract: The President has signed an Executive Memorandum directing the National Economic Council to develop a Federal Plan and a National Strategy for using learning technologies to improve education and training and to lower costs. This vision ensures that its workforce will have "access to the highest quality education and training, tailored to needs, wherever and whenever it is required." Efforts to achieve these goals resulted in the Advanced Distributed Learning (ADL) Initiative. In developing ADL, it quickly became apparent that the guidelines and standards, implementing technologies, and learning objectives that serve DoD's needs are almost identical to those of other public government agencies, the private sector, and academia. The four objectives of ADL are to: (1) exploit the Internet as a delivery medium; (2) reduce development cost and time through the use of Sharable Content Objects (SCOs); (3) develop collaborative relationships across industry, academia, and government agencies; and (4) explore new technologies for potential training applications. The ADL brings together the work of many sectors such as the IEEE, AICC, IMS, Ariadne, and the Dublin Core to develop a common technical framework. This presentation outlines "why ADL" and current activities within the ADL Initiative.

Introduction:

In November 1997, the White House's Office of Science and Technology Policy and the US Department of Defense launched the Advanced Distributed Learning (ADL) Initiative. In an Executive Memorandum, the President directed the National Economic Council to develop a Federal Plan and a National Strategy for using learning technologies to improve education and training, and to lower costs. The public and private sectors' shared vision is to ensure their workforces have "access to the highest quality education and training, that can be tailored to needs, and delivered cost effectively, anytime and anywhere." The ADL Initiative is designed to be a catalyst for joint public and private sector projects that advance the application of technology in education and training through the development of an ADL Sharable Content Object Reference Model (SCORM™).

This effort sought to leverage and accelerate emerging object-oriented databases and commercially available Internet technologies to better manage and deliver education and training products and services. With respect to management and delivery systems there have been wholesale infrastructure changes as organizations move from distance learning programs using "plain old telephone service" (POTS) to distributed learning environments using "powerful, advanced network solutions" (PANS). By better managing learning content using standardized meta-data tagging and expanding delivery options the ADL Initiative will ensure that learners will have "access to the highest quality education and training, tailored to needs, wherever and whenever it is required."

In deference to "distance learning" wherein the instructor and the learner are physically separated by distance - but electronically connected by the Plain Old Telephone System (POTS) technologies - "distributed learning" in an ADL context, encompasses educational and training activities orchestrated via emerging information technologies. In the last 100 years, technology has revolutionized communication, transportation, healthcare, entertainment, and now education and training. There are compelling reasons to act now to establish a series of guidelines, including technical specifications and best practices, to enable the burgeoning e-Learning economy.

Prior to the 1970's technology, were predominately industrial, focusing on corporate automation: mass production, corporate control, more blue-collar jobs, factory-like schools, coupled with slow economic growth. In the 1980's - 1990's there was a transition to the "Information Age" and office automation was the order of the day. There was a growth in information workers with new job skills. The emphasis was on innovation, and this included increasing investments in putting technologies into schools. And now, in the 21st Century, the trends outline a networked economy engaged in global e-commerce. Corporations will be placing greater emphasis on knowledge workers, and increasing investments in human capital. By the end of 2001, 77% of companies will use their Intranet for training. By the end of 2002, half of all workforce training will be done through e-Learning. By the end of 2003, 40% of e-

Learning will be aimed at a company's external customers. And by 2005, $50B to be spent on e-Learning. (Sources: ASTD, Gartner Group, US Bancorp Piper Jaffrey)

Finding a better way to manage emerging technologies and expanding networks has, for many, become an organizational imperative. By leveraging e-commerce models is it possible to revolutionized learning? Are there modern, efficient, and flexible alternatives that will be able to support personal networking so that a learner might be able to access resources anywhere and any time they're needed? Will just-in-time access to information, effecting personalized learning opportunities result in a higher retention? And will there be any returns on the monies, time, and effort that will be needed to bring any of this about?

To test these assertions an ADL strategy was developed to:

- pursue emerging network-based technologies;
- facilitate development of common standards;
- lower development costs;
- promote widespread collaboration that satisfies common needs;
- enhance performance with next-generation learning technologies; and
- work with industry to influence commercial-off-the-shelf product development.

By making learning software accessible, interoperable, durable, reusable, and affordable, the ADL initiative seeks to ensure that academic, business and government users of learning software gain the best possible value from the materials they purchase.
In order to facilitate this effort, specifications needed to be evaluated to enable an object-oriented learning environment. This was a top priority. Which universally accepted standards or standards might be applied to developing "powerful, advanced network solutions"? As it turns out, there are plenty of standards too many to choose from. Given the scope of the undertaking, four focus areas involving best practices were established:

- **Content Advocacy Group**. This group is developing functional requirements for education and training objects in subject matter using a collaborative process to identify and prioritize functional requirements and communicate them to ADL partners organized around learning content areas.
- **Business Market Group**. This group defines the business requirements for an efficient market in instructional systems, applications, and products focusing on identifying non-technical impediments to the growth of a market for object-based learning resources, recommending solutions and strategies for resolving these impediments.
- **Technical Working Group**. This group is seeking to identify common technical requirements for software needed to cultivate the vigorous market for interoperable, reusable learning objects by identifying ways to ensure compatibility across platforms, enable instructional objects to communicate with each other, and resolve other technical issues learning management systems.
- **Research Priorities Group**. This group seeks to identify and describe issues related to human learning and performance. In addition to resource data assembled as part of the business marker group, this group is involved in multiple support areas such as authoring systems, knowledge representation, and attendant personnel support systems. Simply stated, is learning taking place? Can it be measured perhaps as performance-based outcomes? And how a learner's profile might be better managed?

Background

In January 2000, the Sharable Courseware Object – Reference Model (SCORM) Version 1.0 was published, providing a meta-data tagging specification. (NOTE: In Version 1.1, "content" replaced "courseware" in the acronym, signaling an emphasis on learning objects as opposed to courses.) The SCORM specification was designed, in part, to address the DoD's frustration with not being able to share distance learning courses among the different learning management systems deployed throughout the department. The SCORM document presents a framework for developing technical standards based on sets of specifications involving web-based learning technologies to enable content reuse, accessibility, durability, and interoperability. This framework references emerging standards from a variety of organizations focusing on web-based learning technologies. The ADL has collaborated with members of the IMS Global Learning Consortium, Inc. (IMS Project), Aviation Industry CBT Committee (AICC), the Dublin Core, ARIANDE, and Institute of Electrical and Electronics Engineers (IEEE) on various parts of the SCORM. Accordingly, significant components of the ADL SCORM can be "harmonized" synchronized with developing industry practices as part of the seminal work of these groups. While the ADL's SCORM defines a very specific so-called "content model", work from other groups is integrated into this model and adapted or extended to meet ADL requirements.

Subsequently, courseware developers in government, industry, and academia have been developing content and services and have gone through conformance testing against the SCORM. Simply stated, the first version of the SCORM was a set of technical specifications that apply to learning content and learning management systems. It defines a specific Application Program Interface (API), data models, and content launch mechanisms, as well as meta-data and course structure formats. It is not the intent of the ADL Initiative to set standards. Others are doing that, especially those involving network protocols and mark-up languages. Instead, in coordination with government agencies, industry groups, academia and other stakeholders, the ADL Initiative is creating guidelines for courseware development based on existing industry practices and standards that promote accessibility, interoperability, durability, and reusability of learning objects. The scope and detail of the guidelines will not be static; they will evolve and grow over time.

Validating the ADL Technical Architecture
A tough issue to deal with is picking the "correct" technology at the right time. There are legacy systems, systems being used here and now, emerging technologies, and the (volatile) future. For the most part, each of these builds on its predecessors. But as technology moves into areas of uncertainty involving operating systems and protocols, increasing attention needs to be paid to baseline architectures. If the technology is good, why throw it away? After all, telephone has been around for over 100 years. It has met the test of time and functionality - and it still meets most of the "-ilities".
Sharable courseware objects needed to meet our functional requirements must meet some criteria, which we loosely call our '-ilities'. Among these "-ilities" five seem most important (though there are several other "-ilities").

- It must be possible to find needed and sharable content objects. They must be accessible. Basically, this means that there should be accepted and standard ways to store, find, and retrieve them.
- Once found, the objects should be usable. This means that they must be interoperable and portable across most, if not all, platforms, operating systems, browsers, and courseware tools.
- Once implemented, the object should continue to operate reliably. If the underlying platform, operating system, or browser is modified (for instance when a new version is released and installed), the object should continue to operate as before. It should be durable.
- The object should be reusable. Other platforms, operating systems, browsers, and courseware tools should be able to reuse, and perhaps even modify as needed, the original content object.
- Finally, this process must be affordable.

The core ADL Architecture Management Group (AGM), which includes technical representatives from government, industry, and academia developed a three phased approach to establishing an advanced distance learning architecture:

- **Phase I – Validate Technical Guidelines:** This phase began with the release of the first technical guidelines for creating object-based courseware. Participants in the project each contributed test applications that exercise various facets of courseware production within the draft (version 0.9) ADL guidelines and test objectives.
- **Phase II – Validate Courseware Development:** Following Phase I, the ADG AMG released version 1.0 Courseware Development Guidelines. During Phase II, participants created complete courses designed to fully exploit the full scope of the guidelines and to test for Phase II objectives.
- **Phase III – Validate Reusability**: During Phase III the interoperability of complex courseware components were fully exercised.

ADL Plugfest Goals
Three times in 2000 the ADL Co-Laboratory sponsored a Plugfest to bring together early adopters of the SCORM. The purpose of the ADL Plugfests is to establish a common test bed for experimenting with new object technologies that are purposely designed with these specific qualities using previously established guidelines. This presented early adopters a chance to create and demonstrate prototypical object components designed that could be launched

and tracked from multiple Learning Management Systems (LMSs). The Plugfests are intended to provide participants with a "fault tolerant" forum for explaining their experiences in migrating their products to follow SCORM guidelines and to present future product plans. First, the ADL Co-Lab offered a relatively safe environment for resolving glitches, and second there was ample peer review and lessons learned at the technical level.

Plugfest Overview

The first round of testing was in June 2000 at the ADL Co-Lab in Virginia, followed by application testing in August at the ADL Co-Lab at the University of Wisconsin and in November at the ADL Co-Lab in Orlando, Florida. ADL Co-Labs were established to promote collaboration in the research, development, demonstration, implementation, and evaluation of ADL technologies and products. Experience gained during the Plugfests is expected to inform the ongoing refinement of the SCORM specifications. The purpose of the ADL Plugfest program is to determine the feasibility of creating an object-based approach that is demonstrably accessible, interoperable, durable, and reusable in education and training domains. Thus, early adopters were invited to create prototypical object components designed to demonstrate these characteristics. These prototypes were each expected to be proofs of concept and experimental rather than complete applications. Plugfest attendees included:

- **Content developers** — brought small sharable "learning objects" that had been beta-tested with the SCORM specification. During the Plugfest, their content was "plugged" into as many LMSs as time permitted to demonstrate reusability. In some instances their content was combined with content from other participants.
- **LMS providers** — brought a beta-tested version conforming to the SCORM API. They were asked to provide their own content for at least some of their data models, or content from other Plugfest participants.
- **Repository developers** — demonstrated prototypical learning content repositories for SCORM-conformant content and media elements. They were invited to present concepts and demonstrate how others can import and then access SCORM content and media.
- **Authoring system vendors** — demonstrated how they were supporting the API and data model. Given the short time from the release of the SCORM Version 1.0, a few of the authoring system vendors were not able to demonstrate a conformant product, but they were encouraged to know how their authoring systems were being designed to support these critical elements.

Ground Rules for Participation

In order to achieve the objectives of the program, prospective participants met the following requirements:

1. **Test Project**: Participants must have a proposed courseware project that could be adapted to ADL technical guidelines either by conversion or through new work.
2. **Contribution to Library**: At the conclusion of each phase of the project, participants were encouraged to contribute components of their project for testing and re-use by other ADL project members.
3. **Lessons Learned**: Participants were asked to document their experiences for compilation by the ADL AMG and redistribution to other project members.
4. **Plugfest Participation**: Project members agreed to actively participate in each of the scheduled Plugfest activities on the agreed upon timetable.

People and organizations participating in the Plugfests were encouraged to make their intentions known early, as space was limited. Those who were not able to actively participate in the first Plugfest were encouraged to observe the proceedings, and schedule themselves for future Plugfests. Since the proceedings were posted on the ADL Home Page, there was additional opportunity to get involved – at a distance. Additionally, announcements for future Plugfests are posted at that site: www.adlnet.org

Plugfest #1 – June 19-23, 2000

Approximately 225 representatives from over 90 organizations, comprising learning software developers and content providers from various sectors of the U.S. government, industry, and academia, actively participated in the Plugfest, which was hosted by the ADL Co-Laboratory in Alexandria, VA. This event brought together early adopters of the SCORM specification to experiment and demonstrate interoperability of content from many sources over multiple learning management systems and from separate organizations. Twelve vendors brought LMSs for conformance testing at the ADL Co-Lab, and 18 content developers brought content.

To varying degrees, all LMSs and content products conformed to the beta test suite based on the SCORM. Since this was a first encounter for everyone – the testers in the lab and the participant products being tested – it was also an opportunity to sort out anomalies in both the test software and the course content packages. And there were numerous demonstrations of interoperability where "working code trumped all theory". For the first time, content from different vendors' LMSs was passed to other vendors' systems without a hitch. Accomplishments included:

- For the first time: Real Code - Real Testing
- Learning content samples ran on multiple LMS systems!
- Tested LMS's demonstrated the ability to run content from multiple vendors' tools!
- Learning content from multiple samples were integrated into a common repository!
- Wide vendor support for SCORM
- The key standards bodies agreed to accelerate and continue to coordinate

Plugfest #2 – August 2-3, 2000
The Academic ADL Co-Lab at the University of Wisconsin in Madison serves as an academic testbed for moving ADL to the nation. It was been created through a unique partnership between the University of Wisconsin System, the Wisconsin Technical College System, the Department of Defense and the Department of Labor.

Unlike the First ADL Co-Laboratory Plugfest, which focused on beta testing of SCORM products, Plugfest #2 showcases the official release of the SCORM Version 1.0 test software and focuses on interoperability demonstrations among advanced early adopters of the SCORM. Demonstrations are planned to showcase SCORM implementation before educators. Plugfest sponsors and participates wanted to:

- Concentrate on content
- Demonstrate reusability and interoperability
- Expose and educate leaders and practitioners to ADL and the SCORM
- Introduce the Academic ADL Co-Lab, at the same time encouraging other academic partnerships through the Academic ADL Co-Laboratory

Plugfest #2 was a watershed event for the Academic ADL Co-Lab bringing together the nation's higher education community, the private sector, standards groups, state and federal government, the national guard, and e-learning vendors, providing an opportunity for the lively exchange of ideas among the communities. Several LMS vendors were able to demonstrate functionality that was not technically possible as early as three week prior to the event. Using SCORM-compliant content, the LMSs were able to find and retrieve learning objects (actually "assignable units" or AUs that were completely disaggregated from their host course), manipulate those learning objects, and pass them on to another LMS. These retrievals were done "on the fly" effectively raising the bar significantly for LMS products.

Plugfest #3 – November 27-30, 2000
Plugfest #3, like the previous Plugfests, focused on the evolving functionality and increasing momentum of the SCORM set of specifications. Plugfest #3, sought to "push the envelope" by encouraging top-notch implementations of learning content. There were real time content development demonstrations, product showcases, technical exchanges and tutorials on specification development. Participants were invited to form multi-discipline teams for the purpose of designing and developing SCORM-conformant lesson modules using the latest authoring tools and LMSs.

Three additional Plugfests have been announced for 2001.

Other Challenges

As ADL programs evolve and are adapted, there will be applications not anticipated. Unintended outcomes – hopefully positive, are most certainly welcome. This short overview of the ADL Initiative illustrates a potential to radically change the landscape of education and training as it currently practiced. Content developers need to construct and deliver an intelligent, virtual environment where learners are allowed to experiment without interference, yet communicate and interact with instructors as they move through the learning process.

ADL brings together public and private sectors to develop a common technical framework based on several key elements, including widespread collaboration, common guidelines and specifications, network technologies, next generation learning technologies - all coupled with reusable content and object-based tools that are platform independent. As programs evolve and are adapted, there will be applications not anticipated. Unintended outcomes – hopefully positive, are most certainly welcome. This short presentation of the ADL Initiative illustrates a potential to radically change the landscape of education and training as it currently practiced.

The progress of the ADL Initiative has been noticed by other chartered organizations investigating the value and promise of the Internet as a viable learning enabler. A commission appointed in 1997 by President Clinton (the President's Commission of Advisors on Science and Technology) called for a rigorous empirical research program at a level equal to at least 0.5 percent of the nation's aggregate spending on K-12 education. The final report, The Power of the Internet for Learning: Moving from Promise to Practice, was presented to the President and Congress of the United States in December, 2000. (www.webcommission.org). The Report calls upon the Federal government to create a comprehensive research, development, and innovation framework for learning technology. In the body of the Report, the ADL Initiative was formally acknowledged.

One of the strengths of the ADL initiative has been the ability to work with those organizations most directly involved in developing applications and setting standards. There are several organizations and companies working on bits and pieces of learning technologies. Rather than trying to "consume the elephant" at one sitting, the ADL Team sought counsel from those that had been performing seminal research and evaluation. As consensus was achieved, those issues were codified and new issues were brought in. And as the SCORM progresses, each revision will hopefully be able to capture more of the learning technology landscape. The SCORM is more of a process than a product and future versions of the SCORM are already being laid out.

As previously described this series of Plugfest events provided ADL partners with the opportunity to synchronize the evolution and convergence of commercial authoring tools, LMSs and Web-based courses with the emerging open-architecture specification. Version 1.1 of the SCORM marked the end of the beta-testing phase of ADL and the beginning of the implementation phase. The specification has been widely vetted, updated and clarified, and is now deemed sufficiently stable to serve as the foundation for large-scale development of ADL tools and content. And more work is in progress. Concurrent with the release of the new specification is the establishment of a new process to "certify" compliance with the ADL SCORM specification. Version 1.2 will include content packaging profiles and a few new metadata tags, and version 1.3 will focus on content object repository profiles.

Now the ADL Initiative has another challenge before it as a result of its success. One day all of the "qualifiers" will disappear (distance learning, distributed learning, e-learning) as a distinction and the world will be left with an infinitely expanded idea of "learning." The ADL Initiative will continue to push forward with newer and more robust versions of SCORM, and will continue to work with all partners — the government, private industry and academia, to enable the creation of the future learning environment. The success of the ADL initiative will be measured by the extent to which:

- Consumers (learners) can acquire high-quality learning software less expensively than they do today;
- Producers of learning content are able to realize a higher return on their efforts; and
- Developers of learning support tools, services, and products are able to achieve a higher return on their investments.

In moving to powerful advanced network solutions, wired and wireless, all efforts would be geared to getting just the "Right Stuff" to the learner. Just the right CONTENT, to just the right PERSON, at just the right TIME, on just the right DEVICE, in just the right CONTEXT, and just the right WAY. That's the end game.

Cinemedia Astur: A Scalable Hypermedia Authoring Tool for the Development of Educational Artefacts

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CineMedia Astur is a powerful hypermedia scripting tool designed specially for multimedia collaborative development environments. In those environments, professionals coming from different disciplines (education, computing science, graphic design, etc.) have to share their knowledge using a common conceptual framework. Different experts conducted by the project's director share a common workspace where they are able to include their designs drafts or ideas, sharing them with other users. The tool supports different kind of interactive objects and media (graphics, animations, video, etc.) and its functionality can be extended by mean of third party components which can be downloaded everywhere in Internet, as the unique constraint is that those components must be compliant with sun's JavaBeans specification. CineMedia Astur supports the entire hypermedia development paradigm, even the evaluation stage as Cinemedia includes special tools for automatic remote testing of the navigation models of the generated applications

Spontaneous Interaction between Kindergarten Children and Computers.
A Case Study of the Project Discetech-Bimbotech.

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Abstract **The project Discetech, started in 1996, in Northern Italy, with the aim of experimenting the introduction of new technologies within the teaching-learning activities of high school classrooms. Since 1998, a similar project, Bimbotech, has been developed for initial classrooms (from 4 to 10 years old children). Several hundreds of experiments, involving several thousands of pupils have been carried on by the teachers, previously instructed and assisted by the staff of the project**This paper briefly introduces the Discetech-Bimbotech project, and then closely examines one of the most interesting Bimbotech experiment's: the organization, the phases, the results and the lessons learned are analyzed. The last section describes how the work will proceed, in order to understand better some pedagogical issues, and also how to disseminate the experience to other classrooms and other teachers.

An overview of the project

The project DISCETECH started in 1996 in the City of Como[1], for the initiative of Politecnico di Milano[2] as an attempt to experiment new technologies, for teaching and learning, within the Italian school System. Since 1997 the project also branched out in Lecce[3] for the initiative of the Faculty of Engineering of the University of Lecce and, since 2000 a new branch was opened in Milan too.

In the first phase, the project aims to give teachers basic ICT knowledge that can be used later on during their teaching activities. In the second phase teachers are asked to project and realize a didactical experience in the classroom in order to:

?? Discover useful strategies of using multimedia technologies in the didactical process;

?? Evaluate the efficiency of the above strategies regarding: content acquisition; knowledge skills acquisition (e.g. focusing and selecting information); behavior skills acquisition (e.g. cooperative skill and teacher-student communication).

Overall Discetech project has involved, so far, 430 teachers (some of them for more than 1 year) and more than 250 education projects have been developed, involving nearly 5000 students

Spontaneous Interaction between children and computers

Environment

This experience has been carried on by one of the most active group of teachers of Bimbotech[4]. The classes involved were two, one of 25 children, and the other one of 19 children, children were between 3 and 5 years old.

5 years old children	16	36%
4 years old children	18	41%
3 years old children	10	235

The overall aim of the experiment could be summarized as it follows:

a) To introduce the PC in the day by day class activities, promoting the self-interaction of children with the computer.

b) Let children consider the PC as a tool among the others that are daily used in the classroom.

The experiment has been organized in three different phases

a) Spontaneous approach

b) Self-interaction

c) Use of the PC for a special purpose guided by the teacher

Phase a: Spontaneous approach

Objectives

a) Let children have a first contact with the PC

b) Let understand the function of the mouse, as a tactile interface with the computer.

Multimedia tools

The multimedia CDs used in the project were various and different from phase to phase. In the first phase the CD used was "*So di più. Primi passi/prime lezioni*[5]".

Spaces and Time

At the beginning of the experiment the PC has been settled in the classroom, in a quiet area. Two chairs in front of the PC protected the machine. This phase lasted 3 weeks; the PC could be used during moments of free playing.

Activity and Methodology

This phase focused on five years old children, divided in groups of five. Children found the PC already powered on with the first CD installed; in groups they could explore by their own the CD.

The first ones to explore the CD were the ones who already had a PC at home or the usual leaders of the class, it followed an exchange of suggestions, tries and information. The teacher helped children only on demand (except if they accidentally quitted the CD)

Later on, the younger children (4 years old), interested in the PC could use it, but only with help of 5 years old children.

In the meantime 3 years old children could watch the older ones, if interested.

5 years old children who reached first phase's goals	16	100%
4 years old children who reached first phase's goals	18	100%
3 years old children observing	6	60%
3 years old children not observing	4	40%

[1] About 80.000 people, 50 km North of Milan, on the shores of the famous Como Lake.

[2] The largest technical University in Italy, with Faculties of Engineering and Architecture.

[3] A city, in the very southeast corner of Italy, of size comparable to Como.

[4] The school is *Scuola dell'Infanzia Salita Cappuccini - Circolo Como 8*[4]. The teachers involved in the first two phases (formation and modelling) are Giordana Corbani, Luisella Verga, Gabriella Bonanomi, Cristina De Giusti. One of them (Gabriella Bonanomi) is in charge of developing the project within the classes.

[5] roughly translatable as "I know more. First steps/First lessons" published by Leader Family

Phase b: Self Interaction

Objectives

a) Develop the ability of surfing in a CD with a simple structure.

Multimedia Tools

In the second phase 5 CDs have been used, from the easier to the more difficult one: *Il mare con la nonna*[6], *La lepre e la tartaruga*[7] *Sheila Rae la coraggiosa*[8] *L'Assedio al Castello*[9], *Darby il Drago*[10].

Spaces and Time

This phase lasted 8 weeks; the PC could be used during moments of free playing.

Activity and Methodology.

The PC was powered on only on demand. The first three CDs were installed by the teacher and they could be surfed by groups of 4 or 5 children between 4 and 5 years old. Later on children could ask which CD they wanted to use. Children interacted autonomously between themselves and with the machine.

When children have deeply understood how to interact with the first three CDs or they have lost interest the teacher installed the fourth and the fifth CD, so in this phase 3 years old children were essentially observers.

5 years old children autonomously surfing	12	75%
5 years old children not autonomously surfing.	4	25%
4 years old children autonomously surfing	12	67%
4 years old children not autonomously surf.	6	33%
3 years old children observing	8	80%
3 years old children not observing	2	20%

Phase c: Use of the PC for a special purpose

Objectives

a) Develop the ability of using software to create and print graphical pages.

Multimedia tools

In the third phase the following programs have been used: *Microsoft Plus Junior, Microsoft Paint, Corel Print House* and *Kid Pix Studio.*

Spaces and Time

The last phase lasted 4 weeks; the PC was used when the class was split by activities.

Activity and Methodology

The teacher powered on the PC and children could use it in groups of 2 or *Microsoft Plus Junior, Microsoft Pain* were discovered by children autonomously or when asked, under the guide of the teacher. During this phase two children (a 4 years old kid and a five years old one) were chosen as tutors by the others to solve problems and give suggestions (included how to quit the program and the PC). Only if they were not able to solve a problem the help of the teacher was asked. Children were able to print on their own from *Microsoft Plus Junior*, but they needed help to print from paint.

5 years old children drawing and printing	9	56%
5 years old children drawig	7	44%
4 years old children drawing and printing	7	39%
4 years old children drawing	11	61%

The third software was used by the teacher who followed the request of the children, such as change size or colors to the images.

Results

At the end of the experiments above described, the staff asked the teachers to specify if they were satisfied and why. The following the summary of their answers in the context of high level overall satisfaction

A. Children, having the possibility to use the PC as one of the various tools located in different areas of the class, learnt to consider the machine as one of the other possible games or tools, to appreciate its possibilities and to know its limits rather than to consider it as a mythical object.

B. The use of the computer was integrated in the usual activities of the class: children of 5 and 4 years old guided by the teacher were able to look for and create images and symbols used later in the creation of books, stories, games...

C. Approaching computers in groups, rather than as a "single", has given the children the possibility to develop relationships of cooperation. The first type of relationship was aiming at solving technical issues (e.g. how to use the mouse and to understand or guess the meaning of the icons). Later relationships aimed at solving "strategy" issues, in order to achieve goals (eg. How to win a specific game or how to pass to the next level) were developed.

D. The co-operation among children has been positive both for the already capable children, who learnt how to express their abilities, and for the less skilled ones, who learnt how to interact with the machine without a direct help of the teacher. The goals set for the first phase have been achieved by every child: everyone understood the function of the mouse, even if the ability in using it changes from child to child according to the age, the previous experiences and the time of use.

E. A lot of children developed good (or very good) skills in surfing the CD's. Some children surfed autonomously, some others following the instructions of the classmates. Levels of intention were different: someone surfed randomly, some others knew what they wanted to search for.

Some children, who were usually not able to pay attention for a long time, have improved their concentration skill, some children were much more interested than others in the use of the PC.

[6] published by Istituto De Agostini

[7] published by Istituto De Agostini

[8] published by Istituto De Agostini

[9] published by Piccoli Editore

[10] published by Istituto De Agostini

Participatory Approach to Design of Socio-Technical Systems

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Abstract: Historically the technical centered approach was criticized because of its propensity to create technical objects without considering their future use. The user centered approach seeks for better understanding the users, their practice and the environment (including organization and institutional aspects) in order to take all these factors into account from the first stage of a tool design.

The design of the socio-technical system is itself a socio-technical activity, one of the important tasks of it being the organization of the involvement of users at each phase of the design project. This is a participatory approach to design. On a whole this approach can be considered as a research action, implying the constant follow-up of the design process and the progressive analysis of users needs, of changes in their work habits, of the occurred problems as well as different recommendations proposed by users.

The practical part of our article illustrates the concepts of participatory design approach that we applied to the design of the graphical web browser NESTOR. This tool helps to construct meaningful information from the "raw data" one's get access on the web.

Introduction

Any particular system development project takes place in a wider context of technology development in which human artifacts and human tasks co-evolve. The artifacts-in-use of current technology embody affordances and constraints for human activity; at the same time, the tasks people engage in embody requirements for further technology development. Understanding artifacts in terms of the scenarios of use they enable and obstruct makes it possible to more deliberately manage the co-evolution of tasks and artifacts. We explored a method for pushing the participatory activities further "upstream"in the design process, to the initial analysis of requirements.

In our research we adopted several principles shared by most participatory design practitioners (according to Computer Professionals for Social Responsibility):

Respect the users of technology, regardless of their status in the workplace, technical know-how. Consider every participant as an expert in what they do, whose opinion needs to be heard.

Recognize that users are an important source of innovation,, the design ideas arise in collaboration with participants of different fields.

View a system not as a collection of software and hardware but as a network of people, practices and technology embedded in particular organizational contexts.

Treat problems that exist and arise in the workplace by or in collaboration with the concerned parties. Try to find concrete ways of improving the working conditions of users, for example, co-designing new opportunities for revealing creativity; increasing worker control over work content.

Be conscious of one's own role in PD processes; try to be a "reflective practitioner."

Our research is performed as part of a larger educational technology European project "Learning Network for Teachers (Learn-Nett)." The project is coordinated by Bernadette Charlier from FUNDP (Les Facultés Notre-Dame de la Paix). A primary objective of the project was to construct the network allowing the share of education resources, than to develop and evaluate computer-based, collaborative learning tools and environments in support of teachers. Participants of the project include teachers, students and researchers from eight European universities, a high school, a research center and a distance learning department.

Case Study

We applied a participatory design approach to the development of a web browser and cartographer NESTOR. This tool allows to visualize the Web browsing and organize the gathered information on the graphical map, it pushes users to construct meaningful information. Different scenarios used as a source material in the participatory analysis were extracted from videotaped observations of students activities. We supplemented videotaped observations with other forms of data including notes taken during observations, videotaped interviews of student and teachers. In the interviews we asked students and teachers general, open-ended questions on collaboration, experimentation, and pedagogy. The interviewers were encouraged to elaborate their views and to take the discussion in any direction they wished. Classroom observations, interviews and artifacts were collected over a period of two years from four universities.

This approach allowed us to adapt the tool to the activity, to add functions necessary for the work as well as to develop another interfaces, such as cooperative synchronous work, according to suggestions and recommendations submitted by users.

We have learned that participatory design is far more involved than merely inviting users to a design meeting. The users must feel engaged. They must have effective access to relevant information. They must have status, power, and scope of action sufficient to allow them to take positions and contribute to decisions.
We believed that several factors contributed to this favorable quality of participatory interaction. Users develop a greater sense of ownership of the analysis and design because the activities are grounded in authentic activities occurring in the user's world. We think that our method successfully shifted power in the direction of the user. The users contributed to activities and decision-making from the very start, they were highly engaged by the analysis process and contributed significantly to the analysis results. We conclude that the method has a promise as a technique for evoking self-reflection and analysis in a participatory design approach.

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Perspectives on Web-based Historical Audio

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The National Gallery of the Spoken Word (NGSW) is developing an on-line repository of spoken word collections. To do so, project is researching a number of technical and educational issues. The project team drawing on people from the humanities, library science, engineering and education) is working on creating a distributed system architecture based on the Open Archival Information System (OAIS) as well as best practices for watermarking, digitizing, and preserving spoken word resources as well as metadata schemas and interface design. While a number of search techniques work well for text, search techniques for very-large-scale databases do not yet exist for spoken materials. Participants in this project include researchers who are recognized leaders in the development of algorithms for searching using acoustic and linguistic models. In addition, the NGSW is developing an educator's forum to establish best practices with historical audio on the web. The goal is to establish a set of activities and tools that will make digital audio repositories useful to students, educators and the curious public.

Development of Interactive, On-Line Cases in a Medical School: A Case Study in Pediatric Genetics

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Abstract: The Web is increasingly becoming a platform of choice for delivering medical education. The representation of content on the Web takes a myriad forms, from image identification to complex, simulated cases. This paper is an attempt to explore instructional design issues that play a significant role in the development of effective case simulations. Ten rich, complex case simulations were developed using theories of metacognitive and motivation and empirical support from case based reasoning. Forty more will be added to the web site based on the evaluation data received from the current version. The authors conclude that the Web offers a potent, viable platform for the delivery of theoretically robust case simulations.

Introduction

According to the Association of American Medical Colleges Medical Student Objectives Project (http://www.aamc.org/meded/msop/report1.htm#Goals), a predominant goal of medical education is the development of clinical skills among students. These include reasoning deductively to solve clinical problems (medical decision making), and constructing appropriate management strategies for patients. Recently, an engagement with web based instruction has generated richly annotated web sites for the delivery of the medical curriculum. However, much of this content is focused on the Basic Sciences, with the relatively little attention allocated to objectives pertinent to the development of clinical skills.

Purpose

The purpose of this paper is to explore the design and development of interactive, case based learning environments to improve diagnostic reasoning among medical students completing their third and fourth year clinical rotations. The specific discipline utilized here is Pediatric Genetics. The following questions framed the foundation of this development:

- Can current empirical support for case based learning form an effective foundation for developing web based cases?
- What types of motivational and metacognitive strategies are compatible with the development of case based learning on the Web?
- Does the Web offer an adequate platform for active learning essential for simulated cases?

Methods

Phase I

Fifty case presentations on real patients were initially developed by a fourth year medical student, using html and javascript. Although the cases were successfully received by students, the interactivity lacked the following elements of effective instructional design:

- User friendly navigation
- Instructional strategies consistent with instructional goals
- Adaptability based on prior knowledge and experience
- Scaffolding structures to allow for support in retrieving diagnoses
- Extensive, meaningful feedback
- Effective metacognitive and motivational strategies
- An on line evaluation

Phase II of the project describes how each of these concerns was addressed.

Phase II

Phase II began with rethinking the objectives in a more focused way in order to align instructional strategies with the objectives. A task analysis was performed to ascertain the flow of content and nature of interactivity. Instructional strategies that would promote metacognition and motivation were strategically placed. Feedback provided was rich in nature and used the capabilities of the web to capture and present group data. An online evaluation form was created to assess perceptions of learning via cases. This was accessible after each case was completed.

Development Platform

All cases were programmed in html and Cold Fusion, using an SQL database residing on the school server. Data was collected for each student for analysis.

Results

Ten cases have been programmed, and we have invited medical students and residents to use these cases and provide feedback. The remaining 40 cases will be developed after the evaluations have been completed.

Discussion

We now attempt to discuss questions posed in the introductory section. We found that empirically based guidelines could be extensively and usefully employed in the design of web based cases. This support was drawn from areas such as metacognition, novice-to-expert research, quality of feedback, and computer based simulations. Secondly, the Web allowed to manipulate and present collective information from students (such as pooled data on performance on cases). Consequently, the implementation of social motivational theory could be a part of the case feedback structure, unlike any other media. Finally, three forms of interactivity were employed: hypertextual access to information, prompted recognition and recall.

Conclusion

Simulated, online case based learning is a relatively new field of study in medical education. The online cases described above are an attempt to create authentic environments for learning, using empirical support and instructional design theory. The Web was found to be a powerful medium for the delivery of complex case simulations developed with effective instructional design principles and supporting theories. The ongoing evaluation of these cases will provide further feedback, on which further enhancements can be made.

Analytic Geometry on the Web

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Abstract: The purpose of this paper is to show how to develop interactive didactical material on the web with a specific educative goal and structure. The idea is to develop the ability of the students to relate the geometric and algebraic properties. This relation becomes evident in Analytic Geometry. The software resources that are available make it easy to develop the material focusing in the concepts.

Background

Using the web to provide learning material for the students is increasing rapidly. In the recent past we worked in the computer's laboratory with interactive tools that gave the students the possibility of studying geometry in a dynamic environment Recently the same people that produced the PC-software gave the teachers a tool to translate their interactive sketches to Java applets. This new tool is a good way to develop material that can be used widely to learn geometry through the web.

Traditional ways of teaching geometry have not been effective. The approach usually used is through memorizing the canonical equation of a curve. The loci concept is very often forgotten and the students do not relate the coefficients in the equations with the geometric properties. This approach has proven to be highly inefficient because the student gets easily confused with the equation of, for example, an ellipse and a hyperbola. Also it is very difficult for the student to understand the variation of the form of the curve and the coefficients in the corresponding equation. Also, the student does not develop the algebra in a different context, which is more meaningful for him as compared to the algebraic manipulation alone.

In the classroom laboratory we used The Geometer's Sketchpad. This software is a tool that allows us to construct, in a classical way, geometric figures with ruler and compasses with the advantage that it is dynamical and one can do recursive programs and scripts for the constructions. This software is very simple yet it allows you to make sophisticated constructions. There is also the Geometrie Cabrie that is very similar. In fact, conceptually and the MS-DOS version Geometrie Cabrie came out earlier. The Windows version of The Geometer's Sketchpad was available first.

The material

The approach used in the computer laboratory with the Geometer's Sketchpad allows the student to fully understand the loci concept dynamically. The problem is that not always we have the availability of a computer laboratory at school or there is not enough time to do all the exercises during classroom time.

Thus we are developing interactive sketches that show the geometric concepts such as loci and eccentricity, and help the student understand the relation between the form of the curve and the coefficients of the corresponding equation such as the lengths of the semi axes in an ellipse. For an ellipse it is possible to show how the eccentricity relates to the curve. The visualization is accompanied with a worksheet that leads the student to watch and think about the characteristics of the loci he or she is constructing. The difference with other Geometry interactive material found at the web is that ours has a structure that allows the student to explore one by one each of the relations for every one of the curves. This method was used in the classroom with worksheets that contain geometric constructions and associated questions that the student must answer while animating the construction. The intention of the questions is that the student can construct relations and concepts and make conclusions about them.

This way of working with the computers has been used by the authors for several years and has proved to be very efficient because it allows the instructor to answer the doubts of the students rather that being engaged in showing how to do the constructions with the software and it also keeps the students really working in the mathematics without distractions. Many of the negative reports in a computer classroom are related to students that engage themselves in reviewing their personal mails instead of paying attention to what is done in the class.

We are translating about thirty worksheets previously used in the PC-laboratory to Java applets. These worksheets include material from the line to the hyperbola allowing the student to explore many of the properties of the loci It also lets the instructor explore the different geometric definitions of the loci. The translation from Geometer's Sketchpad to Java-applets is immediate. The worksheets are proving to be more difficult to translate because the approach at the PC laboratory is different to that used in a dynamic interactive construction that can only be moved or animated To show the use of geometry in real life, each module includes an application of the concepts studied in the module. A link is also provided to resources on the history of geometry

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The Role of Social Presence in Online Courses:

How Does it Relate to Students' Perceived Learning and Satisfaction?

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Research has demonstrated that social presence not only affects outcomes but also student, and possibly instructor, satisfaction with a course (Moore, Masterson, Christophel, and Shea, 1996). Teacher immediacy behaviors and the presence of others are especially important issues for those involved in delivering online education. This study explored the role of social presence in online learning environments and its relationship to students' perceptions of learning and satisfaction with the instructor.

The participants for this study were students who completed Empire State College's (ESC) online learning courses in the spring of 2000 and completed the end of semester course survey (n=97). A basic correlational design was utilized.

This study found that students with high overall perceptions of social presence also scored high in terms of perceived learning and perceived satisfaction with the instructor. Students' perceptions of social presence overall, moreover, contributed significantly to the predictor equation for students' perceived learning overall. Gender accounted for some of the variability of students' overall perception of social presence, while age and number of college credits earned did not account for any of the variability.

Implications of the study effect the design and instruction of online courses in terms of students' perceived learning and satisfaction with the instructor. Instructors need to be aware of the

impact that their immediacy behaviors and social presence or lack thereof may have on their students' satisfaction, motivation, and learning.

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A PAD-Based Classroom Computer System

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Abstract: In this work we present an environment that aims to facilitate the presentation of multimedia content in the classroom. The principal innovation of this system with regard to other proposals is the use of a wireless-access interface implemented on a palm-top computer or PDA, an approach that has been successfully explored in other fields. For its development we presuppose that the classroom has a LAN connection to the Centre's local network through which connection to the Internet is available. The system comprises a PC connected to the network, a video projector connected to the PC with VGA and RS-232 cables, and a wireless-network access point. Teachers are supplied with PDAs using a wireless connection, with which they log on to the Centre's network.. This system enables teachers to essentially carry out two functions from the PDA: to control the operation of the PC installed in the classroom by means of a virtual PDA and a keyboard emulation, and to control the operation of the projector.

Introduction

Throughout history different technological innovations have been incorporated into the teaching process, from the invention of paper and the printing press to the innovations that are currently striving to make headway in this field, such as multimedia materials. Nevertheless, the reticence of teaching staff to accept and incorporate technological innovations into their daily routine is well known, at least if they are not aware of the immediate and significant benefits for their activity, or how simple they are to use.

In this work we present an environment that aims to facilitate the presentation of multimedia content in the classroom. The principal innovation of this system with regard to other proposals [1] is the use of a wireless-access interface implemented on a palm-top computer or PDA, an approach that has been successfully explored in other fields [2].

Architecture Of The System

Figure 1 shows the architecture of the system. For its development we presuppose that the classroom has a LAN connection through which connection to the Internet is available. The system comprises a PC connected to the network, a video projector connected to the PC with VGA RS-232 cables, and a wireless-network access point. Teachers are supplied with PDAs using a wireless connection, with which they log on to the Centre's network.

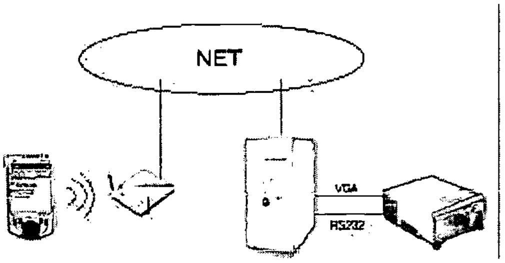

Figure 1: System architecture

In our proposal we use a PC with an Intel Pentium III microprocessor running 500 MHz, the Windows 98 operating system, an NEC Multisync MT 1030G+ projector, an Compaq WL400 wireless network access point and a Compaq Pocket PC PDA [3], with the Windows CE operating system and a Compaq Wireless card-connection. Using this system we have developed a client-server (PDA-PC) application written in Java (JDK 1.3) [4,5].

This system enables teachers to essentially carry out two functions from the PDA:

a) to control the operation of the PC installed in the classroom by means of a virtual PDA, the operation of which is similar to that used by many laptop computers, and a keyboard emulation (*java.awt.robot* class has been employed for both tools, enabling the server to launch events according to the orders sent by the client through the communications socket [4]), which also allows mouse sensitivity to be adjusted and different keyboard simulations to be selected.

b) to control the operation of the projector. This can be turned on and off, focused, zoomed in and out, etc. (functions are obviously limited by the characteristics of the video projector itself). This task is carried out with serial port communications between the PC and the projector, which are administrated using *Java Comunication API* classes [5] that need to be adapted the protocol that is specified by the manufacturer of the projector.

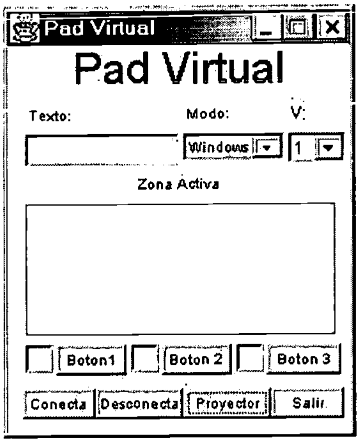

Figure 2a

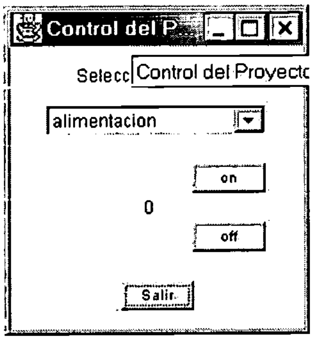

Figure 2b

Figure 2: a) Main application screen
b) Video projector control

Figure 2a shows the principal screen of our application. Here we can see the keyboard emulator in the upper section, the active area of the PDA in the centre, below the simulation of the three mouse buttons, and in the lower section we find the control buttons. These allow the PDA to be connected to and disconnected from the PC, the projector control window to be opened (shown in figure 2b) and application to be closed.

Discussion

The proposed system enables teachers to remotely control the PC and video projector in a practical manner similar to how they would do so if they could physically use both systems. For example, they can access the Internet or the PC in their offices to download a PowerPoint presentation, a Web page or a PFD file. They can run the corresponding visual application, and they can even access their agendas to set exam dates, or access their e-mail accounts to read questions posed by their students.

This system is only the first step in a much more ambitious project. The idea is to embrace teaching using commercial applications as well as personal contributions and reduce the mobile equipment required by teachers and students to as simple PDA. With this they will have access to didactic material, communication tools, administration applications, etc.

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Net-based Learning

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Abstract: The CERN "Web University" is a European-wide project where distance audiences participate in seminars at CERN from their own countries. CERN is setting up a video-on-demand service and opening its lectures and seminars for people in the 20 member states using real-time network connections. The exact learning method depends on learners' needs; they can select live and/or networked based video-on-demand service. Live distance learning is achieved by using real-time, interactive videoconferencing over the broadband research network or by using real-time broadcasting over public Internet. Interactive sessions are carried out using a Web-based Virtual Room Videoconferencing System (VRVS) and broadcast using RealVideo from the CERN Webcast server. Furthermore, learning is independent of place and time as the slides used during lectures are integrated into the recordings of live sessions and stored on multimedia servers. The integration of the slides is done using SMIL or Sync-O-Matic 2000 software.

Introduction and goals

CERN (European Organization for Nuclear Research, http://cern.ch/) created the Education and Technology Transfer (ETT) Division in the beginning of 2000 and adopted a Finnish initiative, Web University (http://cern.ch/webuniversity). The Division is setting up a video-on-demand service and opening access to CERN lectures and seminars for distance learners in the 20 CERN member states using live network connections.

The CERN Web University is a European-wide pilot project where distance audiences participate in CERN seminars from their own countries. Partner countries include Finland, France, Holland, Italy and Slovakia (Rinta-Filppula 1999, Ruokamo & Pohjolainen 1999). Activities in Finland are part of the Finnish distance learning project "Open Learning Environment" (1999-2003). The Web University is based on the concept of a virtual university where distance participants communicate over networks by using applications such as multicast interactive videoconferencing, webcasting, video-on-demand, World Wide Web (Web) and email. The pilot uses national research networks, European-wide high speed Internet and public Internet.

Distance learners can participate in CERN seminars from their personal workstations or from suitably equipped conference rooms in their institutes. The method of learning depends on learners' needs; they can select live or networked based video-on-demand services. Live distance learning is achieved by using real-time, interactive videoconferencing over broadband research network based on Internet technology or by using live broadcasting over public Internet. Interactive sessions are organized by using the Web based Virtual Room Videoconferencing System (VRVS) and broadcast from the CERN Webcast server using RealVideo. In addition, the learning is independent of place and time because the slides used during the lecture have been integrated into the recording of the live session and stored on a server. The integration of the slides has been done using SMIL or Sync-O-Matic 2000 software. VRVS has been developed by Caltech in association with CERN and Sync-O-Matic by the University of Michigan in association with CERN.

The target audience are researchers and postgraduate students, but some courses in physics and information technology have also been offered to undergraduate students, journalists, general public and high school students. By using this technology researchers can keep up to date with fast changing fields of interest and the latest scientific discoveries from CERN may be immediately integrated into student curriculum (Rinta-Filppula & Korhonen, Rinta-Filppula 2000). Furthermore, selected CERN lecturers are also experimenting with the qualities of meaningful learning based on constructivistic theory (Jonassen, Ruokamo & Pohjolainen 1998).

Future plans

In the beginning of 2001, CERN decided to collect together all real-time transmissions, webcasts and digital recording activities into a new Division and record digitally all Academic Training lectures (about 100 hours/year) and Summer Student lectures (about 100 hours/year). At the same time, selected lectures will also be transmitted in real-time and with some interaction with the distance audience.

All digital recordings will be archived on the CERN Document Server (CDS) that is used to store all scientific documents at CERN. In addition, selected digital recordings will be automatically mirrored to servers in the member states right as soon as recordings are available. In the future, CERN will further develop recording technologies and practices in close collaboration with the member states.

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eLearning today is the most important area of developing and training. In Häme Polytechnic eLearning is not only by offering courses on the Internet, it is totally new approach to combine technology, contents and skills in order to empower learners with a new ways of learning and grow. HAMK helps and provide support to enthusiastic staff and teachers in order to bring their new ideas of teaching into reality. This form of support includes technical and teacher training; financial; instructional design and development; and continuous research.

Combining Different Aims in a Portfolio System: a Web-based Portfolio and the Various Ways in which it can serve the Student

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Abstract: A portfolio in a competency-driven curriculum can serve many functions.
This article describes the essence of competency-based learning and focusses on the role the portfolio can play in the formative and summative function of assessment. Important issues are validity and reliability. The implications of combining different functions for the design of an electronic portfolio will also be discussed.
In the presentation the focus is on the design (including examples of student-portfolios) and the implementation procedure.

0 Introduction

A portfolio is an organised, goal-driven documentation of a student's professional growth and achieved competence in the complex act of a profession. Although it is a collection of documents, a portfolio is tangible evidence of the wide range of knowledge, dispositions, and skills that a student possesses as a growing professional. Documents in the portfolio are self-selected, reflecting student's individuality and autonomy (Campbell 2001). Portfolios can be used in different ways in education. In the literature on portfolios three main aims for the compilation of a portfolio are usually distinguished, resulting in three different types of portfolio (Wolf 1997):

1. To address evaluation requirements: assessment portfolio;
2. To advance professional growth: professional growth portfolio
3. To aid in employment searches: showcase portfolio

An additional emerging aim, which has recently gained much attention, is that of 'sharing knowledge', being part of learning community. The fourth function of the portfolio is the communication function. The function which is eventually assigned to the portfolio is closely linked to the educational concept existing within the institution and the way this is implemented at curriculum level. The specific functions which the portfolio has to fulfil determine its design and eventual method of implementation. This article will describe the function of a portfolio in a competency-based curriculum.

1 Educational Concept: Competency-based Learning.

For several years now forms of competency-based learning have been introduced into large sections of higher education in the Netherlands. This has involved different definitions of the concept of competencies. Elshout-Mohr (2000) describes competencies as follows: 'In the Dutch context, competencies refer to attributes of individuals that enable them to handle complex professional tasks in an appropriate, process-and product-oriented manner.' Other definitions go deeper into the 'attributes', Klarus (1998) for example refers to 'an individual's capabilities (cognitive and behavioural skills)' while others describe 'attributes' as attitude'. What all these definitions have in common is that students become acquainted with professional practice during their studies and learn to deal with professional situations of greater or lesser complexity.

Characteristics of competency-based learning are:

1. Realistic tasks. During the course students work on realistic tasks: study tasks and assignments have an explicit and demonstrable link to professional practice and competencies. Ideally products and tasks are commissioned directly from bodies in the professional field with students being responsible for delivering or implementing them. The main focus lies on developing the student's competencies. This means that education is demand-driven, the educational programme 'facilitates'.
2. Students are responsible for their own learning process. During the programme the responsibility of individual students increases: they become the manager of their own learning. The principle behind this is that the responsibility which the student has for providing particular services (see 1 above) will have a positive influence on the responsibility which is assumed for the learning process.
3. Assessment of students is based on competency levels rather than the testing of professional knowledge and skills: students prove that they can function at a certain level.
4. Students are addressed as starting professionals during their studies. Professional practice thus has a systematic place in the programme and is involved in the assessment of study results and student's competency development.
5. Learning organisation. Programmes are continually developing in response to the ever-changing and ever-increasing complexity of professional situations: an innovative attitude is expected of professional practitioners. Tutors (currently practising professionals) and students (future professionals) learn from and with each other.

The choice for competency-based learning has far-reaching consequences; it is not only the programme which will be renewed, but the whole organisation which will change (see further on this: Te Lintelo 1999, Mirande 2000, Terwindt 2000).

2 Competency-based Learning and the Portfolio

2.1 The Personal Growth Portfolio

The biggest change for students in competency-based education is having to assume greater responsibility for their learning process and providing evidence for this. The student is given responsibility for all phases in the learning process: orientation, planning, implementation and evaluation. *Traditionally* the student's input was restricted to the implementation phase. In the orientation phase (what has to be learnt?), the planning phase (which activities will need to be carried out to achieve this?) and the evaluation phase (has what had to be learnt actually been learnt?) the responsibility lay with the tutor. In a competency-based curriculum, the student takes or is given responsibility in every phase. This means that the programme becomes demand-driven instead of input-driven and has the role of facilitating the student's learning process. In competency-based education meta-cognitive knowledge and skills (including reflection) are essential skills for the student: students need to be able to analyse the strengths and weaknesses in their learning process and in their knowledge and skills. On the basis of this they have to make choices, formulate learning aims and monitor their own learning process. The portfolio is eminently suitable for supporting these processes. A portfolio in a competency-based curriculum is thus by necessity directed towards the student's development (professional growth portfolio: Wolf,1997). The developmental aspect points in two directions: students record and monitor their own development as well as developing their meta-cognitive skills while working on the portfolio.

When the portfolio is used in this way it is much more than just a collection of selected work. Dochy et al (2000) cite research which shows that the learning experiences and strategies which students develop to work with the portfolio (collecting and analysing data, organising, interpreting, reflecting) are important skills in the concept of life-long learning. Through reflecting on the learning process, working in the

portfolio and receiving feedback, students develop meta-cognitive knowledge and skills. Research among teachers (Tanner, 2000 and van Tartwijk, 1998) indicates that compiling a portfolio stimulates systematic reflection on one's own educational practice because choices and considerations have to be made explicit. A condition for this is that a context is created in which the portfolio forms the impetus for discussion about one's method of work. For students this means that a portfolio must also fulfil a communicative function. At the Amsterdam Faculty of Education we are investigating in a longitudinal study the effects of the portfolio on the selfregulation by students.
An important condition for a personal growth portfolio is that students feel that they are the owners of their portfolios (Wade, 1996). A consequence of this is that the student must have a certain measure of freedom in the design and composition of their own portfolio and that the student can decide who has access to the various components in the portfolio.

In short a personal growth portfolio has the following functions:
1. Monitoring one's own learning processes and making visible growth and development in relation to the competencies;
2. Communication about choices, aims and learning processes;
3. Support for students in their reflection;
4. Registration of the student's individual curriculum. In a demand-driven programme students will inevitably be following a curriculum tailored to their own individual learning needs.

2.2 The Assessment Portfolio
The function of a portfolio in competency-based learning is not necessarily restricted to its role in students' development; it can also function in the assessment of students. Using the evidence collected in their portfolio students can show that they are competent at the level of a starting professional. This means that output feedback in the form of a one-dimensional score (for example pass/fail) is no longer sufficient, and that assessment and feedback must be directed at the way in which and the degree to which the student has developed. The assessment has a formative function here, this form of assessment steers the learning process and contributes to the student's development. Feedback (from peers, counsellors) must be directed at the strong and weak points in the student's functioning and support the reflection process. This assessment function can be completely fitted into the personal growth portfolio.

When it has to be assessed whether a student is competent at a certain level (for example, to decide whether a student is sufficiently competent to receive their diploma), the assessment has a summative function. What requirements need to be met for a portfolio to fulfil this summative function? In answering this question the issues of reliability and validity need to be considered[1].
In the discussion about assessment portfolios it is generally held that assessment portfolios, unlike personal growth portfolios, should fulfil certain external quality demands to make reliable assessment of students possible. (Wolf, 1997). Assessment portfolios must be comparable; demands are made on the number and sort of artefacts which have to be included: in other words they have to be more or less standardised. But is this a justified demand? Is it in fact necessary for assessment portfolios to be similar and comparable and if so, to what extent? Or is it rather that in this new educational concept different demands need to be made of assessment and that so far we have adhered too much to old criteria in regard to standardisation and reliability in portfolio assessment?

Elshout-Mohr (2000) looks for new criteria and Table 1 gives a clear overview of three educational settings each with their own learning goals, learning arrangements and assessments. In the third column a description is given of the consequences of the different settings for
assessment.

Table 1 Alignment of learning goals, learning arrangement and assessment

Setting	Learning goals	Learning arrangement	Assessment

[1] Reliability means that the outcomes of assessment should not depend on accidental variables such as characteristics of the assessors. Validity means that assessment procedures should measure knowledge, skills and competences, which are relevant for the context in which the assessment takes place.

Setting 1: teacher – directed	Discrete knowledge and skills	Teacher-directed programme; guided practice.	Students do tests and examinations marked by the teacher.
Setting 2: student-directed	General skills	Strategy training; Individual practice in a variety of situations.	Students demonstrate general skills in performance. These are assessed with fixed evaluationscales.
Setting 3: competence-oriented	Professional competence	Active participation in professional work or simulations of such work; guided work-experience; construction of personal working and learning concept.	Students present views and implementations in - portfolios - practical assignments. Assessors may develop new assessment criteria if necessary.

In the competence-oriented approach, the learning arrangements are based on the ideas that learning is situated in a professional context and that learners profit from learning episodes in which they participate, as novices, in professional work. Participation provides them with opportunities to construct their own views on the work and the profession, and to regulate their own learning. The right-hand column in Table 1 summarises how assessment procedures might stem from the same approaches to learning as the learning goals and learning arrangements. In setting 1 and 2 identical assessment criteria are used for all students. Elshout-Mohr argues that in setting 3 "congruence between the instructional setting and the assessment procedure can best be reached by employment of assessment criteria that are attuned to student's work and self-regulated learning. It is not fair to assess students by using standard tests and fixed criteria".

In fact what she says here is that in a competency-based curriculum, with a demand-driven programme where the student carries a great deal of responsibility, assessment needs to be 'demand-driven' as well. Not only the curriculum has to be tailored to the individual student, but also the assessment. The evidence presented by the student must of course fit within the general framework of the professional competencies; but every student gives these their own unique interpretation which can only be done full justice in a non-standardised assessment. Assessment criteria have to fit not only within the framework of the professional competencies but also be relevant to the learning process of each individual, self-directed student. Such an assessment wins in validity at the level of the learning process of the individual student. It is precisely in a demand-driven competency-based curriculum that validity has a higher priority than reliability (Klarus, 2000). How you collect the evidence, and the nature of the evidence, is not important as long as the portfolio is valid, up-to-date, authentic, dynamic, longitudinal, multidimensional, interactive and rich in evidence of competence (Dochy, 2000).

Programmes which are concerned with developing demand-driven, competency-based curricula struggle with the form of assessments and the role which portfolio can play in these. Van Tartwijk (2000) signals a tendency away from freedom in students' individual selection of material, structure and form towards a more structured portfolio in which attainment targets are used to direct a self-evaluation which is supported by material included in an appendix. The underlying motive here is the pressure from educational departments to increase the reliability of portfolio assessment and in this way also indirectly to increase their influence on the content of the curriculum. This emphasis on reliability above all else fits, we believe, within more traditional educational models. If the assessment demands a great many requirements which portfolios must fulfil, this means that students will eventually make portfolios which bear a strong resemblance to each other. There would be an unintended conformity in the program. These portfolios are reliable but not valid as far as the student's individual learning process is concerned. However, if, in a competency-based curriculum, the responsibility lies with the student there will be a wide variety of portfolios in which the assessors have to interpret whether a student has sufficient proof of competence or not. Elshout-Mohr (2000) suggests that the problem concerning reliability and assessment can probably not be solved at the level of content, but at the procedural level: a carefully planned and controlled assessment procedure, which of course would be identical for all. The portfolio can play a central role in such a procedure. The criteria and standards to which the content must conform are not part of the portfolio and can be reached in discussion between tutor and student and possibly also the assessor.

3 Design of the Portfolio : a Combination Portfolio

In the literature on portfolios an area of tension is signalled, also for students, between the formative and summative functions of a portfolio (Wolf, 1997 en van Tartwijk, 2000). Personal growth portfolios (formative) give a valid impression of the learning process at an individual student's level. This 'evidence' can also fulfil a function within a summative evaluation (see above). The area of tension for the student lies in the fact that that a personal growth portfolio demands an open attitude to learning and being vulnerable. Such an attitude is difficult to combine with the fact that the same portfolio will play a role at certain moments in the assessment of the student. The question is then how both functions of assessment (formative and summative) can be combined in one portfolio. In the Netherlands we have developed a portfolio design in teacher education institutions which is constructed so that it can fulfil both functions at the same time without difficulty[2]. This format meets the following requirements:

- The ownership rests with the student; the student decides who has access to the various components of the portfolio;
- It offers space, freedom and creativity to the students; they decide how they will prove their competence and what is included in the portfolio;
- The portfolio fulfils a function in the communication among students themselves and between students and tutors.

A web-based portfolio is able to fulfil these requirements and unite various functions. Students collect evidence on their own web-page in the form of products, and feedback and reflection on these. This material is ordered around the professional competencies. From this developmental portfolio the student then makes a selection: what do I want to show my assessors which will prove as convincingly as possible that I meet the demands of the competencies? What we have here is in fact an assessment portfolio within a developmental portfolio, a portfolio with different layers. The student only has to show the selected assessment portfolio to the assessors. This means that we leave the ownership of the portfolio with the student. Only a digital portfolio allows this possibility. In our presentation we will show the design of the portfolio with examples and give a brief description of the implementation procedure.

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The Online Learning Alchemist: Preventing Gold Turning Into Lead

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Abstract: This paper addresses the creation of materials and resources for use in online learning, focusing on the new and emerging roles for teachers and learners in conjunction with developments in our understanding of the human-computer interface. As more educational providers adopt network-based technologies as delivery portals, the demand for skills in the creation of effective online resources is becoming critical. If we are to provide the learner with online resources that will enhance knowledge construction and the teacher with clear measures that these activities are effective, then we as resource developers must resurrect the role of what might be termed the online alchemist. Our first task is to ensure that new digital resources are not simply transferred from their original format but repurposed to ensure learner(s) accessing those resources are able to interact with both the content and their collaborative partners with new levels of flexibility and manipulation. We must transcend the too frequent use of technology as a means to replicate existing resources and conceptualise environments that engender new paradigms for teaching and learning. Our challenge remains to ensure the gold we have in effective teaching strategies and learning resources is not tarnished through ineffective applications within the online learning context. One strategy to achieve this is through *proactive evaluation*, a framework that integrates a set of factors and influences to better inform the development of online learning resources.

Introduction

The imperative for tertiary education providers to embrace online learning as the primary mode for access to teaching and learning resources has never been greater. While many practitioners are familiar with the issues and processes associated with the production of these materials, many institutions are demanding their creation without necessarily having staff competent in all aspects of the online paradigm. At the same time, research studies have demonstrated online environments to be both positive and negative in terms of effectiveness and achievement of outcomes (Franklin, Peat, Lewis & Sims, 2001). Given this environment, questions remain as to both the effectiveness and value of online learning and the available skill base to achieve institutional objectives. What benefits therefore do options for collaboration, conferencing and information-access provide the 21st century learner? In a recent presentation, Peter Goodyear (2000) proposed that:

> The World Wide Web is the biggest disaster to hit technology-based learning since the introduction of the personal computer.

While his argument may not be so much anti online learning as a challenge to prove that computers actually benefit the teaching and learning process, the *disaster* articulated appears to reflect the frequent examples of *online learning* that are no more than colourful, often confused, digitised text. And why has this transpired? One reason is because it is now too easy to take existing, often print-based materials, and without so much as altering their look or feel place them into a web-page and market it as *online learning*. And if those responsible for the conversion to web-based delivery have limited skills in issues of leaner-computer communication, then further problems can result in the effectiveness of these resources. It is not that the resources themselves are problematic. Rather it is the assumption that access by learners operating in the online environment will generate the same outcomes as those achieved in the classroom environment for which they were originally designed. Given this scenario, I argue that online learning can potentially be little more than a lead weight, limiting learning opportunities and effectively destroying what were once useful, integrated classroom materials. To address the issues of skill deficiencies and digital replication, this paper identifies a series of factors critical to the online development process, describing their critical components and the characteristics peculiar to the online learning paradigm that influence the overall conceptualisation of effective teaching and learning resources.

Strategic Intent

One of the first questions we always ask our clients is "Why are you attempting to place these resources or explicit answer, then it is likely that the strategic intent or rationale for the product has not been defined succinctly. Without a clear understanding of the purpose of the product and the stakeholders who have an investment and/or interest in its outcomes, the chances of success are reduced. Within the context of the tertiary education environment, these stakeholders include the administration, the faculty, the development group and most importantly the students. Without full commitment to the concept from all stakeholders, even with the best intentions, effectiveness in terms of learning outcomes being achieved may not be realised.

The critical issue is the extent to which the online component(s) being considered will add value to the overall teaching and learning process. For example, if an institution decides to "go online" without allocating sufficient funds to recreate materials so that they will be consistent with learner-computer communication, then the decision could prove extremely costly with few, if any, positive educational outcomes. Indeed, anecdotal feedback is suggesting a rebellion against online materials; for example, where online is seen to be an economic solution used be institutions in response to government funding cutbacks and academic workload increases. In some cases the intent has been to introduce online studies to reduce class contact time, resulting in student anger and resentment for being *short-changed*, not to mention issues of quality.

Content

Many online projects have focused on the conversion of existing paper-based resources into their digital equivalent, with a proliferation of unit outlines and study guides in either HTML or .PDF formats made available for student access. But this is not online learning, and if portrayed as such then is a misrepresentation of the capabilities and benefits of the technology. If content materials and learning activities are to be placed online, then a significant level of thought must be placed on the very nature of the online medium and the underlying implications for current practices of teaching and learning.

STATIC <--> DYNAMIC				
Predetermined and Presented	**Teacher Contributed**	**Learner Contributed**	**Captured Dialog (Interactivity)**	**Constructed**
Content defined and prescribed by the teacher, and does not change for one iteration of delivery.	Content defined and prescribed, but additions or modifications made by teacher if and when required.	Content defined and prescribed, but learner additions and contributions enhance the resource base.	Through collaborative endeavours, content material is added to the overall resource base for the program.	Content defined through research by participants and subsequent interpretation and construction.

Table 1(a): Influences Affecting Online Content

As shown by the influences identified in Table 1(a), the online environment caters for a range of content formats: from predetermined static media to a dynamic state where content is sourced, repurposed, constructed and enabled by and for all participants in the learning process. Between these two extremes are the more typical options for delivery of course content in terms of resource material being contributed to by both the teacher and the learner. It is important that this range of options is understood and that the implication for the discipline base is considered. To fully exploit the online environment means having to reassess the overall approach to the content, how it should be presented or accessed and the relationship between teacher and learner in that process. The components associated with the content must also be addressed by considering their interaction with the influences and their availability to the learning community. As detailed in Table 1(b), the issues to consider will have a significant impact on the role of the content and subject matter in the broader learning process. Underlying this notion is the understanding that content can no longer be seen as being "owned" by the teacher or discipline but rather as an information base that can be perceived and worked with in many different ways.

COMPONENT	Issues
Structure Organisation & Information	If adopting strategies that enable the dynamic construction of knowledge, traditional forms of information presentation may have to be modified.
Matches Goals & Outcomes	The extent to which program goals and objectives are predefined may be affected by strategies that enable the learner to use knowledge construction techniques.
Contextual and/or Situated	With a dispersed cohort of learners, content must be considered in terms of the context in which the learner is situated rather than that of the teacher's particular experience.
Accuracy, Integrity, and Totality of the Information Base	Recognition of the learners' ability to contribute to the knowledge base presents questions as to accuracy and integrity – from whose perspective are these characteristics of the content to be measured and assessed?
Extensibility of Content	Is the discipline base so rigid that no options for new content are considered possible, or can new alternatives be considered for collaboratively constructing and extending the knowledge base?
Quality of Expression (language, grammar, image resolution)	To what extent can traditional norms for quality of presentation be maintained if a more dynamic approach to content is considered appropriate, and what impact might this have on roles in the development process?

Table 1(b): Online Content – Major Components

Learning Design

The term *learning design* is used instead of *instructional design* to emphasise the learner-centred environments online resources can provide. Taking this stance is particularly important because it forces designers to conceptualise the development process from the learner's perspective rather than that of the content. However this does not preclude developers from adopting an instructivist (I) or presentational strategy compared to a constructivist (C) or generative approach, but does require careful thinking about the learner and the options provided for interacting with the content and their learning partners.

I < -------- Pedagogy --------> C	Learning Outcome	Resources (Media, Modes)
Individual teachers and learners have different philosophies on the most appropriate ways that knowledge is gained and learning acquired. As online environments can be perceived as supporting the constructivist paradigm, adopting rigid instructivist strategies may degrade the overall effectiveness of the encounters experienced by the learners.	These options link learning strategy to outcome and affect each component of learning design: problem solving; declarative knowledge; concept learning; principle learning; procedural learning; cognitive strategies; attitude & motivation and psychomotor (Smith & Regan, 1999)	The ways in which media elements are used and extent to which they are accessible will influence the individual components of learning design.

Table 2(a): Influences Affecting Online Learning Design

As detailed in Table 2(a), the design of resources will be influenced by the pedagogy, outcome and resources considered appropriate for the task. When considered in terms of the specific components that are critical to the overall design task shown in Table 2(b), the complexity of addressing educational and technological elements of the process are emphasised. Embarking on the design and development of resources for online environments requires new layers of thinking to be added to the well-established principles of course development.

COMPONENT	Issues
Prior Experience	Online learning is a new environment, and learners must have the requisite skills to effectively work within this paradigm.
Learning Styles	Does the provision of a range of media elements address the different motivational and perceptual styles of learners, and what impact will this set of options have on the overall development effort.
Learning Environment	The extent to which the environment is designed as a digital page or a virtual world will impact on the overall development effort (see Interface Design)
Pathways/Sequencing	The strategies for online learning can establish predefined pathways or enable students to explore and discover different facets of the content. Managing these options to minimise information overload becomes critical.
Outcomes	In providing an online environment, are the stakeholders providing for a range of outcomes or are the consistent with predefined objectives.
Assessment	Closely linked to outcomes, are new forms of assessment being considered for the online environment, such as collaborative understanding and concept formation.
Level of Learning	What impact might governmental standards have on the design – and do those standards influence or constrain the preferred modes of delivery within the online contect?

Table 2(b): Online Learning Design – Major Components

Interface Design

The interface between learner and computer is one of the two most neglected aspects of online learning, the other being interactivity, as both are integral to successful and ongoing communication. As detailed in Table 3(a), the options available for on-line productions can range from the non-contextual through to the theatrical, where the learner is conceptualised as an active player in the overall learning process rather than a passive observer (Laurel, 1991; Sims, 2000).

Overall, the conceptualisation of the interface must consider the strategies employed to position the learner within the *illusion* of the virtual learning environment; the way in which representations, metaphors, icons are employed to support communication; how design decisions affect connectedness and interference within the learner-computer interface and the extent to which animations and sound effects impact on cognitive load and degradation of learning (Sweller, 1988). The associated components for Interface Design are identified in Table 3(b) and are linked explicitly to the elements of Learning Design, one area that can be neglected by developers new to the creation of online resources. To maximise the online learning experience it is not sufficient to apply rigorous educational design to content materials as the means by which that content (resource, activity, conference, reading) is presented to the learner will impact on its overall effectiveness.

Non-Contextual <-------------------> Contextual <-------------------> Narrative <-------------------> Theatrical				
Information Design	**Interaction Design**	**Input/Output**	**Navigation Design**	**Aesthetics**
What procedures have been employed to ensure maximum communication of information?	Have the various interactivity options been catered for and communicated to the learner?	How clear are the options for entering and accessing content and responses?	Does moving between resources affect continuity of delivery or context?	How does the "look and feel" contribute to or detract from the communication experience?

Table 3(a): Influences Affecting Interface Design

COMPONENT	Issues
User comfort - connectedness	Has appropriate usability testing determined the extent to which users are able to work with the resources and make the necessary connections between content elements?
User control User centred	In what ways are users able to control the learning process and link the activities to their own learning requirements?
Supports content structure	Has the interface been conceptualised to be consistent with the content structure while maintaining acceptable standards?
Supports learning design approach	Has the interface been designed to be consistent with the particular paradigm employed for the course?
Alignment of Mental Models	What strategies have been employed to ensure the mental model of the design group has been effectively communicated to the learner?
Customisation vs Individualisation	In what ways can the learner structure the environment to meet their own individual learner needs or preferences?

Table 3(b): Online Interface Design – Major Components

Interactivity

Interactivity is about successful communication and, in the context of online learning environments, one of the most crucial factors to address. As a component of the human-computer relationship or encounter (Sims, 2000; Sims, 2001), interactivity can include passive presentation, navigation, undirected exploration, directed involvement and specific manipulation. The extent to which these constructs of interactivity impact on the continuity of communication between learner and interface, content, other learners or other teachers is critical to the overall effectiveness of the experience and is inextricably linked to the factors and influences associated with content, learner design and interface design.

Student Support

Providing appropriate support for the learner cohort is even more critical in the online environment because in many instances they will be working independently in their preferred environment. Even though this environment may include collaborative work, the learner's only medium of communication is the computer, and therefore support becomes critical to ensure their mental model is consistent with that of the other stakeholders in the process. In addition to the typical help systems, announcements and guides, recent research (Sims, 2000) has suggested that more explicit support is required to bring the learner into the online environment, especially by eliminating assumptions that learners will know what to do and why they are doing it.

Utility of Content

Within Australia, new digital copyright legislation and the proliferation of digital resources has provided new incentives to focus on the international standards for online learning environments. A crucial component of any development exercise therefore is to examine the extent to which content can be used in multiple environments (within and outside the product being developed), the means stakeholders might have to customise the materials and the interoperability between other learning objects in the wider curriculum.

Learner Outcomes

The final factor to consider relates to the ways in which outcomes have been successfully achieved. For example, measures of learning associated with both intra-curricula and extra-curricula activities; the level of learner satisfaction with the overall experience; the completion rates and the extent to which pass rates and grades are consistent with alternative delivery options. Overall the design effort needs to include items to enable a comparative analysis of student outcomes in relation to the overall development parameters.

Proactive Evaluation

The classification of factors and associated influences as discussed above provide the basis for a concept I refer to as *proactive evaluation*, developed in association with Graeme Dobbs and Tim Hand. The essence of this concept is that by first considering the complex interactions between educational design and online environments, designers and developers with new or limited skills in online learning will reduce the risk of producing poor-quality or ineffective materials as well as the likelihood of critical, negative evaluation. The ideas presented can be viewed as an extension to current practice in instructional or learning design, as many of the factors identified stem from that theoretical base. However, the underlying principles assume that the environment for which the development is being undertaken is not a traditional instructional setting, but an online world in which the traditional relationships between teacher, learner and content no longer always hold true. By applying the proactive evaluation concept, development teams will not only ensure all aspects of creating online learning resources and activities are addressed, but that subsequent formative and summative evaluation will be more rigorous and meaningful. In addition, the concept focuses the decision making process on the complex interaction between disciplinary content, learning outcomes and computer-based learning environments. By better understanding and addressing these relationships, more effective teaching and learning resources will be consistently produced.

Conclusion

In mid-1970, Donald Bitzer mesmerised an audience in Perth, Western Australia with a demonstration of the PLATO system. The capacity of computer-based technology to display combinations of media elements and respond meaningfully to user actions and manipulations was even then well established. Over the ensuing 25 years, the power and capability of the computer to support the learning process has often been lost in the maze of marketing publicity of technical gadgetry and wizardry, and has been maintained through the new wave of e-learning and online learning initiatives. Unfortunately, without the requisite skills, it has become all too easy to create web-based materials without understanding the underlying principles of online, interactive learning and rather than creating golden learning opportunities, many materials have been more leaden, with learning a confused labyrinth of information, links, colleagues and navigation. The factors and influences presented here, which are critical to online learning, have been expanded to provide a framework for the concept of proactive evaluation. By enabling development teams to address the critical issues associated with the creation of learning resources for delivery in an online environment we have a greater chance of ensuring our gold retains its lustre, and learners gain significant value from their online experiences.

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Effective Instructional Technology Training and Support for Faculty

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Abstract: The Technology Serving Learning Institutes have provided instructional technology training to 60% of Southeast Missouri State University faculty since 1997, with most gains made since 1999. To prepare faculty for online course development, the Institutes were redesigned in 1999 to employ a flexible format based around a pedagogy course. The new format increased faculty participation in the Institutes, and fostered development of more course web pages, with greater sophistication than previously seen. Walk-in, phone, and e-mail faculty support continued beyond the Institutes in the Office of Instructional Technology (OIT). The OIT developed custom course management software, the Online Instructor Suite (OIS), which combined a manager, online calendar, online gradebook, online testing, and web page generator to meet instructor needs.

Introduction

Southeast Missouri State University is a regional four-year public university enrolling 8000 students. The University's Strategic Plan expresses Southeast's mission, with a focus on enhancing student learning through optimal use of information technology and development of "innovative applications of technology ... " with the ultimate goal of extending access to information technologies to faculty by providing training opportunities and support, and by extending distance learning opportunities via technology. These goals drove our efforts to provide instructional technology (IT) training and support to Southeast's faculty in the form of Technology Serving Learning (TSL) Institutes.

Early TSL Institutes

The Institutes originally followed a short course model, in which participants worked intensively over 5-8 days on topics such as PowerPoint 4.0, Authorware, and Web-Page Authoring. In Summer 1998 (S98), two-day "companion" courses were added to address specialized topics such as online testing and gradebook applications, leading on-line discussions effectively, and using video with Web pages and PowerPoint. Participants were to develop useful products, such as Websites or PowerPoint presentations, during or immediately after the Institutes. Deep immersion in the content would allow participants to return to the Departments as "experts" in the technology studied. We expected demand for the original Institute sessions to drop after the experts returned to the Departments.

What did we learn from the Institutes' first two years? The Institutes were quite popular. The hands-on nature maximized involvement in the design process, allowing participants to brainstorm with facilitators. Fears about turf issues and faculty resentment of IT spending were unfounded. However, the Institutes failed to leverage previous faculty experience, and they did not account for demands imposed on faculty by course content, accreditation agencies, and departmental resources. Faculty time commitment problems persisted, and despite efforts to impose balance, technical proficiency usually trumped pedagogical practices. We created few Departmental "experts", but early participants did generate interest in the Institutes among colleagues. Finally, our intended focus on product was imperfectly realized, with some participants failing to complete projects. Clearly, the Institutes required revision.

A New Format

The Institutes' popularity led us to offer Winter Institutes in January 1999 (W99). The W99 Institutes were not full-featured offerings; rather, they were teasers for the Summer Institutes and accommodations to faculty having scheduling difficulties. Fears of interfering with Spring semester preparations led us to organize W99 as single-day sessions. Nevertheless, we expected low enrollment in the three offerings. We were instead astonished to find demand so high that second sessions of each had to be hurriedly arranged. While length was the most noticeable change from S98 to W99, two concurrent improvements occurred: we completed the transition from Windows 3.1 to Windows 98 (necessary for FrontPage 98), and we began to teach CSTL-developed software (GradeA Gradebook).

Though not constrained by faculty's need to prepare for a semester's imminent beginning, we retained single-day sessions in Summer 1999 (S99) to allow faculty selection of programs maximally suited to individual needs. Modular design also allowed us to work around facilitators' schedule conflicts and more easily repeat high-demand sessions. To address concerns about the technology/pedagogy balance, we adopted a two-tier model, in which a mandatory pedagogy session was followed by choice of twelve applications sessions over three weeks. The pedagogy session, facilitated by OIT's Instructional Design Specialist, offered good composition practices that, while emphasizing Web pages, could be applied in any environment. The applications sessions practiced good pedagogy in specific software environments. A second custom-developed module (UTest, an on-line testing application) was introduced in S99.

We used the two-tier, single-day session model for all Institutes since S99. By hiring a PhD in Instructional Design in the OIT, we were able, for the first time, to present instructional design from a rigorous, theory-based perspective in Winter 2000 (W00). In Summer 2000 (S00) we increased the number of offerings of both pedagogically oriented and technically oriented sessions. Advanced instructional design and Web page development sessions were taught to attract veterans of previous Institutes. S00 also saw the first offering of an on-line session, "Teaching in the On-line Environment". The Winter 2001 Institutes focused on Web page development, with our custom OIS software serving as a course manager.

Results

A total of 251 faculty have attended the Institutes, nearly 60% of the faculty on campus. Most importantly, we saw a continuous increase in participants over the four Summer and three Winter Institutes. After large new participant enrollments in S97 and S98, the number stabilized at ~30 each in W99, S99, W00 and W01. We concluded from this pattern that, after attracting the early adopters in S97 and S98, faculty not prone to early adoption steadily joined the Institutes, as they observed successful IT implementations from previous Institutes. With new participant enrollment stable while overall enrollment climbed, veterans must have found enough value in the Institutes to return for more. We therefore conclude that we are winning over faculty to IT approaches to teaching and learning.

We also saw that our resources were expended efficiently. The cost/hour of instruction delivered to a participant fell ~50% from S97 to W01, due to more efficient technology (better copying/printing capabilities in the CSTL), self-written software (lower software license costs), and better organization (experience improved resource management). Recruitment cost declines also contributed to the overall drop in costs; we therefore argue that our increased enrollments did not result from expanded recruitment efforts. Indeed, faculty have recently begun to call far in advance of our recruitment cycle, requesting enrollment in *whatever Institutes are offered*! We apparently benefit from superb word-of-mouth advertising. Participants' PD stipends declined from $17/hr to $10/hr, convincing us that increased participation was not due to PD money "bribery".

Responding to our early disappointment with the lack of "expert" creation, we began in W99 to recruit participants from earlier Institutes to serve as facilitators. We believe that these faculty have become experts through self-confidence derived from having been selected to act as facilitators, and from greater care taken to learn the technology and pedagogy, knowing that they would be under the direct scrutiny of colleagues.

All Institute participants were asked to complete an evaluation instrument consisting of open-ended questions and questions seeking a response on a nine-point scale (9 = high). The instrument questioned interest, facilitator quality, content, pace, quality of the student helpers, effectiveness of the Institute, its usefulness, reasons for taking the Institute, suggestions for future topics, and overall faculty satisfaction. Evaluations have been generally very positive with typically an 80% response rate, and responses of 8.0 to 8.2. When rating effectiveness, 110 responses of "Effective", 36 "Somewhat effective", two "Somewhat ineffective", and one "Ineffective" were recorded. The few complaints received focused on issues other than content, so we felt that we succeeded in making the case that IT has an important place in college teaching.

The Institutes brought other improvements to campus, and especially to teaching and learning. Faculty involvement in campus IT issues has increased greatly since the Institutes began. Attendance and presentations at IT conferences has also significantly increased. We feel that Southeast has moved from the trailing edge of adoption to the leading edge of development and implementation. Over 300 of 380 faculty have active IT server accounts; over 500 course sections have web pages. Many faculty Web pages showed improvements in organization and format; these pages also tended to appear in more easily navigable Websites than before. Finally, we have increased the number of online courses (offered and under development) from zero to 60 in only two years! Southeast faculty, almost all of whom have attended at least one Institute, developed all these courses. Importantly, sound instructional technique is being included in course Web page development and pedagogy is taking on as strong a consideration as the technology itself. We feel especially satisfied with this outcome, as the number of technically sound online courses nationwide far exceeds the number of instructionally sound online courses. The emphasis on pedagogy in online instruction is an important component of IT training and support at Southeast Missouri State University.

Future Plans

With new participants continuing to enroll, basic Institutes, such as PowerPoint, will remain in both Summer and Winter sessions. Advanced topics (e.g., cascading style sheets, active server pages, Macromedia Flash), and pedagogically-oriented Institutes (e.g., leading effective on-line discussions, teaching critical thinking on the web, using the Socratic method in on-line teaching) will be developed to serve veterans desiring additional training and to increase the focus on effective use of technology to enhance teaching and learning. Institutes to support on-line course development, and additional selected Institutes offered entirely on-line are planned. Additional components of OIS will be taught in sessions in the Summer 2001 Institute, including online calendar and online conferencing software.

PERSONAL DIGITAL ASSISTANTS IN THE CLASSROOM: AN EXPERIENCE[1]

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Abstract:
shown to be aseptic or "slow" in the adoption of new technologies. Personal Digital Assistant are low cost technology that permit individual use. Learning can be produced in a natural context (not in a computer room) using a specific language, video-game in our case, that allows both the children and the teachers to use the technology in an easier and more direct way. An experience with 263 children was carried out in Chile were it was shown through qualitative and quantitative results the success of the experience. The paper finishes addressing how wireless communication can be used in this environment to obtain social interaction and collaborative learning.

1. INTRODUCTION

1.1. Why computers in the schools?

The incorporation of computers in schools has allowed determining the effects of technology in the educational process. Studies indicate that this tool favors specific cognitive skills, time dedicated to the task, and student motivation for learning. Positive effects have been detected in **reading speed** (Krischer et al 94), in reading comprehension, an increase in **visual vocabulary** (Becnel 91, Rockman 93), and better performance in **Algebra** (Council 90). Also, **attention span and concentration** are favored by this computing tool.

The positive effects of the computing tool on learning are due to the fact that it personalizes learning to each student and presents contents in contexts not associated with school. The computer is an effective tool since it provides feedback, corrects without making emphasis on mistakes, frees children of the difficulties of interaction with adults, and finally, it is attractive for the student (Fitzgerald 91).

1.2. Problems with computers

1.2.1. *Costs*

However, the software and hardware technology needed to equip a classroom is still expensive for developing countries where the number of machines per school must be limited to 3, 6, or 9 and in exceptional cases, 30 (Hepp 99). For that reason, the effective usage that each child can make of them is still very low.

Complementary, the effective use of computers can be low due to operational reasons. Computers can lose their configurations due to system crashes or improper handling by the user, need system management and operating system training.

1.2.2. *Lack of Software embedded with curriculum*

While each school may have at least one computer, the acquisition of computers has not been matched by the development of educational software according to the objectives of traditional elementary education (Soloway 98). The existing software in this category is mostly in English, or it is not designed with formal ends, and there is no systematic effort to develop solutions that would satisfy the most basic needs of the curriculum of each country (Nussbaum et al. 99). So, it is more probable that the software installed on the machines is of general use – such as word processors or spreadsheets – than specific tools designed for learning.

The experience of the Chilean project Enlaces (Hepp 99) shows that teachers have greater appreciation for software that directly addresses their curricular objectives (regardless of how simple it is). They would like it to be closer to their methodological focus and in the Spanish language. This is very important because the issue of software simplicity has a direct impact on the platform that must be used to run the programs. Simpler software will require less associated hardware, and for that reason, cheaper technologies could be used that would allow for massive use.

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1.2.3. *Difficulties in technology adoption*

In the United States (Mackenzie 99), 70% of teachers can be classified as aseptic or "slow" in the adoption of new technologies. Some of this is because they have received little support or opportunities and insufficient equipment. Others consciously resist. These "slow" adapters have little tolerance for change and are not very disposed to changing existing behaviors unless evidence exists that the efforts involved in the change will have results (Mackenzie 99). They demand a complete, finished product before accepting the idea. They demand a total solution that is friendly, complete, and with good foundations.

Other causes for resistance are the frustration involved in learning how to use the computer, lack of confidence about the effects on learning, the perception of the computer as a competitor for the children's attention and as a risk in terms of the investment of time and effort that it implies, the fear of losing control or looking bad in front of the class, and the resistance to assuming new roles that this incorporation implies (Hurtado 97). To combat these fears, it is necessary to adequately train teachers for the use of technology. If this is not done, the feeling of lack of preparation for the use of the technology can become very high, even in developed countries (Mendels 99). Thus, the massive use of technology is not only made difficult by the low budget available to schools –a problem that does not only affect Latin America, but also the United States (Soloway 98)– but also by the difficulty of adoption for those who have to use it. However, the proportion of teachers who maintain a reticent attitude toward the introduction of computers in the school diminishes when they perceive positive results; they take an open, enthusiastic attitude toward its adoption (Núnez 96).

2. An Experience with PDAs in the Classroom

2.3. PDAs: Computer Technology at Lower Cost

Today, technology offers new personal tools. The tendency is that each person will have a computer in his (or her) pocket to assist them with their work. Nowadays, electronic agendas, pocket PDAs, and even new cellular phones with additional functions are becoming more popular. The appearance of this technology has been more effective and lower cost than traditional technology. This opens an opportunity to explore new applications, especially in education.

PDAs[2] are used in many different areas (business and entertainment, among others), some with more diligence than a PC. They can offer alternative technological possibilities in addition to their ergonomic and portability advantages (Yoshiyasu et al. 98). Also, users show great interest in mobile technology (wireless mobile web restricted with portable computers: Notebooks, PDAs, wearable computers) as assistants for their activities (Ammitava 99). However, few studies exist related to the incorporation of mobile technology in schools as a support tool for educational activities capable of generating similar results (Luff & Heath 1998).

2.4. A computation tool Based on PDAs for the classroom

2.4.1. *Key issues of the design*

Keeping in mind what was mentioned in Section 1, the idea arises to incorporate low cost personal technology that would permit individual attention for children. Learning would be produced in a natural context (not in a computer room, which breaks the learning context), using language that allows both the children and the teachers to use the technology in an easier and more direct way; they would forget that they are in front of a computing tool. Encountering this kind of language is a fundamental aspect for this kind of tool.

Ludic and motivational aspects determine the attitude of the students in front of the technology. Students prefer activities in which the educational content is presented in a game-like context, particularly when aspects like competition, time, and/or points present immediate and interesting challenges (Hubbard 91). The interest of the students in video games is so high that if we take advantage of it in the interest of education, we can create a great tool for learning and motivation (Baltra 90).

Several authors attribute great importance to games in the psychological and social development of people, especially children. There is a good deal of evidence of their measuring role in the socialization and learning processes (Bruner et al 76, Rogoff 93, Vygotski 79). According to Vygotski (Vygotski 79), games are the promoters of general development in children since they allow for teaching rules as well as investigating their own capacities and limitations. All this can later be extrapolated to real situations. In games, children generate their own spaces and opportunities that allow them to develop imagination, their symbolizing capacities (through the "as if") and consequently develop abstract thinking skills as well as the comprehension and recognition of implicit rules that affect the game and reality. The child rehearses new activities and reflects on ideas without the pressure which frequently accompanies more formal attempts at learning (Bruner et al.76, Rogoff 93).

[2] Personal Digital Assistant,. Hardware which supports mobile technology..

For this reason, the language of games seems to be the most appropriate to use in the implementation of technology. Such language allows children to learn without realizing it, forgetting that they are doing a "task" or that they are in a classroom. They can operate without the fear of making a mistake; all this changes the dynamic of traditional classes for both teacher and student.

2.4.2. *Target Population and Tool description*

In Latin America, there is a high rate of failure in the compliance with minimal educational objectives. In the case of Chile, the failure rate reaches close to 12% in the four years of general elementary education (GEE) (Nussbaum et al. 99). This means that a significant percentage of the children that finish 4 years of GEE do not know how to read nor do they possess basic mathematical concepts. In consequence, they represent the group at highest risk for later failures in school, given that they do not manage to adapt to the framework of formal education. The objective is to be able to assist in the education of the aforementioned population, supporting them through the use of a low-cost portable computing tool with educational games including basic mathematical concepts and beginning reading.

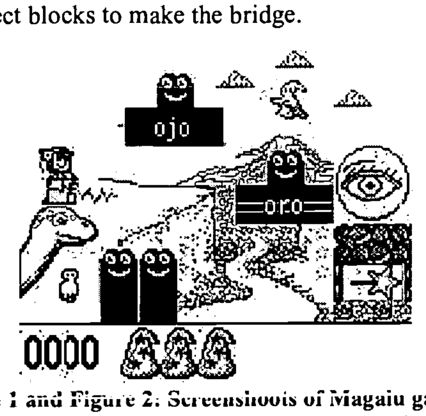
The educational tool (Nussbaum et al. 99) consists of a portable video game console, oriented toward children of 6 or 7 years of age. It contains 7 specially-designed educational video games which support the essential contents of the Spanish language as well as mathematics from first and second grade of elementary education. The tool does not require previous knowledge, which means that it is easy to use for both children and teachers as soon as it is turned on. Also, given that the equipment is basically a mini-computer, the video games are supplied with "intelligence" (an expert self-regulation system) which adjusts the difficulty levels of the games as the child uses the equipment..

In a first implementation, the Nintendo Gameboy platform was used because it is very popular and low cost. A cartridge was designed that contains the aforementioned software for the machine. In the future, other alternative platforms may be analyzed which comply with the requirements, may minimize cost, or integrate already existing personal technology.

Seven games were designed which cover mathematical and language contents:

GAME	MATHEMATICS AREA	SPANISH LANGUAGE AREA
ROLI	• Geometry • Subtraction • Addition	Construction of words beginning with the identification of the omitted initial and final syllable
HERMES	• Identification of the symbols >, <, = • Addition and subtraction	Identification of the initial phoneme at different levels of complexity
MAGALU	Numeric sequences presented at different levels of complexity	• Identification of initial syllable • Visual vocabulary • Decodifying
SELVA	• Estimate and count elements • Addition and subtraction • Identification of symbols >, <, =	• Discrimination between capital and lower-case letters • Codifying words in terms of their phonic elements • Completion of words based on the identification of consonant groups
COLGADO	-	• Codifying words in terms of their phonic elements • Codifying words based on the identification of consonant groups

Each game is associated with a story. For example, the game **Magalu** (Figs 1 y 2) consists of a little magician that must complete a bridge in order to get the magical objects that will make her a great Magician. Magalu must shoot magic at the correct blocks to make the bridge.



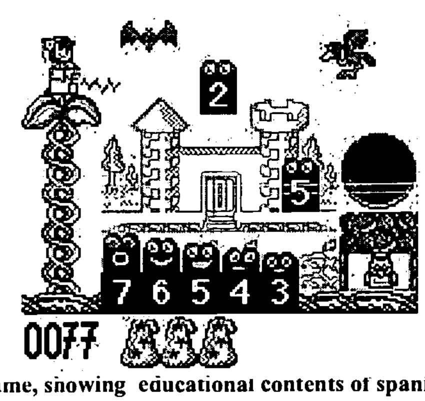


Figure 1 and Figure 2: Screenshots of Magalu game, showing educational contents of spanish language and mathematics, respectively.

2.5. Experience

To study the behavior of the children in regards to the tool, it was decided that participating schools had heterogeneity in terms of socioeconomic level, type of administrative dependence, religious orientation, average age of first grade students, geographic location, and quantity of students per class. The decision was made to work with 263 first graders from six schools. The process began with training in order to form the teachers. Also, support material was given to the teachers, such as explanatory manuals, as well as charts of the games and how the PDA works.

The work with the establishments was divided into two large groups: those that received more support from the team and those that worked more independently. In the three establishments that worked with more support, implementation began with a periods of modeling in which representatives of the team presented the machine and games to the children. Also, the team asked the teachers for their semester schedule. According to these plans, a proposal was formulated so that each game would be used in parallel fashion with the presentation of the contents in formal classes. The other establishments had absolute liberty to decide which games to use and at what time. They did not have the modeling period previously mentioned.

2.6. Results

2.6.1. *Management and Appropriation of the Tool By Students*

Information was gathered through group interviews, surveys, and observation charts for the game sessions for analyzing the technology transfer. In general, all students showed themselves to be highly motivated by the tool and maintained a high level of attention and concentration during the game sessions. For that reason, thanks to a hand on experience, all of the children developed the necessary psychomotor skills.

The analysis of the collected information allows to conclude that the students' technological transfer was not a difficult process. The students' interest in the machine increased along with their commitment to take care of it, their capacity to handle it, and their motivation to use it as a learning resource.

2.6.2. *Appropriation of Technological Innovation by the School System*

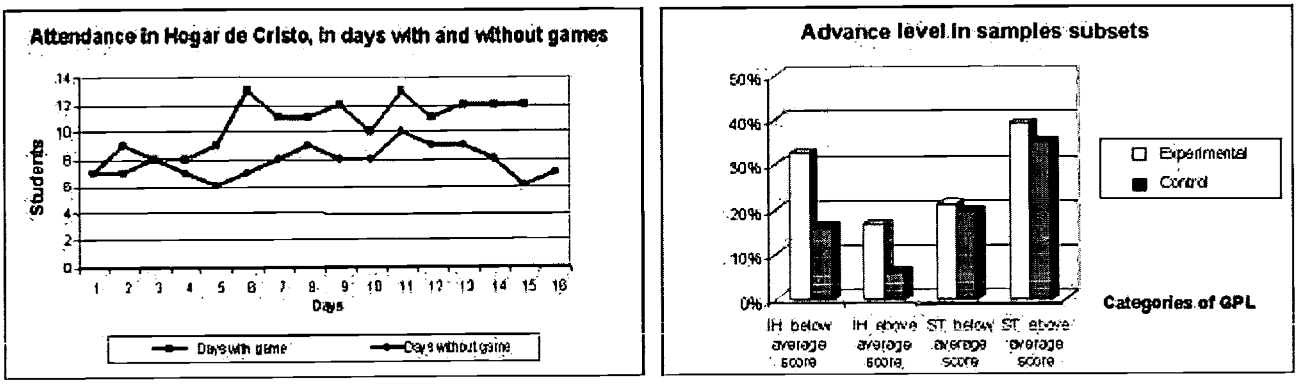
The teachers evaluated the seminars given, indicating that enough tools were supplied for the implementation. The most useful thing for them was the given short training with the machine, followed by the game manuals and group discussions. Talks and simulations, however, were not considered to be of high utility for the implementation process.

The appropriation of the technological innovation process was studied more profoundly during the second semester of implementation. The purpose was to discover the importance of many aspects of the technology transfer. It must be noted that the characteristics of each establishment and of the teachers, significantly influence the characteristics of the processes of technological innovation that are developed in the classroom.

The observation in the schools revealed, in general, a good disposition toward incorporating technological tools in the classroom. As the teachers saw the children's motivation with the tool, they began to get involved in the activities of the project and to work together with the coordinating team. In general, the teachers reported feeling comfortable using the tool. They pointed out the machine's contributions to learning, its impact on the teacher-student relationship, and its contributions to the work of teaching.

2.6.3. *Quantitative Results*

Figure 3, shows how the use of the PDA influenced the voluntary attendance in the Hogar de Cristo school, with children involved with drugs and other social problems with an average age of 12 in first grade. Figure 4 shows the results in two schools where it can be seen the learning effect for children above and below the average, comparing them with a control group that didn't use the machines. Further results can be found at *http://www.ing.puc.cl/sugoi/presentation*



Figures 3 and 4: Some quantitative results achieved using PDAs in the classroom.

2.7. Introducing wireless technology to the Classroom

Once the first experience with PDAs was completed, the following question arose: Is it possible to obtain social interaction and collaborative learning with the help of mobile technology? Necessarily, this question implies incorporating communication capacities into the PDAs, such as those brought by Bluetooth technology.

Of the 12 basic models of collaborative interaction (Davidson & Worsham 92) that can be developed for the objectives and characteristics of the type of applications proposed here, the following is the most appropriate due to the type of interaction offered, number of participants it handles, type of collaborative objective it supports, and the collaborative learning formalisms it offers:

Type of interaction:	Collaborative Group Learning to develop collaborative learning activities.
Description	3 to 5 participants, heterogeneously grouped for an academic activity that seeks a simple objective. The key elements (formalisms that have successful collaborative learning methods) for formal collaborative groups include positive interdependence, individual responsibility, group processing, social skills, and face-to-face interactions.
Model	In the model in Figure 5, the circles represent students, and the arrows indicate the interactions that can be achieved between the subjects, in order to achieve a collaborative environment.
Prescription	Utilized to intensely commit the student to the processing of necessary activities for learning and transfer. This model is adjusted to the formation of the groups, which could support collaborative learning activities in the same place (face-to-face) and at the same time (synchronous).

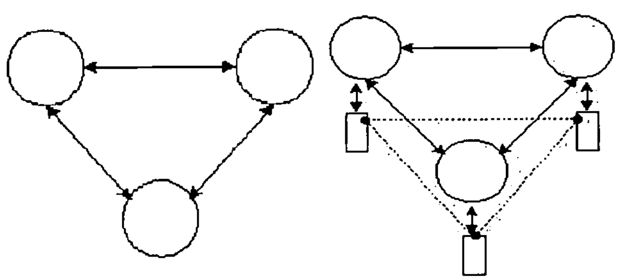


Figure 5 and 6: Models of Collaborative interactions with and without PDAs

Technological support is achieved by extending the previous model to the use of PDAs with bi-directional wireless communication, in this way forming a **local mobile web** (see Fig. 6). This new model allows the students to interact with their PDAs (rectangles in Fig. 6) as well as be able to interact face-to-face in a synchronous fashion. The PDAs send and process the information of the different groups formed during the collaborative activity.

Figure 7 shows the interface of 3 PDAs in a Mobile Computer Supported Collaborative Learning (CSCL) Mathematics application. Each PDA shows a number, and the objective is to sort the three numbers. Collaborators can move with their PDAs to verify the order of the numbers or to place PDAs in a given order they consider correct. When they finish this step, the child who has the lowest number in his or her PDA (or the highest depending if they should sort up or down) presses the button "juego". The rest of the collaborators consecutively press their button in their turn. If the sequence of the numbers has correctly been formed, the Mobile CSCL application communicates it to the collaborators through the wireless network. In case the sequence is incorrect, then the group is told that the answer is wrong (as it can be seen in Fig. 8). To indicate the collaborators the formation order, in the upper left an animation of a number that goes up or down, as it corresponds, is presented. For proceeding to another sequence of numbers, it is necessary that everybody agrees and that they press the button "si" (yes) in the moment that in each of their PDAs appears this option (Fig. 8). The sequences of numbers can be configured dynamically according to different factors, such as speed of answer, right responses, wrong responses, and so on.

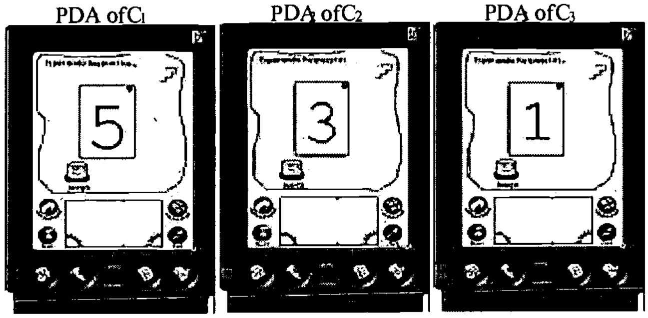


Figure 7 Mobile Collaborative Application for Mathematics

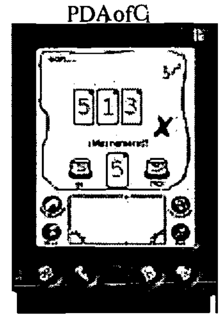


Figure 8: Wrong result

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Using "WoundCare" to Learn

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Abstract: This paper reports on the development and evaluation of "WoundCare: An Interactive Learning Program for Health Professionals" (trial version). A key issue examined in this paper is the extent to which the learning activities incorporated in educational multimedia, such as WoundCare , promote deep rather than surface learning. Specific design features thought to facilitate and inhibit deep learning are identified. Modifications that could increase the learning effectiveness of WoundCare and other interactive multimedia programs are proposed.

Major goals and basic approach

The major goal of this project was to develop an interactive multimedia application that could be used by student nurses to enhance learning related to the assessment and treatment of people with wounds of various types. Specifically, the project aimed to develop an interactive multimedia application that could reduce the impact of problems associated with traditional methods typically used when teaching student nurses how to assess and treat people with wounds. The trial of "WoundCare: An Interactive Learning Program for Health Professionals" (trial version) has also led to a detailed examination of the educational value of the constitutive components of the program. In totality, the project consisted of an analysis of student needs and educational problems, the design and staged development of an interactive multimedia application, and, a comprehensive evaluation of the application and activities engaged in by students using the product in the context of learning.

Previous work

The impetus for developing WoundCare derived from contextual and practical difficulties associated with teaching wound assessment and management to student nurses using traditional methods. The major educational problem identified prior to this project was the ongoing difficulty nurse educators have representing clinical reality in university clinical nursing laboratories when teaching student nurses. Furthermore, it was recognised that use of WoundCare by student nurses had the potential to reduce the impact of practical problems including:

- und a bed or trolley to observe demonstrations;
- lecturers being unable to adequately supervise several sub groups of students practicing the clinical sment activities; and,
- inability to provide similar learning experiences to distance education students unless on campus residential

n

campus computing facilities) was intended to improve students' cognitive, technical and psychological y assert that it can be used to improve learning outcomes. Factors that may contribute to improved learning outcomes when interactive

possibility of accommodating different learning styles .
But, do learning outcomes always improve when interactive multimedia is used? Of course, the realistic answer to this question is 'no'. It therefore becomes necessary to identify the features of interactive multimedia that consistently improve learning outcomes. Particularly important is whether a sequence of educational activities will stimulate deep rather than surface or shallow learning, i.e. thorough understanding rather than the capacity to recall isolated facts (Marton & Säljö 1976a, 1976b). Biggs (1999) argues that promoting deep learning rather than surface learning in tertiary education necessitates educational activities that require students to use both higher order and lower order learning activities. Table 1 presents Biggs' classification of common university level learning activities.

Recent discourse related to interactive multimedia indicates that poor design will often stimulate shallow learning rather than deep learning. An interactive multimedia application that requires little more than clicking on a button to advance from one page to the next exhibits passive interactivity and promotes shallow learning (Sims, 1994). By contrast, an activity that requires the creation of multimedia demands deep learning (Tuovinen 2000). If interactive multimedia is to improve student learning it must be designed to encourage deep rather than shallow learning.

Table 1: Deep vs. Surface Learning Activities, based on (Biggs, 1999, p.55)

Deep Learning Activities	Surface Learning Activities
Reflect	--------
Apply: far problems	--------
Hypothesize	--------
Relate to principle	--------
Apply: near problems	--------
Explain	--------
Argue	--------
Relate	--------
Comprehend: main ideas	--------
Describe	Describe
Enumerate	Enumerate
Paraphrase	Paraphrase
Comprehend sentence	Comprehend sentence
Identify, name	Identify, name
Memorize	Memorize

Materials developed

Early in the development process it was recognised that WoundCare could promote deep learning if it was designed appropriately. WoundCare consequently consists of a multimedia information resource (the InfoBase), Tutorials and a Case Study developed using the Authorware Attain (Macromedia Inc.) multimedia development application. Some screen dumps from the WoundCare application have been included in the Appendix.

The InfoBase included in WoundCare contained textual information, tables, diagrams and photographs for one hundred and eighty topics related to wound assessment and treatment. The topics cover skin anatomy and physiology, infection control, wound healing, assessment of people with wounds, wound status assessment, wound types, wound aetiology, wound healing inhibitors, wound cleansing, wound debridement, wound closure and wound dressing. It was intended that students use material included in the InfoBase to complete the Case Study and the Tutorials. Most of the keywords necessary to complete the Case Study were embedded in the textual material included in the InfoBase. The InfoBase information could also be used by students during relevant practical class activities, while preparing for examinations and caring for people with wounds during clinical fieldwork. While students could look up information in the InfoBase directly, such an activity in isolation from work on the Tutorials and Case Study was not expected to contribute significantly to deep learning.

study. It was anticipated that the structure provided by the objectives and topic listings would assist students to contextualise their study

The four major sections of the Case Study included in WoundCare were intended to promote deep learning of clinical reality. The History section of the Case Study set the scene by presenting a brief case history and photographs of a wound attributed to the t

assessment data, which enabled them to specify diagnoses and treatments. The Case Study currently included in

'examining' the person with the wound and 'assessing' the wound itself. Students undertaking these activities had

When students thought they had sufficient assessment data they could proceed to the Diagnosis section of the

students entered valid keywords in the relevant text entry fields in the Diagnosis section of the Case Study, the

Case Study required students to identify appropriate treatments for controlling wound healing inhibitors, wound cleansing, wound deb

whether the treatments specified were correct.

commands embedded in permanent and temporary drop down menus. Additional navigation aids included buttons that allowed students to move between multiple pages of text, tables, diagrams or photographs available ials or Case Study to view pages in another component of WoundCare was automatically displayed when students returned to that component of the

by using the relevant menu commands.

Validation

After ensuring that the operation of WoundCare was reliable, an educational evaluation of the program was conducted with student and peer reviewers. This paper presents a report derived from the students' evaluations

- determine whether use of WoundCare promoted deep learning rather than surface learning;
- identify features of WoundCare that contribute most to deep learning; and,
- identify that interfere with deep learning.

Sample

The sample for the trial of WoundCare was a convenience sample that included thirty five second year university pre registration nursing students who voluntarily consented to participate. There were thirty female

mpleted a major two part assignment related to wound assessment and management. Each student was also supplied with a copy of WoundCare on CD ROM and an instruction sheet. The software was also installed on computers located in the clinical nursing laborat

laboratories. It was anticipated that students would engage in activities intended to promote deep learning including self directed use of WoundCare (especially completion of the Tutorials and Case Study), preparation -Part A), and a small group multimedia creation activity -Part B).

ta were extracted from written reviews submitted to satisfy requirements for Assignment- -trial questionnaires, diaries, post-trial questionnaires and diagnostic tests. Verbal data obtained from the written reviews of WoundCare (Assignment-Part A) and the open-ended items included in the initial questionnaire, diary and final questionnaire were thematically analysed. Particular attention was paid to classifying the student activities as they engaged with the multimedia according to the Biggs deep and surface learning categories shown in Table 1. Quantitative data derived from the initial questionnaire, diary and final questionnaire were analysed statistically.

Results and Discussion

The trial participants thought that the WoundCare program was relevant to them, registered nurses and other health care workers. The most common reasons for this were that the InfoBase included a large amount of clinically relevant information supported by photographs and other media, and that they could actively work through a clinically-oriented Case Study. Many participants felt the program was easy to use and the instructions and help available were adequate, but an equivalent number thought that WoundCare was either difficult to use or that there was insufficient direction (particularly for completion of the case study). Many participants thought the current navigation using permanent and temporary menus should be changed. Some participants indicated that navigation buttons and hypertext would be better. Some participants thought that it was important to be able to display InfoBase information in a separate window to the Tutorial or Case Study when they were trying to complete these activities. A large number of participants indicated that the interface could be enhanced dramatically by using different colors, borders or background image. It may be that the structural and cosmetic changes being suggested by participants would reduce observable split attention effects and decrease extraneous cognitive load thus maximising the working memory available for the specific learning task being undertaken (Sweller, van Merriënboer, & Paas 1998).

The problem of a computer program failing to recognise text entries is a difficulty frequently encountered when developing interactive multimedia. While the text-matching using wild characters feature of the multimedia authoring program, AuthorWare Attain (Macromedia, Inc.), helped improve recognition of student text entries, some students reported mismatches and an unacceptable number of unrecognised entries. Possible strategies for reducing mismatches and unrecognised entries include capturing student entries and updating the database of recognisable text entries. It may also be possible to improve the communication between the program and its user by including a clarification process when the computer is not sure of a user's meaning.

The available qualitative and quantitative data highlight the difference between deep and surface learning and how simulation may be used to encourage engagement and deep learning. Detailed analysis of this data indicates that use of the InfoBase alone and completion of the Tutorials were not sufficiently challenging and therefore were not thought to contribute substantially to deep learning. This is supported by the suggestion by many students that the Tutorials should include review or test questions. Such suggestions also indicate a need to stimulate greater engagement with the program. Conversely, the Case Study, elicited the most intense mental engagement, motivation and presented the most formidable challenges for students using the program. It may be, however, that the Case Study was *too demanding* for some students, as several commented negatively on its level of difficulty, the time required to complete it, the lack of example questions, the lack of preparatory Case Studies or exercises, and the lack of realism. Consequently, both mechanisms included in WoundCare to promote deep learning, the Tutorials and the Case Study, could be improved.

The trial participants' views regarding the small group multimedia creation activity (Assignment-Part B) were varied. While many participants thought that the activity was too demanding, some indicated that it was an appropriate and enjoyable activity. The variable quality of submissions did, however, suggest that this task may have been too difficult for many student nurses.

Limitations

One major limitation of this evaluation was that the evaluation and teaching described here were carried out by the developer of WoundCare. Additional limiting factors associated with the lack of anonymity of participants are possible excessive student compliance and sample bias. It should also be noted that these factors and student workloads could have contributed to the attrition that was observed during the study-while 100% of participants completed the initial questionnaire and written review, only 22-35% of participants completed the logbook, final questionnaire and/or diagnostic test.

Future work and implications

The experience of developing and evaluating "WoundCare: An Interactive Learning Program for Health Professionals" has been a learning experience for all who have been involved in the project (1997-2000). It is easy to identify things that could have been done differently in order to expedite the development process or improve the end product. The student evaluation indicates that the current version of the WoundCare is robust, relatively easy to use, despite its identified limitations, and includes activities and material that can facilitate deep learning. From a developer's perspective WoundCare is relatively easy to expand and modify using the AuthorWare Attain (Macromedia Inc.) multimedia development environment. Nevertheless, the results of the evaluation reported here indicate that there are some significant problems that could inhibit deep learning.

Firstly, the student activities may not have led to deep learning because they were not sufficiently engaging. For example, WoundCare tutorials encouraged students to read InfoBase information but there were no questions to stimulate deep learning and give feedback to the learner. Thus if we examine Table 1, the tutorial activities and interactions should encourage more of the high demand mental processes in the first column.

Secondly, deep learning could have been impeded by design features that resulted in extraneous cognitive load, split-attention effects, reduced interaction effectiveness and reduced motivation (Sweller et al. 1998). For example, extracting, integrating and applying information derived from multiple places in the WoundCare InfoBase in order to complete the Case Study requires intensive use of available cognitive resources and is therefore very demanding (Chandler & Sweller 1992). The interactive Case Study was considered to be an appropriate type of challenge but may have been too cognitively demanding. Student progression through a series of increasingly difficult learning activities prior to attempting the existing Case Study may reduce the cognitive demands the activity currently requires.

Thirdly, the success or failure of multimedia in education may not be due to the inherent features of the program itself, rather to a creative or inappropriate use of the materials. For example, one of the student activities associated with the use of WoundCare by students was the specification of data for a new case study that could ultimately be incorporated into the program. As previously noted, this was a very demanding activity that again required students to extract, integrate and apply information derived from multiple places in the WoundCare InfoBase. Students could also use other sources of information if required. The activity associated with seeking and processing information in order to formulate case study data appropriate for an imaginary person with a particular wound and present an appropriate justification again required intensive use of cognitive resources (Tuovinen 2000). With hindsight, it may have been better to provide students with completion exercises, where part of the multimedia creation task had already been done and they needed to fill in the gaps (Paas 1992; Sweller 1999).

These problems reinforce the view that developers must give serious consideration to the level of processing expected of students when they participate in learning activities requiring the use of interactive multimedia. The results of this evaluation of WoundCare have established the need to:

- improve the aesthetic appearance;
- incorporate buttons and hyperlinks to make navigation more intuitive;
- develop and incorporate tutorial review questions and diagnostic tests;
- develop and incorporate additional case studies (with varying levels of difficulty);
- review feedback mechanisms and content; and,
- prepare additional InfoBase content and media.

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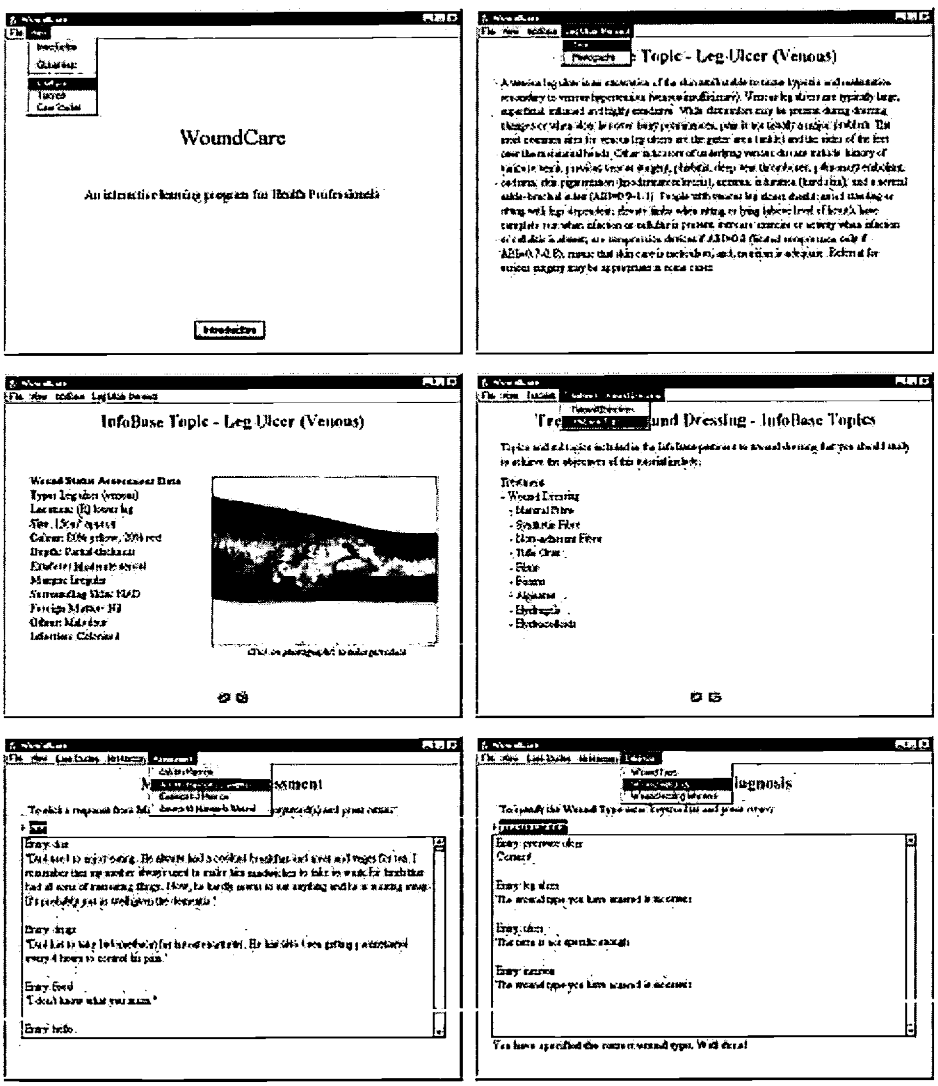
Appendix: Sample Screens from WoundCare



These images show that navigation throughout WoundCare was achieved using menus and some buttons. The upper left image on this page shows the title page. The upper right image and middle two images show pages from the InfoBase with text and a wound photograph. The lower two images show sample text entry and response fields included in the Case Study.

Broadband Multimedia for Distance Education via Satellite

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Abstract: Multimedia, World Wide Web (WWW), video and telecommunications technologies, computer-based simulations, distance learning are a familiar sight in most schools. The aim of this paper is to propose an architecture of Advanced Data Broadcasting System (ADBS), an asymmetrical network system delivering data and interactive services at a high data rate to a large number of user stations via a direct broadcast satellite using the DVB/MPEG-2 standards. The core of this architecture is based on Digital Video Broadcast, which is a simple, turnkey solution for real time MPEG audio and video, which has the only streaming multimedia server that supports delivery to thousands of simultaneous users regardless of bandwidth requirements.

Why Satellite Technology for Tele-Education?

In a Tele-Education environment, the concept of virtual classroom is commonly used. This concept can be split in two different aspects: Real-Time Virtual Classroom (**RTVC**) and Deferred-Time Virtual Classroom (**DTVC**). The implementation of a virtual classroom could be done using satellite either as unique option or in combination with ISDN and Internet.

In the case of the RTVC, the most important part is the communication from the teacher to the learners. For this reason we need then high speed channels (around 2 Mbps) for the teacher, and slower ones (around 64 Kbps) for the learners. It is clearly an asymmetric communication, with a big information flow in one direction, and a small one in the return direction. Some possibilities to solve this kind of communication might be satellite, ISDN (Primary Access), ADSL, or a cable network. Concerning the DTVC, apart from several lectures of the teacher which might be solved as in the Real-time Virtual Classroom, the communication between the teacher and the learners is more symmetric, and, talking properly, the teacher becomes a tutor in this case. The functionality needed are e-mail, computer conferencing, maybe tools sharing and videoconference. This can be solved using Internet and a Basic Access of ISDN.

The nature of a large majority of current multimedia services is inherently point-to-multipoint. Today's explosion of new multimedia household and business applications is mainly asymmetric: distance learning (RTVC), web browsing, continuous broadcast streams, financial and sports news 'tickers', and weather forecasts, near-audio-on-demand, near-video-on-demand, software distribution. If these new applications are to be successfully implemented, the infrastructure deployment must be immediate, cost effective and on a large geographical scale. The terrestrial transmission channels have demonstrated their physical, and above all, economical limits for the provision of such services. With respect to the very reduced deployment of cable and ISDN lines, a satellite-based solution provides the possibility of deploying in a very short term and on a very large geographical basis these new business-oriented applications. In fact, a satellite-based solution solves the time and geographical constraints imposed by the emergence of these new applications and provides the most efficient way for data broadcasting delivery.

Advanced Data Broadcasting System (ADBS)

ADBS is an asymmetrical network system delivering data and interactive services at a high data rate to a large number of user stations via a direct broadcast satellite using the DVB/MPEG-2 standards. The ADBS system is based on Interactive Data Broadcasting System (**IDBS**) which uses the forward channel of a DVB system. ADBS offers a number of data applications based on Internet protocols such as TCP/IP, UDP/IP and HTTP. The ADBS software also provides a set of lower level functions for addressing/routing and higher level functions for filtering/storing. ADBS supports unicast, multicast and broadcast applications. The return link is usually a telephone line plus modem to access an **ISP** (Internet Service Provider) of user's choice.

ADBS supports several levels of conditional access, security and privacy. The basic mode of operation assumes that an end-user station receives data in a passive mode from the satellite channel addressed to it. Alternatively it may connect (through Internet) to the base station via SLIP or PPP link to its preferred ISP. Only authorized users may connect to the base station through Internet and operate in interactive mode (e.g. an on-line Web session).

They are served according to the scheduling strategies implemented by the system manager. Conditional access is implemented at the DVB transport level by conventional means, using smart cards or similar technology. In addition, every user station has a unique station identification (hardware address) which is used at link level for individual addressing of stations. The current implementation can deliver data at a rate of about 8 Mbps in SCPC (Single Channel Per Carrier) mode and/or at the full data rate of the transponder up to 40 Mbps in MCPC (Multiple Channel Per Carrier) mode.

The base station consists of a DVB uplink and a satellite router/server which are directly interconnected through the DVB gateway. It performs basic server tasks and delivers IP datagrams as a MPEG-2 data structure. The DVB uplink performs all necessary multiplexing, coding and modulation tasks for transmitting data over a direct broadcast satellite. The satellite router/server acts as a proxy using ADBS. At the system maintenance level, a set of utilities is provided for installation and configuration of the system, user management, access control, security and authentication functions, and scheduling policy. At the application level, ADBS provides support for Internet services. For instance, ADBS supports a set of multicast and broadcast applications and allows user interaction in an on-line and an off-line mode. Moreover, the proxy server provides a local cache for the requested data to increase the transmission efficiency (in terms of speed and delay).

The user equipment consists of a small-size satellite dish (e.g., 60 cm) and a DVB PC-board for processing the incoming satellite data. A standard Web browser such as Netscape or Microsoft Internet Explorer is used for interaction with the system. The DVB PC board performs demodulation, decoding and demultiplexing, reconstructs IP datagrams from the cells and routes internally to the appropriate applications. The end-user stations can access the base station in a number of ways, the telephone line/modem connection being the most popular; this connection, called the return link, is used for transmitting requests and control information only. The system can operate in one of three modes: fully interactive, partly interactive, and passive.

For fully interactive services, data is requested via the return link and retrieved over the satellite link (e.g. tele-education, Internet interactive services, Web site visits). For request-reply transaction services (e.g. the transmission of a large multimedia file), the return link is required for the transmission of the requests but can be released during the reply phase (e.g. distance learning, near-video-on-demand, software distribution). For passive-receive operations, data is filtered by the multicast or broadcast services from the local hard disk and no return link is therefore required (e.g. on-line newspapers/magazines, continuous broadcast streams, financial and sports news 'tickers', and weather forecasts).

Conclusions

In some ways, satellite technology has more promise than both DSL and cable modems. Its advantages are mobile access to remote areas and incredible speeds. Streaming technology via satellite delivers an advanced information system for distance education with a capacity to support traffic of voice, video and data, by interconnecting the LANs of several university centers.

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Computer-mediated Communication in English Language Study

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This paper presents the authors' two-year experience in conducting e-mail exchange distance learning project between the students of RSPU and WKU. The project is based on the research instrument of Professor J. R. Garrott "Cultural Values". The project goal is to stimulate the Russian students' study of English, rethink questions of language together with American students, introduce students to a new culture on a more informal level using computer-mediated communication.

To achieve the goal of improving students' English proficiency (for the Russians) and learning how to use standard English to communicate with non-native speakers of English (for the Americans), the project has relied on e-correspondence. The project is carried out in four stages. Project authors have gathered the results of this effort.

Language learning by e-mail involves students with different native languages working together in order to learn about other cultures and lifestyles and English language itself.

Evaluation of Program Impact Based on Teacher Implementation and Student Performance

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Abstract
Twenty-one schools from the United States and Singapore participated in this evaluation of a high-school biology CD-ROM called *BioBLAST®*. Results include a summary of teacher descriptions of their curriculum-based justifications for using this software as well as a compilation of program features that teachers describe as facilitating successful implementation of new learning technologies. Analysis of teacher reports provides a profile of three types of strategies teachers used to implement the program. Analysis of student performance on pre/posttests shows how implementation strategies were associated with student gains in particular schools and classes. A comparison of student pre/posttest scores one year later with previous pre/posttest results suggests that changes in implementation strategies, teacher incentives, or a decrease in support services had a direct impact on student performance. Students with a wide range of prior knowledge were able to use the software and show performance gains appropriate to their knowledge level and experience.

Introduction

This report examines technology implementation decisions made by teachers in the context of a particular multimedia high school biology software program called BioBLAST®, a computer-based, multimedia, learning environment for high school biology classes. This study examines the relationship between teacher implementation strategy and student performance. The software program described in this investigation was designed to help teachers address both NSES goals. Based on these goals, a scenario was created for a problem-based learning environment that put students in the role of NASA Advanced Life Support researchers. Student teams are challenged to use the software tools and resources to accomplish their goal: Design and test a plant-based life support system that can support a crew of six for at least three years without re-supply.

Reports from national commissions, disciplinary groups, researchers, employers, faculty, and students repeat the call for instructional innovations in science, mathematics, engineering, and technology (SMET) education[1]. Across all these reports Springer, Stanne, and Donovan (1999, p. 22) find a consistent recommendation for a shift in emphasis from teaching to learning and greater use of, "active, collaborative, small-group work inside and outside the classroom." The National Science Education Standards (NSES, 1996) recommends that teachers move away from methods of direct instruction to an inquiry-based approach to teaching. The report further recommends that teachers use alternative approaches to improving student learning that address both the method of instruction and the need to identify the content being addressed. Instruction should be student-centered rather than teacher-directed, and classroom curricula should be linked to real scientific issues and events (NSES, 1996).

An evaluation study by Cook, Habib, Phillips, Settersten, Shagle, and Degirmencioglu (1999) reports that gains in student achievement were associated with schools that have a focused academic articulation of goals for student achievement. This finding is consistent with research by Phillips (1997) and Lipsitz, Mizell, Jackson, and Austin (1997) who report that student performance improvements are most closely related to academic focus and less tied to social climate issues. Cook, et al., (1999) acknowledge that the results of their evaluation study are limited by the fact that program implementation fell short at nearly

[1] Association for the Advancement of Science, 1989, 1990; Boyer Commission, 1998; National Research Council, 1995, 1996; National Science Foundation, 1996; Peak, 1996.

all of the schools included in the study. They suggest that ways to improve and understand program implementation are greatly needed in order to understand student change.

This study examined teacher implementation strategies by adapting the issues addressed by Cook et al. (1999) and Kerr (1999) to the context of high school science teachers involved as lead teachers in the field testing of the BioBLAST software. The following research questions are examined in this study.

1. What were the academic and pedagogical goals that teachers described as their curriculum justification for using this software?
2. What strategies for implementing the software were reported by teachers?
3. How were implementation strategies expressed in student performance as evidenced in the pre/posttest scores? Are these student performance measures consistent with teacher reports?
4. What does the comparison of teacher implementation strategies and student performance during the different periods of the program cycle suggest regarding classroom application of this curriculum supplement?

Method

BioBLAST was developed by the NASA Classroom of the Future[2] in collaboration with the National Aeronautics and Space Administration (NASA) Advanced Life Support research program. The virtual reality interface of the CD-ROM draws students into a futuristic, problem-solving scenario that is situated in a simulated, lunar research facility. In the virtual lunar base environment, students use graphical simulation tools and resources to prepare for their mission goal: to design and test a model for a plant-based, life-support system that can sustain a crew of six for three years. Along with the goal of helping teachers move to an inquiry-based approach to teaching, a secondary goal of this program is for students to have access to current life science research in the process of investigating a legitimate problem.

The data collection techniques include teacher surveys, observations of teachers and students in their classroom environment, interviews with teachers, pre/posttests, and student and teacher reports. Twenty-one high schools from urban, suburban, and rural areas of the United States and Singapore participated in the classroom testing of this software. The school applications were self-selected in all but two cases. The specific schools included were selected from the group of applications based on geographic distribution, access to technology required to run software, and level of interest in learning alternative teaching techniques as expressed by teachers in their personal essays.

This study compares teacher implementation strategies with student performance during the final stage of the formative evaluation cycle (beta testing) with student performance during the pre-publication cycle when professional development support for teachers was no longer available. Participants differed in the location and level of technology available at their school and in the level of administrative support for implementation of curriculum-related instructional technology. This analysis of student outcomes based on comparison of pre/posttest scores involves a subset of the larger group who fully implemented the program and returned the completed pre/posttest materials. Table 1 provides a summary description of schools involved in the larger and subset groups.

Results

The following questions were examined in analysis of the data collected from teachers reports, surveys and interviews; student reports, pre/posttests, and surveys; and observation of on site and off site implementations of the program.

1. What were the academic and pedagogical goals that teachers described as their curriculum justification for using this software?

Many teachers described their use of BioBLAST software as offering an opportunity to change their methods of teaching to incorporate use of technology within the context of instruction and to include

[2] *BioBLAST* was produced and developed by NASA Classroom of the Future™ for the National Aeronautics and Space Administration through Cooperative Agreement No. NCC5-203. awarded to the NASA Classroom of the Future, Center for Educational Technologies, Wheeling Jesuit University, Wheeling, WV 26003.

more cooperative learning group activities. Moving to group work was cited by one third of the teachers as a greater challenge to their teaching practice than incorporating the new technology. Teachers also reported that Internet access and at least class email accounts accessible within the classroom were an important technology component of this program. These communication resources allowed students to ask questions to NASA experts and find current resources on the Web. Teachers commented that students were drawn into the QuickTime virtual reality interfaces since many video games that are popular among teenagers use this kind of interface. The "BaBS" culminating simulation was captivating to nearly all students and was the students most favorite aspect of the BioBLAST program. Students also responded favorably to the scenario link with current NASA research and laboratory exercises that had real connections with NASA experiments.

A summary of program features that teachers reported as most important to them in selecting new resources to adopt and implement is provided in Table 2. An important feature that emerges from this summary is that teachers want software/technology tools that will support their curriculum goals and help them grow. Teachers report changes in their teaching position, restructuring of existing course, the creation of new courses, and the implementation of alternative scheduling at their school based on experiences with the BioBLAST program as a "test-case" technology-integration program.

Table 1. Summary of Schools Involved in the Larger and Subset Evaluation Groups

School	Student Total	Asian	Black	Hispanic	Caucasian	Native American	Pacific Islander	School Affiliation	School location
6.12.4.6	280	11	160	36	71	2	0	public	urban
8.9.10.16	14	6	0	0	4	0	3	public	rural
8.9.5.7	35	29	0	1	1	0	3	public	urban
13.9.X	60	0	56	1	2	1	0	public	urban
13.14.6.8	101	8	1	1	90	0	0	public	urban
14.25.13.17	60	2	6	0	51	0	0	public	suburban
14.4.13.19	25	0	0	0	20	5	0	public	rural
14.10.3.4	130	7	1	4	118	0	0	private	suburban
14.13.X	25	0	0	0	0	25	0	public	rural
14.25.9.9	19	0	0	18	0	0	0	public	rural
14.25.7.11	147	16	7	7	110	0	6	private	urban
13.15.16.22	150	1	13	46	87	0	30	public	suburban
15.8.1.1	118	2	2	0	114	0	0	public	suburban
15.8.8.12	48	0	1	0	47	0	0	public	suburban
16.1.12.18	85	4	9	4	68	0	0	public	suburban
3.1.0.X	36	0	0	29	6	0	0	public	urban
22.1.2.3	119	6	36	24	54	0	0	public	suburban
21.22.11.17	36	0	0	0	35	0	0	public	rural
23.22.X	25	0	1	0	25	0	0	private	suburban
Raffles	42	22	0	0	0	0	20	private	urban
College Prep	20	1	0	0	16	1	2	private	suburban
TOTAL	1575	115	293	171	919	34	64	private - 5 public - 16	urban - 7 suburban - 9 rural - 5

Table 2. Program Features that Teachers Report Facilitates Successful Implementation:

Has administrative and department-level support;	Designed to help teachers grow
Links to real-world event(s);	Includes a description of prior knowledge required;
Includes a vision of how to makes learning more meaningful;	Includes a description of computer and laboratory access time required;
Includes guidelines for enhancing classroom learning that demonstrates effective use of technology through exposure to new methods, materials, and other	Includes a taxonomy of content and process skills addressed so that teachers can link program to school framework for basic math and science objectives;

teachers;	
Activities encourage student problem solving and facilitate cooperative group work	Addresses teacher needs for appropriate assessment material
	Applicable in small units or chunks and still effective

2. What strategies for implementing the program were reported by teachers?

Teachers used the laboratory and computer-based investigations provided by the software development team and incorporated these materials into their academic grading system. Teachers adapted the suggested sequence outlined by the project development team to suit the needs of their students, their school curriculum guidelines, and the time they had available in their course schedule. Teachers selected implementation strategies based on topics and scientific inquiry process skills that they believed their students most needed to address. The software development group suggested that teachers view their implementation of the software as having four phases much like the four phases of the problem based learning approach to teaching. The four phases of BioBLAST were presented to teachers as: Phase 1, Orientation to the problem; Phase 2, Research and analysis of the sub-units of the problem; Phase 3, the Mission in which the sub-units are integrated and combined for testing possible solutions to the problem; and Phase 4, the Report in which students present a summary of data collected, data analysis, results of initial testing, and recommendations for solutions and continued research.

Based on analysis of teacher reports, surveys, documentation of email communications, and observation of teachers in their classroom, we found that teachers implemented the software in three distinct ways. The "Lab" group focused most of their time on skill-building activities and one or more of the laboratory activities. This group allowed their students to interact with introductory materials and structured exercises embedded within the software simulation programs. Teachers using this implementation style reported that their students did not have science content and process skills required for the more advanced activities. The "Simulator" group completed the Orientation, Research, and Mission phases of the program. This group allocated at least three class periods (45 minutes each) for their students to complete the "BaBS" model building simulation in which previous plant, human, and resource recycling research is compiled and integrated and tested. The format and assessment of the Report phase were more open-ended than previous activities, and this may be why some teachers did not implement this phase. The group called the "Researcher" group completed all four phases of the project and had their students complete a project report as their culminating activity for the program.

3. How were implementation strategies expressed in student performance as evidenced in the pre/posttest scores? Are these student performance measures consistent with teacher reports?

Not all teachers submitted pre/posttest results. Teacher surveys and reports were required, but pre/posttests were not. A small percentage of the Lab group submitted their pre/posttest results, and teachers reported that they did not feel that they gave their students the full benefit of the program because they did not use the simulations. The entire Simulator group and all but one of the Researcher group submitted their
students' pre/posttests for evaluation.

The pre/posttest consisted of 16 questions, seven of which were multiple choice, the others requiring short answer and one concept-mapping responses. Analysis of pre/posttest scores on the seven multiple-choice questions indicates that student performance was significantly improved in all but two cases. The paired T-test analysis shows huge gains in nine of the eleven cases. Table 2 provides a summary of the main effect of the T-test score for each school. In one of the cases where student scores overall did not improve, the student pretest scores were already nearly perfect on the multiple choice test questions. In the other case, student scores improved, but this improvement was only significant on one question, and not all seven or on overall score. Teacher reports from the eleven participating schools expressed confidence that the program helped them successfully implement new teaching practices that incorporated student-centered and inquiry-based approaches to learning. Below are a few excerpts of teacher observations about student learning from the software program.

- "BioBLAST made student learning more meaningful; students are beginning to show more proficiency in their use of technology; the simulations encourage student thinking because they have to ask themselves why did they only survive that long, what happened?"

- "Later in the [biology] course, students would reference what they saw in BioBLAST as a reference for other bio curriculum activities; BioBLAST seemed to provide a good transfer, a good bridge, and a solid base for students to refer back to..."
- "Students were frustrated by the technology, but were also engaged by it...[through the use of this program] I accomplished the goal of incorporating more math, graphing, and research skill-building into student work; working in teams was most challenging, but in some cases most rewarding for students."

A doctoral research study (Cain, 2000) was conducted during the alpha testing of the software that analyzed student group discussions while using the Mission Phase simulation. One of the questions examined in this research study was "In what ways did the content knowledge change after the initial phase of the simulation-based learning activity?" Based on his analysis of the data, Cain reported improvements in student content knowledge in both early and later trials with the simulation. Six out of the sixteen content areas in which Cain noted deficiencies in early trials improved with continued use of the simulator. Improvements in content knowledge, similar to those noted by Cain (2000), was also evidenced in student pre/posttest scores in the following areas: [Question 2] how plants obtain nitrogen; [Question 5] understanding of the interdependence of plants and animals; [Question 8] graph interpretation of physical science concept; [Question 9] experimental design for plant science investigation; and [Question 12] in-depth understanding of human and plant respiration and photosynthesis.

Table 3. Summary of Effect Sizes for Paired T-test Scores*

Teacher Code	Effect Size for Paired T-test by Teacher - Beta Group	Effect Size for Paired T-test by Teacher - Pre-Release Group
8.9.10.16	**1.3**	
8.9.5.7	**0.91**	
13.14.6.8	0.31	
14.10.3.4	**0.4**	
14.25.9.9	**1.13**	
14.25.7.11	**0.72**	**0.43**
15.8.1.1	**0.91**	**0.64**
15.8.1.2	**1.24**	
15.8.8.12	**1.16**	
21.22.14.2	**1.06**	
19.1.0.X	0.08	
Average	**0.84**	

* Values of .4 and higher indicate a main effect. Bold numbers indicate significant effect size.

4. What does the comparison of teacher implementation strategies and student performance during the different periods of the program cycle suggest regarding classroom application of this curriculum supplement?

As Table 3 shows, teacher implementation during the Beta testing process was more successful than their implementation in the later year when there was minimal support and no in-service workshop provided. During the Beta testing, teachers received a small stipend to cover the cost of their reporting, administering, and handling of evaluation materials. Teachers also attended a 5-day off-site workshop the summer before the Beta testing in the classroom began. Weekly updates regarding the project were emailed to teachers during the beta testing, and teachers were encouraged to contact project team members if they had questions or needed assistance.

As reported in the research study by Cain (2000) and supported by analysis of teacher surveys and reports student learning improved and continued through continued use of the simulators. Later implementations of the program may not spend the same amount of time preparing the students for effective use of the simulators and may not allow time for continued trials, analysis, and comparisons of simulator trials. In addition to the professional development and incentive programs, giving students two to four separate sessions to use the simulators, analyze results, make modifications, and compare outcomes is a necessary interactive process for effective use of the simulations. More research is needed to identify what support or feature associated with the beta testing is most critical to facilitating the most successful, long-term implementation success. Since the number of pre- and posttests available for analysis were greatly reduced, it is difficult to conclude whether the trend found in the two cases documented was consistent across all implementations.

Discussion

What generalizations can be made regarding ways to improve program implementation? Can effective implementation strategies improve student achievement? Student performance improvements were statistically significant in all but two cases. The indication of reduced (although still demonstrating statistically significant improvement) student achievement in the pre-release (post-beta) test group reflects the time-sensitive nature of program implementation. The list of program features that teachers report facilitates successful software implementation (see Table 2) suggests that if any one of these eleven factors changes, the implementation strategy may be curtailed or disrupted. Teacher reports and survey data indicates that teachers want a clear set of recommendations for an activity sequence, time to allocate for each activity, and suggestions for effective use of the simulators with student groups to support their implementation strategies. This information was not available during formative evaluation, but can be made available on the Web site to new teachers using the program.

Several interesting observations from this research suggest ways in which software and other learning environment technology tools can motivate and engage students who have previously shown little or no interest in a given course. Analysis of student performance from the pre/posttest scores showed that software implementation that included use of the simulators exhibited gains for groups that were weak in fundamental content as well as for groups that were ready for more advanced concepts. By allowing multiple ways to implement the software, students with a wide range of prior knowledge were able to use the software and show performance gains appropriate to their knowledge level and experience.

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Filling RL/IT Gap with International Curricula

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After several years of constantly increasing enthusiasm in IT area it becomes more and more evident that these expectations were seriously overestimated, there are signs of disillusionment and even some recession. Having solved tremendous technical problems of performance and connectivity the IT has not contributed enough for tackling Real Life (RL) tasks. Cause-to-effect analysis undertaken on the basis of creating and using IT objects as well as solving managerial tasks for the passed decade discovers logical gap between RL and IT spaces being of totally different nature and internal logistics, the gap preventing to directly extend logical framework of RL task down through IT layers or vice versa to launch IT formal logic up-through RL situations. Being observed in Russia, Europe, America, Africa - the problem seems to be completely international and rather timely. We call to discussion of experience for establishing new university curricula in the pointed area.

Teaching Veterinary Physiology by means of Multimedia

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Veterinary Physiology is a basic science subject taught in 150 lecture hours and in adjoining 60 hours of lab work plus a Directed Self Education block. The course is given in three languages (English, German and Hungarian). The high number of students and the aim to foster independent and self-paced learning forced us to develop a multimedia environment for our teaching. First the entire theoretical material was made available in multimedia format (P. Rudas "Veterinary Physiology, a multimedia resource for teaching, learning and self-testing", Mezogazda Publ. House, 1998) and then parts of the lab work was replaced by multimedia type of work (Virtual Physiology Series by Thieme Vlg, Germany). Mid-term tests and the final exam is also based on CBT. Analysis of comparative test results and interviews with the students show that the average score increased by 12% (between 1998-2000) but the attitude of students is unchanged (30% likes multimedia methods, 30% accepts it as an improvement, 40% would prefer traditional methods)

Architectural Concept for an Integrated Learning Platform Using Learning Object Metadata

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Abstract: In the context of inhouse qualification different teaching methods are used at DaimlerChrysler AG. Apart from classical teaching methods, efforts towards a global online training system are currently in progress. In this paper the subsystems of the framework currently under development as well as the motivation, the goals and the first steps of their integration into a global system are presented. This system shall offer a Web-based access to courses and learning materials for different user categories (e.g. student, teacher, personnel staff and authors) and provide interfaces for administration, maintenance, and composition of courses and their media, as well as for the administration of users, resources, qualification and certifications.

1 Introduction

1.1 Motivation

Currently, the area of "online training" constantly gains importance. The shortening innovation cycles within the technical area and the progressive globalization requires the permanent training of employees. This trend requires the availability of detailed technical information, didactically edited training courses and materials for training purposes for the different target groups often long before the introduction of the individual products onto the market. The applied teaching methods already evolved from the classical methods of self-studies with printed media and face-to-face training. The use of "new media" such as training videos, TV transmissions, computer-assisted learning (a.k.a. computer based training, CBT) and teleseminars is increasing. Since the availability of the inter-/intranet, web-based training (WBT) is used as an asynchronous teaching method also. If WBT training courses are extended by synchronous components (Teletutoring), then we are talking about internet based teleseminars (distance learning, DL). In an organization, in which teaching methods are used separately at present to a large extent, an integrated concept is desirable. An integrated system provides central access to learning resources and supports reuse of learning objects in various ways.

1.2 Context and Reqirements

Different teaching methods are used for training within the DaimlerChrysler AG at the moment. These cover self-studies using printed media, face-to-face training, CBTs, training videos and a teleseminar system based on a european-wide satellite TV signal with ISDN back channel for interaction Additionally, a business TV channel called DCTV (DaimlerChrysler television) is broadcasted throughout the company, which offers current information on the enterprise and its products and services.

An education management system (EMS) for the administration of teaching materials (printed media, WBTs, CBTs etc.), resources (e.g. classrooms and their equipment) and user information (their personal data, curricula and learning goals, their participation in training supplies, their test results and learning history etc.) is currently under development and evaluation. A media storage and retrieval system (called "media server") provides central administration, handling and playback of media objects and their associated metadata. New CBT applications are currently developed with web deployment in mind, in order to be offered as online WBTs as well.

For the integration of the learning material on the content level, the use of metadata is essential. At present a suitable metadata set is selected and refined. This selection is based on widely-known standard approaches like IEEE LTSC LOM, DCMI Dublin Core, IMS Metadata, ADL SCORM and so on.
One of the determining requirements of the architecture of the total system (apart from the functional requirements) is the extensive use of commercial standard software in order to reduce the costs as well as to increase the expandability and the scalability of the system. The latter points are particularly achieved by the use of "open" standards and systems.

2 Architecture

The architecture enables the user to select and book/consume suitable training resources. The system should support the user in the selection of the appropriate material in order to fill his individual information gaps. The system enable teachers and managers to arrange curricula from a workstation and assign it to user groups. The participation in the courses and the success in the individual tests and questionaires are stored in the user profile and should serve to monitor the individual learning progress. Authors of learning material should be able to use the administrative interface of the media server in order to add new media and to combine content to new units. They are supported by the possibility to search the entire stock of media by different methods (categories, glossary etc.).
The architecture is based on a three tier software architecture, i.e. the separation in user interface, process management and data management layer as a guideline for the system design. The system is partitioned in several front-end and back-end components like the media server, the WBT playout and tracking system, distance learning components and the user, ressources and qualification management system, as well as further components necessary for the integration.
The integration of the content in terms of individual media objects is carried out by the use of suitable metadata. This data about the media data does not only enable an identification and contains further information about the object, but it models likewise the relationship with other media objects and enables the classification into an educational context. Therefore, they represent a central starting point for search, administration, composition and creation of course sections and complete courses. As mentioned above, the suitability of LOM (learning objects metadata, (see LOM 2000) as a data basis for the selection of the individual data elements is evaluated at the moment. Furthermore, the different possibilities to generate metadata about learning objects automatically as well as the semi-automatic assignation of metadata, for example by categorization, are of special interest.

3 Current Status and Further Work

Currently, the media server consists of several subsystems (HTTP/video/Real/RDBMS), which are integrated by a content management system (Informix Media360) supporting the definition and assignment of metadata sets. The content management system provides backend interfaces for integration with the other components of the whole system. At the moment, the media server is customized and filled with media and the appropriate learning object metadata sets. The use of Saba EMS (education management system, www.saba.com) is intended for the implementation of the user, qualification, courses and resources administration. For the implementation of the DL functionalities, especially online tutoring and virtual classroom, products will be evaluated in more detail in the near future. Users of the system access courses through SABA, while content is originating from the media server. Content modules communicate user interaction data (tracking information) to SABA using AICC standards. The "dynamic" search and composition of course materials using metadata is planned in a further step.

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Computing learning in secondary schools in Spain: some implications related to gender

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Abstract: In this study we examine the gender gap in computer attitudes, ownership and experience on a sample of 425 secondary students from four different schools in Madrid. Differences between girls from co-educational schools and girls from schools with a female majority were also considered. Significant differences were found between girls and boys from coeducational schools, favorable for this last group in respect to concepts about computers and self-confidence in using them. Also between girls from coeducational schools and girls from schools with a female majority were found significant differences, favorable to the last group regarding their interest in computers and their concepts about them.

Introduction

Women's tendency to choose traditionally female stereotyped studies and especially their distance to scientifical and technological disciplines is one of the main reasons for the gender gap in qualifications limiting women's perspectives in the labor market. Health professions, education and social and behavioral science are the fields that women mostly study; on the other hand, women tend to avoid industrial and engineering fields (Carrasco et al., 1997).
In Spain, the male presence in scientific and technical studies remains predominant although is not so noticeable as in other western countries. Concretely the average of women in Informatics accounts for 25% (OECD, 2000). In the secondary education the tendency toward gender segregation in study and professional choices is already shown (Gaviria Soto, 1993). While the institutional support to the introduction of information technologies in schools has been very important in the past years, few studies have examined the students' subjective value and expectations of success on computing and the factors linked to them (such as the perception of the motivation from the parents to learn about computing or of parents' and friends' gender stereotypes related to computing).

The literature about the gender gap in computing in secondary schools have revealed that males dominate its ownership and use and consequently their deeper experience determinates their more positive attitudes toward computers. In some cases, boys' computer experience serves as an orientation for university study choices, making their decisions clearer in contrast to those of girls. In the educational context several studies have shown that the masculine image of computing exists within the schools as well as outside. The gender stereotypes related to computing that boys and girls acquire through the socialization process, through social experiences with significant others in the family, in interaction with teachers and peer groups are manifested in learning processes. The computer use of boys and girls with different family members reflects gender behavior patterns in the socialization process within the family context, in which the perception of parents' motivation to learn about computing also plays an important role (Shashaani, 1993). Several studies have paid special attention to the interaction process in the class during informatic courses. The supposed neutrality of co-educative schools was questioned on the basis of the results of these researches, that confirmed gender stereotyped patterns in the interactions processes within co-educative classrooms, particularly in informatic courses (Jones & Clarke, 1995). The different teachers' behavior with boys and girls in this context, the lack of feminine role models in computing and the unbalanced experience on computing between both sexes, determined by the deeper extracurricular boys' computer use, influence girls' attitudes toward computers and

The Study

Considering this survey of the research literature, and on the basis of the Eccles' et al. model of Achievement-Related Choices (1994), we have designed this study from a social psychological perspective to examine the gender gap in computing subjective value and expectations of success, ownership and experience and the intention of choosing computer sciences as profession on a sample of 425 secondary students from four different schools in Madrid. Differences between girls from coeducational schools and girls from schools with a female majority were also considered. It was hypothesized that boys would show more positive subjective value (interest and concepts about computers and their use) and expectations of success regarding computing (self-confidence) and would have more experience with computers than girls from coeducational schools. Girls from schools with a female majority's tendency regarding these aspects would be similar to boys'.

The participants were 274 female and 151 male students who attended four schools in Madrid (1996): two public co-educative schools (one of them with a female teacher for informatics), one private co-educative school and one private school with a majority of girls (85%). The students age range is between 14 and 17 years old. The students were asked to complete a questionnaire during school time, under the supervision of their class teachers. The survey questionnaire consisted on seven sections related to the following areas: demographic information, relationship to the parents, informatic as professional vocation, gender stereotypes associated to computers, perception of parents, teachers and peers attitudes toward computers, perception of parents' and teachers' support to learn computing, computer experience and use, attitudes toward computers.

Findings

The results of this research support the hypothesis that there are significant differences in computer attitudes and experience between girls and boys in co-educational schools as well as between girls in the two types of schools considered, based on a sample of secondary students in Spain. Males were more interested in computers than were females in co-educative schools, had more self-confidence in working with computers, and their concepts about computers were also more positive. Nevertheless, girls reported a positive self-confidence in respect to computer use despite their lack of interest on it. Boys have more positive concepts about computers than girls, particularly in respect to the importance of computer skills for getting a job and the usefulness of computers for making labor tasks easier. However, boys and girls tend to agree with the general utility of computers in daily life. In our research we found that girls expressed a lower perceived ability to use computers and to learn about them than boys. That is, the subjective task value of the implication of computer tasks is more positive for boys than for girls. The cost value is also different for boys and girls in our study, since girls find computers not so enjoyable as boys and expressed a greater fear and insecurity of using computers. Table 1 below shows these results.

Table 1 Attitudes toward Computers: Boys and Girls in co-educative schools (means)

	Girls (co-educative schools)	*Boys*		*t*
Interest in computers	2. 93	3. 37	(***)	6. 52
Self-confidence	4. 25	4. 73	(***)	4. 62
Concepts about computers	3. 78	4. 05	(***)	3. 73
Concepts about using computers	3. 56	3. 68		1. 43

p< 0,05*; p< 0,01**; p< 0,001***

Girls from the school with female majority were significantly more interested on computers and showed more positive concepts about computers than girls from co-educative schools expressing a higher agreement with the importance of computer skills for getting a job and the usefulness of computer for facilitating work tasks (Table 2).

Table 2. Attitudes toward Computers: Girls in schools with female majority and Girls in co-

educative schools (means)

	Co-educative School	*Maj. of Girls School*	*t*
Interest on computers	2. 93	3. 22 (***)	4. 08
Self-confidence	4. 25	4. 43	1. 65
Concepts about computers	3. 78	3. 99 (**)	2. 82
Concepts about using computers	3. 56	3. 47	. 92

p< 0,05*; p< 0,01**; p< 0,001***

Significant differences were found with respect to computer ownership and experience outside school. More boys than girls have and use a computer outside school and use it more than girls for programming, playing computer games and using internet. But no significant differences were found between both groups in regard to the computer use for word-processing. In our research, boys used the computer mainly for playing computer games whereas girls used it for word-processing. In our study girls from the co-educational school with a female computer teacher showed the highest scores in the sub-scales related to interest and self-confidence in using computers of the three groups of girls in coeducational schools. Therefore, since female computer teachers could serve as a role model for girls to improve their interest in computing, hiring on female teachers in this discipline should be also considered. Since girls in the female majority educational context showed more interest in computing more positive concepts about than those of girls in the co-educational context, experiences in single-sex groups for girls in spanish secondary schools should be considered as an alternative to resolve the gender-based unbalance in computing in this educational level. The experience differences in computing between both sexes should serve as a basis for group formation. Thus, boys and girls with same experience level could further be grouped together in a positive co-educational environment.

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The Solver Learning Environment and Anchored Instruction on Mathematical Word Problem-Solving

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Abstract: This article examines the Solver Learning Environment and anchored instruction on mathematical word problem-solving. To collect data, a teaching experiment was arranged in 1996 at the Kaukajärvi School in the city of Tampere, Finland. The participants of the study (N=66) were fifteen years old. Several tests were arranged to measure the mathematical word problem-solving skills of the pupils and to evaluate their mathematical abilities. The pupils' attitudes towards mathematics, mathematical word problem-solving, information technology, and the environment used in the teaching experiment were also measured. In this paper, we present some ideas and the pupils' attitudes towards the anchored instruction utilised in the Solver Learning Environment.

Introduction

The main aim of the study was to examine the connection between different learning environments and the development of the problem-solving skills of pupils at different levels of mathematical abilities. The study compared the development of the problem-solving skills achieved in the technology-based Solver Learning Environment with a learning environment of conventional pencil-and-paper tasks. During the teaching experiment, data was collected on Solver's suitability to develop pupils' problem-solving skills at different levels of mathematical abilities. A group of mathematics teachers at the Kaukajärvi School prepared mathematical word problems and their model solutions for the Solver Learning Environment in co-operation with the author. Solver was produced as part the Nääsnetti Project of Multimedia Services of Alexpress Ltd., which is part of the Aamulehti Group Ltd. The Nä Multimedia Project was a part of the Finnish Multimedia Programme (FMP). (Ruokamo-Saari 1996a, 1996b, 1997, Ruokamo 2000a, 2000b, a, b.)

The participants in the study were ninth graders (N=66). Empirical group comparison methods were used in the study. During the teaching experiment, group A studied mathematical word problem-solving in the technology-based Solver Learning Environment (Solver Group). Group B studied the same material with conventional teaching methods, using only pencil-and-paper. The control group did not take part in the problem-solving lessons; they just participated in the tests. The contents of the Solver Learning Environment were designed to take a contextual approach and transfer into account: the word problems were connected to real life situations and thus to the real world. Problem solving was through collaboration and the view of learning was "moderate" constructivistic (Reusser 1991a). Solver was designed to support the activity and reflection of the pupils. (Ruokamo-Saari 1996a, 1996b, 1997, Ruokamo 2000a, 2000b, a, b.) This article describes the Solver Learning Environment, and discusses the ideas and pupils' attitudes towards anchored instruction on mathematical word problem-solving.

The Solver Learning Environment for Solving Mathematical Word Problems

Solver is a technology-based learning environment that includes different presentation forms of hypermedia (e.g. hypertext, graphics, animation, sound, video) and network properties, social interaction, physical learning activities and mental thinking processes in a learning situation (Ruokamo-Saari 1996a, 1996b; Ruokamo & Pohjolainen 1998).

Solver was used to study the connection between the level of the pupils' mathematical abilities and development of their problem-solving skills (Ruokamo-Saari 1997). It is designed based on the HERON, ANIMATE, and Jasper programs. HERON is a computer-based program developed by Reusser et. al. for word problem-solving (see Reusser 1988, 1991a, 1991b; Staub et. al. 1994; Reusser 1993, 1995). ANIMATE is developed for word problem-solving. It is an unintelligent tutoring system based on computer animation (Nathan 1990, 1991). The Jasper program is developed for scientific problem-solving by the *Cognition and Technology Group at Vanderbilt* (Hmelo et al. 1993). (Ruokamo-Saari 1996a, 1996b, 1996c.)

In the Solver Learning Environment, the properties of on-line and off-line hypermedia are connected. The on-line part is designed to be used via the Internet and the off-line, local part is programmed with the Multimedia ToolBook 3.0. Figure 1 presents the user interface for the Solver Learning Environment (in Finnish): an on-line HTML document and motivating video for the "*Home Party*" problem series is seen on the left and an off-line ToolBook application and an empty solution space is on the right. (Ruokamo & Pohjolainen 1998; Ruokamo 2000a, 2000b, a, b.)

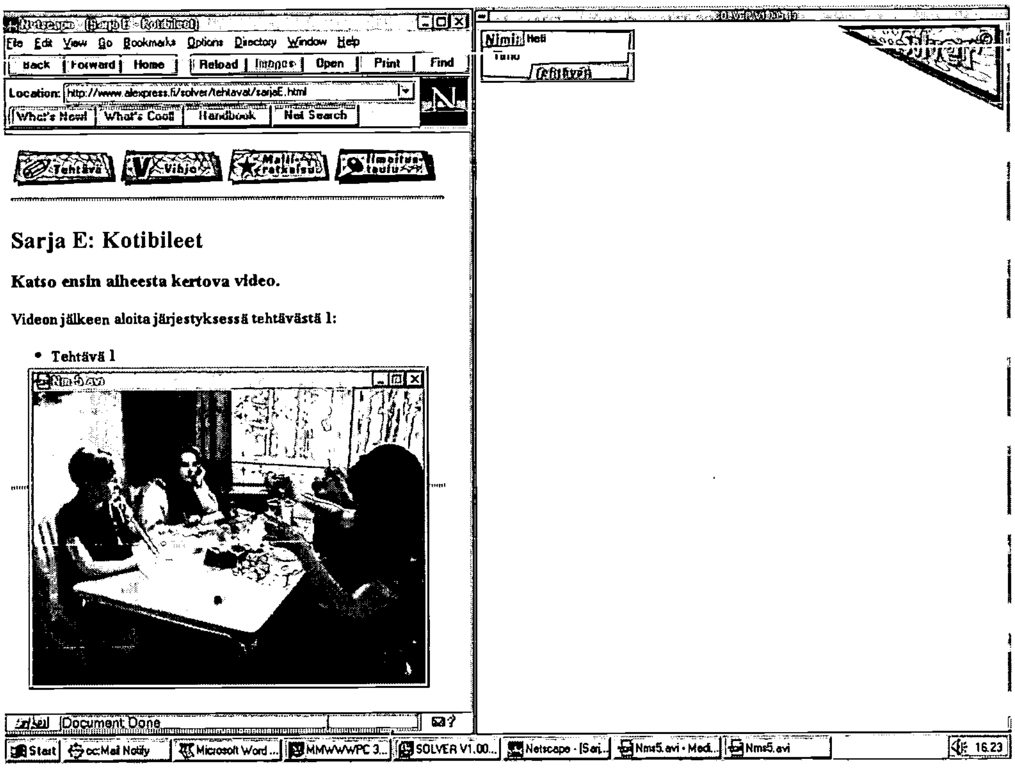

Figure 1: The user interface of Solver and the motivating video for the *"Home Party"* problem series

Videos, problem tasks, hints, model solutions, and a bulletin board were programmed using HTML, so that these could easily be distributed via a network, and they could later be updated. A situational and contextual approach was adapted in creating the problem situations. The topics that were chosen for the word problems were based on pupil inquiry: the pupils were asked about the real life problems that they would like to solve. Video material was produced to introduce the problem situations to the pupils and to motivate them to solve the problems. Six different series of problems connected to real life problem situations were developed. The problem series were as follows: *A) "Camps", B) "Rabbit Minttu", C) "Course in Computing", D) "Sport Quiz", E) "Home Party", and* (Ruokamo 2000a, a, b.)

At the beginning of problem solving, the pupils familiarised themselves with the problem situation by watching the motivating video. Following this, they read the problem text very carefully. Below is a transcription of the task 1 for the *Home Party* problem series:

> *"Susanna arranged to have a home party with her sister Johanna. They served punch to their guests, for which their parents had given them permission to use their 10 % home wine, if the girls diluted it to 2 %. The girls said that diluting the wine to the correct amount wasn't easy at first. They had practised with a glass that held 2 dl of home wine. The girls poured the wine into the punch and added the required lemonade to the bowl to dilute the drink to 2 %. How much diluted punch did the girls get with one glass of home wine?"*

The problem text could include links. By activating these links, the pupils could obtain definitions, rules, formulas, and other information about the subject. If a problem was too complex to solve, they could select the hint tool to obtain tips on how to construct the solution. When constructing the solutions, the pupils might ask one another for hints in problematic situations. Using the bulletin board, the pupils were able to discuss problem-solving processes with other pupils. Based on these conversations, they could further develop their own constructions. The pupils solved word problems by constructing solution trees with cognitive tools. This process resulted in solving the problem posed in the text. In the Solver Learning Environment, the model solution for a given mathematical problem was presented systematically, and the pupils were assumed to discover the solution procedure. The pupils' solutions were saved for later analysis. (See Ruokamo & Pohjolainen 1998; Ruokamo 2000a, a, b.)

Solver did not tutor pupils in the problem-solving process unless it was asked for help or hints. This property was thought to be suitable for especially the better problem-solvers who did not necessarily need any tutoring but were able to conduct autonomous and original problem-solving. Tutoring was designed to meet the needs of those pupils who had difficulties in problem solving. It was also important that pupils had the chance to notice by themselves the possible mistakes they made during problem solving. When pupils asked for a hint during the solution process, Solver tried to find a so-called context sensitive hint related to the pupils' situation in their solution. If the pupils' way of constructing the solution was very original and Solver could not help them, it asked the pupils to try to find support from other pupils via the bulletin board. (Ruokamo & Pohjolainen 1998; Ruokamo 2000a, 2000b, a, b.)

The user could start modelling in any situation and move on to an open solution space. In principle, pupils were able to construct the entire solution without tutoring until the final stage, where Solver asked the pupils to evaluate the final equation (see Fig 2.).

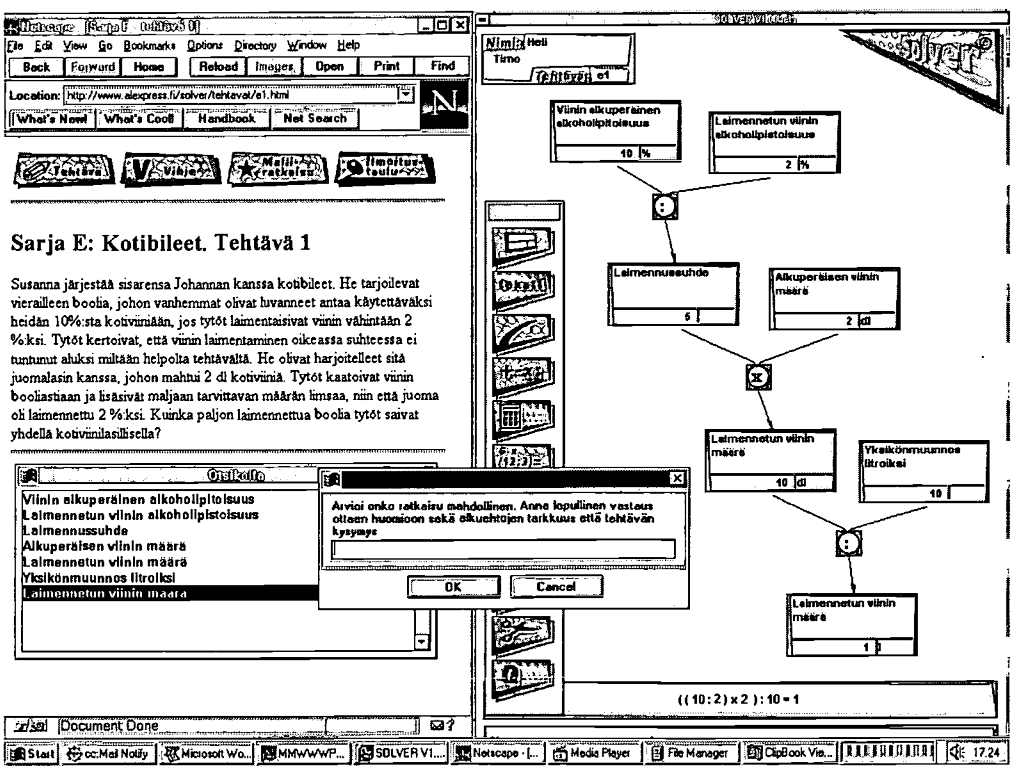

Figure 2: Task 1 of the *"Home Party"* problem series, titles, solution tree and the request to give final result for the problem

After checking the results, the pupils could see a representation of the model solution and could compare it with their own solution. Even if the solutions were not similar, they could be correct. All the pupils' solutions were saved to files, so that the problem-solving processes could be examined and compared later. The new solutions proposed by the pupils could later be used as examples of alternative ways to construct solutions. (Ruokamo & Pohjolainen 1998; Ruokamo 2000a, 2000b, a, b.)

Some Ideas of Anchored Instruction

The *Cognition and Technology Group at Vanderbilt* (1993) has examined *anchored instruction*. The anchored instruction approach represents an attempt to help pupils actively become committed to learning by anchor instruction in interesting, complex and realistic problem-solving environments (cf. *contextual and situational approach*). These environments are designed for the type of thinking that helps pupils to develop the general skills and attitudes that are helpful in effective problem solving and help them to learn specific concepts and principles. The group (Cognition and Technology Group at Vanderbilt 1993) has carried out experimental surveys in multimedia learning environments for scientific problem-solving. They have utilised videos and computer technology to recreate various experiences that could be realised by real scientists. They thought that pupils were able to respect scientists in this way, and that they were able to experience actual scientific working process, not just to see final product of the process. Pupils should be able to see science (and mathematics) as an important part of their everyday life, and be able to pay attention to scientific activity in their communities. The group was willing to improve the pupils' skills to solve the problems that helped them to understand the relations between knowledge and theory. Based on the results achieved by the group, multimedia learning environments could be effective in increasing special, content based knowledge. (Ruokamo 2000a.)

Hmelo et al. (1993) have carried out a longitudinal study into the effects of anchored instruction on mathematical problem solving transfer. Based on the results of their study, anchored instruction leads to the total control of the initial problem. Pupils who had participated in teaching were able to transfer their understanding and qualitative reasoning ability to a new problem. (Ruokamo 2000a.)

Pupils' Attitudes towards Anchored Instruction on Mathematical Word Problem-Solving

In this study, several attitude tests were arranged. The pupils' attitudes were very positive towards mathematical word problems. The majority of pupils agreed that *"Real life mathematical word problems are useful* (45 %, N = 65) and *"I solve real life word problems with pleasure"* (34 %, N = 65) (in other words, the claim is well founded). Forty-two per cent of the pupils agreed that *"Problem-solving was meaningful because the mathematical word problems were connected to everyday life"* (the claim is well founded). Thirty-two per cent of the pupils who studied in the Solver Learning Environment and 52 per cent of the pupils who studied with pencil-and-paper made this choice. Almost one third (27 %) of the pupils in the Solver Learning Environment totally agreed with this statement (even considered the claim as very well founded); at the same time, this percentage for the pencil-and-paper group was just 10. Pupils in the Solver group were more satisfied with the fact that problems were connected to everyday life – the motivating videos that introduced problem situations might have a positive effect on their opinions. Almost half the pupils (49 %), and the majority of pupils in both groups – 57 per cent of the pencil-and-paper group, and 41 per cent of the Solver group – made the choice that the statement *"Mathematical word problems were somehow connected to my own life"* was to some degree well founded. (Ruokamo 2000a.)

Forty-seven per cent of the pupils agreed (to some degree well founded) that *"The tasks in the problem series have been interesting"* – over 50 per cent of the pencil-and-paper group and 41 per cent of the Solver group made this selection. Thirty-seven per cent of the pupils agreed (to some degree well founded) that *"The themes in the problem series have been interesting"* the majority of the pupils in both groups made this choice – 43 per cent of the pencil-and-paper group and 32 per cent of the Solver group. Thirty-seven per cent of the pupils thought that the statement *"In my opinion mathematical word problems are useful"* was somewhat well founded. (Ruokamo 2000a.)

The Attitudes of the Pupils towards Anchored Instruction in the Solver Group

In the Solver group (N=21), 38 per cent of the pupils thought that *"I became interested in solving the problem tasks because of the video that introduced the problem situation"* was well founded. Four pupils thought that the videos were Solver's best properties. The majority of the pupils (35 per cent, N = 20) thought that the claim *"It was useful that when solving tasks, that during each of the lessons all the tasks in one problem series were connected to the same situation and theme"* was very well founded. Thirty per cent thought that it was extremely well founded and the same percentage thought that it was somewhat well founded. Almost half the pupils (48 %) thought that *"The videos made it easier for me to understand the problem"* was somewhat well founded. Forty per cent of the pupils (N = 20) thought that *"The hints in the Solver Learning Environment helped my progress with problem-solving"* was somewhat well founded, but two pupils thought that Solver's worst property was that there was no use for the hints. The pupils thought that the videos were motivating and they were very satisfied with Solver's contextuality and situationality. (Ruokamo 2000a.)

The pupils who studied in the Solver Learning Environment were asked for their point of view on what was the most interesting problem series. Their opinions divided as follows: *Home Party* was the most interesting problem series (43 %), the *Course in Computing* was the second (24 %), *Rabbit Minttu* was the third (19 %), and the *Sport Quiz* (14 %) was the fourth. None of the pupils selected *Camps* or *Family Travel Costs* as one of the most interesting problem series. To the question *"What was the best in the Solver Learning Environment?"* some of the pupils answered as follows:

- *"It was different from math lessons. Solver helped in some tasks."*
- *"It was different from the ordinary study of maths and it was funny and interesting."*
- *"It was a good change to the ordinary math lessons. It was very different. A very fine thing."*
- *"We get to learn a new maths program on the computer. Some of the tasks were interesting."* (Ruokamo 2000a.)

Based on the results of the study, there was a connection between the pupils' gender and their attitudes towards the Solver Learning Environment: girls reacted more positively towards the Solver's situational model as a tool for problem-solving, and to the contextuality of the Solver Learning Environment. According to the variance analysis, there was a statistically significant difference between the pupils' gender and their interests towards a series of tasks ($F = 13.349$, $p = .002$, $Eta^2 = 0.413$). Gender affected interest in all six series of tasks. The interests of the pupils divided as follows: eight girls and just one boy thought that *Home Party* was the most interesting series of tasks. All the pupils who thought that the *Course in Computing* was the most interesting problem series were boys – there were five of them. Two girls and two boys selected *Rabbit Minttu* as the most interesting problem series. Two boys and one girl selected *Sport Quiz* as the most interesting problem series. No one thought that *Camp* or *Family Travel Costs* was one of the most interesting problem series. (Ruokamo 2000a).

Conclusions

This paper describes the Solver Learning Environment developed as a part of the study dealing with mathematical abilities and development of mathematical word problem-solving skills. Several attitude tests were organised as a part of the teaching experiment to gather data of pupils' attitudes towards mathematics, mathematical word problem-solving, information technology, and environments used in the teaching experiment. This paper presents some ideas and pupils' attitudes towards anchored instruction on mathematical word problem-solving. The conclusion may be reached that pupils' attitudes were fairly positive towards anchored instruction on mathematical word problem-solving.

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Entertech: An Engine For Personalized, Collaborative Training

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ABSTRACT: The EnterTech™ Project is a collaborative effort of Texas business, education, and community organizations to develop a job skills training program specific to entry-level manufacturing positions in technology industries critical to the Texas economy. Its goal is to effect change by creating a job training program that is based on industry needs, that can be delivered to large numbers of people, and that teaches transferable skills and knowledge through simulated work environments.

Demonstration And Report

The EnterTech Project is the development of a support model including a unique, realistic, interactive approach to training designed to provide employers with employees that are (l) ready for entry-level positions in technology and related supply and service industries; (2) equipped to solve work-related problems and add value to their workplace; and (3) prepared to continue improving their skills and education. The Governor of the State of Texas is providing funding to support the project. The IC^2 Institute, The University of Texas at Austin facilitates the project for a coalition of more than 70 employers, community-based organizations, educators and policy makers. Targeted learners are high school and college students, dislocated workers, incumbent workers, recipients of public assistance, and unemployed or underemployed people. http://www.utexas.edu/depts/ic2/et/report.html

The Training Program

EnterTech is web-based training for people who want to enter and succeed in the technology workforce although the skills are transferable to other industries. The learner acts as an employee with peers and supervisors in a virtual technology company. This web-based company is part of an integrated learning environment that also includes a personal planner, institution and instructor's guide, group activities, and interactions with the instructor.

The employer-validated competencies are based on actual on-the-job observations, and in-put from entry-level workers. Competencies include understanding an employer's needs and expectations, developing good workplace habits and ethics, utilizing available resources, managing time, communicating well, reasoning mathematically, solving problems and on-going learning. While these skills are taught by performing actual entry-level tasks in the virtual technology company, the skills are transferable to other industries also. In addition to workplace tasks, the learners solve problems relating to their personal lives, such as transportation issues and child care issues, as they impact the workplace. Learners utilize local resources to solve these problems.

Outcomes

1. Creation of a virtual technology company on-line with the learner as an employee in the virtual company.
2. Learning in a virtual work setting such that the learner gets a "feel" of a technology company.
3. Delivery of knowledge, skills, and abilities in a virtual work setting with problem solving scenarios relating to work as well as addressing problems where the learner's personal life impacts work.
4. Expansion and contraction of the length of the training program driven by the learner's successful completion of module post-tests facilitated by (a) tracking the learner's progress and (b) directing each learner to new training materials based on the individual's appropriate skill level.
5. Experience by learner with word processing, spread sheet applications, and email.
6. Availability of information and web links to community resources to assist the learner in understanding how to create support networks at home and at work.
7. Creation of a results-oriented portfolio with problem-solving and assessment results, and actual work examples with levels of skills achieved by the learner upon completion.

Example EnterTech Pilot Sites

Capital Area Training Foundation (Austin, Texas)

Instructor: Frieda Gress, Program Coordinator, Telecommunity Partnership Initiative
EnterTech is offered to adult learners in an evening continuing education environment. The Capital Area Training Foundation is a non-profit, industry-led organization that brings educators and employers together to create a quality workforce and to prepare all students for lifelong learning and career success. EnterTech is offered as part of their Telecommunity Partnership Initiative, a program offering free computer skills training, community access, and job-seeking assistance for adults in the evenings at Travis High School in Southeast Austin.

Kyle Family Learning and Career Center (Kyle, Texas)

The Kyle Family Learning and Career Center offers EnterTech in conjunction with adult basic education, GED preparation, and computer skills training curricula. The Center is one of the programs of Community Action Inc. of San Marcos, Texas. A bonus feature to this rural organization is co-housing with a workforce development center to create a one-stop center for social services, training and employment referrals.

Near Northside Partners Council (Fort Worth, Texas)

The Near Northside Partners Council (NNPC) is incorporating EnterTech with its Neighborhood Jobs Initiative to connect Fort Worth inner-city residents to jobs in growth sectors offering better pay and benefits. Unlike many urban, inner-city neighborhoods, their main employment issue is not one of unemployment but of underemployment. The majority of residents work in low-skill, low-wage jobs. NNPC seeks to enable better job placements. Their long-term goal is to evolve into an organization that emphasizes job retention and advancement in the labor market.

McAllen ISD - Options in Education High School (McAllen, Texas)

EnterTech was offered as a supplement to business and marketing coursework to sophomores, juniors and seniors within an alternative high school setting. Options in Education High School is an alternative educational program that recognizes the unique learning and motivational needs of students and provides a flexible, student-centered learning environment which empowers them to achieve their full potential as lifelong learners. The diverse grouping at Options consists of high school students from who are not experiencing success in traditional settings.

eLearning, Teaching and Training: a First Look at Principles, Issues and Implications

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Abstract: Although it has yet to make a major impact on education and training in the UK, interest in eLearning is growing. The means exist to create Virtual Learning Environments (VLEs) but if these are to become widespread in Higher Education then a "cultural shift" will be needed - a shift away from a focus on teaching to a greater focus on learning. This raises a number of issues - including the attitudes and perceptions of a number of stakeholders - and has implications for institutions, the curriculum, staff and students. These implications are explored in this article and point to a need for institutions to review current policies and practice if they wish to maximise the potential of eLearning.

The Context of Change

Changes in society are occurring on a global scale resulting in "a mass higher education system that is re-assessing its learning and teaching practices and exploiting the use of communication and information technologies." (Maier and Warren; 2000) A further consequence of these changes is that our clients (students) are demanding more flexible modes of study, just-in-time training, work-based learning and accreditation of prior experiential learning (APEL) whilst world-wide government initiatives continue to promote the concept of life-long learning. We are also told that Higher Education Institutions (HEIs) wishing to exploit technology effectively need "a clear and shared understanding of a wide range of issues - pedagogical, infra-structural and organizational." (Barblan and Fayant; 2000)

Many companies and large organisations also realise that they must continue to train employees if they are to remain competitive. Modern and dynamic companies no longer view training simply as a cost but more as an investment, linked to their ability to be both profitable and successful. However, traditional training methods tend to be very time consuming and are not particularly responsive to individual needs.

In addition to these changes, we have witnessed an unexpected and exponential growth and interest in the Internet and in the World Wide Web (WWW) in particular. Alongside eMail, eBanking, eCommerce and eShopping we now have eLearning and Teaching (ELT). eLearning is attractive to the corporate market "because it promises better use of time, accelerated learning, global reach, fast pace and accountability." (Cross, 2000)

What is eLearning?

In a very short space of time definitions of eLearning have mushroomed. These include, "the convergence of learning and networks and the new Economy," (Cross, 2000) and "the use of network technology to design, deliver, select, administer, and extend learning." (Masie, 2000) Goodyear (2000) is clear that eLearning is not just the equivalent of cCommerce or of learning on the Web but asserts that it is, "the systematic use of networked multimedia computer technologies to;

- empower learners,
- improve learning,
- connect learners to people and resources supportive of their needs, and
- integrate learning, performance, individual and organisational goals."

He syggests that eLearning is essentially dependent upon, and shaped by, three enabling technologies; the infrastructure of the Internet, the presentational capabilities of modern multimedia computers and the information sharing tools and protocols of the world wide web (WWW).

Already, there are claims being made for eLearning and its ability to revolutionise education and training. Citing Cross (2000), legitimate eLearning is more likely to:

- focus on the needs of the learner, not the trainer or institution,
- take advantage of the net: real-time, 24/7, anywhere, anytime
- bring people together to collaborate and learn
- personalize, often by combining 'learning objects' on the fly
- offer more than one learning method
- incorporate administrative functions such as registration, payment ... monitoring learner progress, testing, and maintaining records.

So, whilst it is still a relatively new concept, currently eLearning appears to be characterised by the exploitation of Web based technologies to create learning materials and for course delivery, accessed via a browser with some form of on-line learner support

Implementing eLearning

To facilitate eLearning, a Virtual Learning Environment (VLE) is usually employed containing four main elements:

1. courseware – self study learning materials, simulations, multi-media components
2. supporting materials – reference materials such as articles, case studies, books, World Wide Web links
3. on-line assessment – both formative and summative tests, quizzes and assignments
4. on-line support – via e-mail, Computer Mediated Communication (CMC), chat rooms, bulletin boards.

At one level such an environment can be the extension of an existing Intranet (Fig. 1) that will usually contain three of the above components.

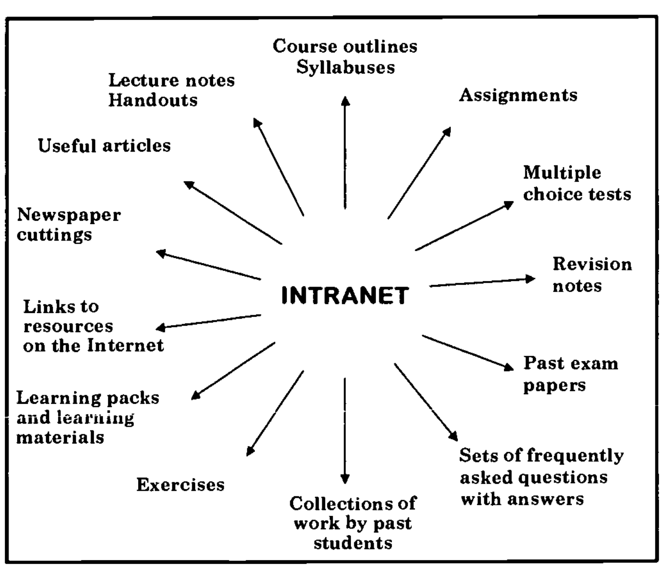

Figure 1 - Elements of an Intranet (based upon a figure in FEFC, 1998)

The missing element, on-line support, is often provided by e-mail or some form of bulletin board. As an interim arrangement this may work satisfactorily but a true VLE will integrate these functions fully and provide more sophisticated support, tracking and assessment tools.

Issues

Whilst the use of Virtual Learning Environments can provide a much enhanced 'distance learning experience' (Ryan, 1997) and reach new markets, there are also some drawbacks. Many of these can be partially addressed through training and support (Rogers, 2000) but unless a student has frequent and regular access to the technology and the necessary range of skills to exploit it, then they are likely to have an unsatisfactory learning experience. It is questionable, for example, whether all subjects can be delivered satisfactorily at all levels, to all students. It is relatively difficult at this time to provide the kind of 'hands-on' experiences via the Internet that may be gained in a science laboratory, engineering workshop or training kitchen. It is relatively easy on the other hand to present content-laden subjects and conceptual ideas via the Internet but, for the moment, many kinds of social interaction are probably still best experienced in face-to-face classrooms. Some commentators recommend a mixture of more traditional and eLearning approaches that acknowledge the diverse range of learning styles and subject matter in order to achieve maximum effectiveness.

A major area of concern reported by many researchers and practitioners (Ben-Jacob et al, 2000; Laurillard, 1995; Rogers, 2000; Ryan, 2000, Smith and Hardaker, 2000) is cultural shift. This 'shift' has a number of facets, some more tangible than others, but can be broadly described as a move away from teacher-centred, didactic exposition to a more resource-based, immersive and learner-centred environment. It would be dangerous to assume that all students will welcome this shift of emphasis away from teaching towards learning. Whilst many have responded positively to the use of ICT and VLEs in particular, (Birbeck, 2000; Smith and Hardaker, 2000) there are those who are sceptical and believe that flexible learning approaches are an abrogation of responsibility by the teacher. (Halsall, R. et al, 1998) It is certainly our experience (Ryan and Woodward, 1998) that more is expected of students and tutors operating virtually than within a traditional distance regime and this does not always suit all participants. It is important to introduce students (and staff) to this new way (culture) of learning and teaching, including how to learn (and teach) within a virtual learning environment.

The design of VLEs tends to promote the concept of a community of learners and opens up possibilities for networking, peer interaction and collaboration at a level not often seen in traditional classrooms. (Barajas, 2000) Interaction is at the heart of learning with ICT and the skills and attitudes required to make most effective use of VLEs are likely to be distinctly different to those normally operating within a traditional higher education institution. (Ben-Jacob, 2000; Rogers, 2000)

In turn, this cultural shift raises a number of issues for both students and tutors including:

- perceptions of learning and teaching
- attitudes towards being 'required' to learn as well as being taught
- the ICT skills required to operate efficiently
- ownership and control of learning and teaching
- the respective roles and relationships between stakeholders

No matter how far down the eLearning road one travels, the above issues (and others) will need to be considered and appropriate strategies developed for meeting the needs of users. Of paramount importance is the issue of staff development. "Academic staff development in the pedagogical applications of new technologies is fundamental to the transformation of teaching and learning ..." (Sprat et al, 2000)

Implications

Given the issues raised above, any institution or training organisation would be advised to review its current policies and practices if it is to maximise the potential of eLearning. There is a wealth of material in the public domain that outlines good practice and indicates what steps need to be taken to replicate that practice and address issues and potential problems. What follows is not an exhaustive list but is intended to provide a starting point for considering the large number of factors that will impact on all stakeholders engaged in eLearning and Teaching (ELT).

Institutional

As suggested by Barblan and Fayant (2000), an audit of current practice across the organisation with regard to the use of ICT and learning, teaching and training strategies is a good place to begin the review process. Part of this review should include an ICT staff audit to establish levels of competence. This will provide a substantial amount of information about current operating practices and also give some insights into the prevailing culture. It is quite likely, for example, that an organisation familiar with more traditional teaching and training strategies will need to develop a new vision for the future which is student (client) rather than teacher or institution-led and this information will be helpful in developing an ELT policy. It will also be necessary to establish and maintain a stable telecommunications/networking infrastructure that will be future-proof. For eLearning to be as significant as on-campus provision there needs to be a greater emphasis on (and more resources devoted to) ICT infrastructure. The initial costs of ELT are high and financial resources will need to be committed to on-going development and maintenance.

Rome was not built in a day and any organisation intending to move into the eLearning world should consider developing short, medium and long-term plans for the implementation of ELT. Incremental change is far more likely to produce the required shift in culture than a full-frontal onslaught. It may be helpful, and promote a greater sense of ownership, if individual schools, faculties and departments are charged with incorporating ELT in all future strategic plans.

It is well known that the exploitation of ICT in learning, teaching and training requires a multi-disciplinary approach. Establishing a centre of expertise, if one does not already exist, which can become a one-stop shop for all matters relating to ELT would enable the range of expertise necessary to make most effective use of the technology accessible to the majority of stakeholders.

Although major software houses make wide ranging claims for their products it is acknowledged by practitioners that no one tool will deliver everything necessary for a fully functional VLE. It is better to identify and establish an eToolkit (a range of tools) that will deliver the organisation's policy on ELT rather than trying to use a 'hammer to drive a screw'. This toolkit may be based on one of the major VLE platforms such as Lotus LearningSpace or WebCT but should also include a number of specific tools for web audio and video streaming. This will allow a greater range of learning, teaching and training strategies to be employed within the virtual learning environment.

Although an ICT audit of staff may reveal them to be competent users they are still likely to require additional support to enable them to more fully exploit the potential of the selected eTools. It is advisable to provide a comprehensive staff development programme ranging from awareness raising to the design, development and exploitation of VLEs and the ELT toolkit. Alongside this provision there should be a range of user-support mechanisms both on and off campus for hardware, software, authoring and design. Consideration should be given to strategies that encourage greater collaboration/co-operation between schools and departments so that expertise is shared for the common good. One approach to providing on-going support and leadership might be the appointment of school/department-based ELT experts from amongst the 'ranks' to act as consultants and co-ordinators at a local level. Teaching and training within a VLE often occurs outside of 'normal' working hours. Tele-working is a legitimate method of operation and institutions may need to review staff contracts in the light of requirements for more flexible use of time – e.g. a longer teaching year, evening and weekend work.

In addition to the above, institutions will also have to develop an eLibrary, a comprehensive range of e-student support services and ensure that there are safeguards in place and a fallback position to support students when the technology fails. It may also be necessary to review regulations governing registration, assessment and accreditation to provide greater client orientation (flexibility) that facilitates just-in-time training and life-long learning. Some organisations will be better equipped than others to embrace these changes but whatever their position in the global market place everyone will benefit if future ICT developments in learning and teaching are grounded in sound educational practice, documented, evaluated and published.

Curriculum

The traditional offerings of universities and training organisations will need to be reviewed in the light of the changing market-place with its greater emphasis on, 'just-in-time' training, life-long learning, work-based training, mentoring and key skills. There is a worldwide shift towards more consumerism in education and training with its associated increase in client-centred content and greater involvement of the student/trainee (consumer) in determining outcomes and methods of assessment. To ensure that products are accessible and appeal to a worldwide audience institutions will have to conduct more in-depth market research. The delivery of these new curricula will have to become more flexible in terms of time and place with students operating outside of 'normal' university semesters.

Because eLearning is still in its infancy there are as yet no identified or established models to inform curriculum development. Some exist with regard to the use of ICT generally and computer mediated communication (CMC) in particular (e.g. Mason, 1998; Ryan, 1997). The articulation of such models will be helpful in the medium to long term and avoid much duplication of effort whilst building upon what we already know about thc impact of ICT on learning and teaching.

One major difference between ICT-based and traditional learning, especially at a distance, has been the collaborative nature of much of the interaction and the extent to which the peer group supports one another and uses the tutor as a facilitator rather than a content-expert. Combined with market forces this shift in emphasis, from teaching to learning, may well lead to the greater involvement of a range of stakeholders (students, employers, industry, and the community) in the development of new courses and programmes.

An added bonus of working within a VLE is that students must make effective use of a range of ICT tools that can result in the acquisition and development of essential and transferable key skills. Programmes of study that are delivered within VLEs must ensure that there are opportunities within the curriculum to acquire and develop these skills or some students (those who enter with the skills) will have an unfair advantage over those who do not possess them.

Research has shown that novel ways of learning and teaching are possible when we employ ICT tools. What we have learnt about the use of these tools and the opportunities they provide should be fully exploited within VLEs so that the widest possible range of learning, teaching and training facilities are made available.

Students

Much of what has been said about the curriculum will impact directly upon students. Institutions should consider the likely impact that technology will have on students and be prepared to raise their awareness of the differences between traditional and eLearning and Teaching. Many students, for a variety of reasons, may have had limited exposure to the full range of ICT tools. Some students may have had limited access to the technology and only a minority are likely to have experienced operating within a virtual environment. If eLearning is to be successful then institutions must consider how students will gain regular and frequent access to appropriate technology, which may include home access via cable and satellite television and personal computer/communications devices such as laptops, handheld computers and WAP phones.

Alongside the traditional skills and abilities of students such as reading, writing, speaking and processing information it will be necessary for them to acquire and develop additional skills to fully exploit ELT. These will include using a wide range of ICT tools, time management and reflection both on and in action. For some students used to operating in isolation within a traditional distance context, they will also need to learn to collaborate and support their peers. Students may also need to modify their expectations of the tutor especially if they perceive them as being the 'sage on the stage' as they in turn adapt to their new role as 'guide on the side'.

Because eLearning is so technology-dependent, it is essential that there are clearly established lines of communication and support to ensure that students are not disadvantaged in the event of technology failure. It may be necessary to providc a full range of support mechanisms accessible 24 hours a day, 7 days a week to make most effective use of ELT. Within most UK universities this would be considered as an unusually high level of 'customer care'. However, with changed expectations about the learning and teaching processes and the role of the technology, it is likely that new ways of thinking about how we perceive students and how they perceive teachers will need to be adopted.

Staff

Perhaps the greatest first step for academic staff and trainers will be the need for an increased awareness of the cultural shift from learning to teaching alongside embracing what technology has to offer. Staff development may help to facilitate aspects of this shift but there will need to be a fundamental belief in these new ways of working if they are to impact significantly on current practices. Training in the use of a range of ICT tools and their appropriate exploitation is but a small part of the overall staff development package that will need to be on offer and willingly embraced.

If full use is to be made of the novel opportunities provided by the technology then teachers and trainers will require time to translate existing and develop new courses for delivery within a VLE. Scholarship is more critical within an ELT environment (where expectations about currency are higher) and tutors will need time to undertake appropriate research to identify current and relevant resources to ensure those materials are always up-to-date. It is probably the case that most UK academics already have access to a dedicated computer, which will be essential if they are to exploit ELT effectively. There may also be a need to review timetabling to ensure greater cost-effective and efficient use of academics engaging in both traditional and ELT. Consideration may need to be given to alternative methods of allocating tutors to students e.g. case-loading. Terms and conditions of employment are different across the world but many UK HEIs operate on the basis of 'contact' hours. Such a basis for allocating time is probably inappropriate within a VLE and staff must be willing to be involved in a review of contracts with regard to working outside of 'normal' institutional hours, days and semesters.

The same need that students have for technical and user support will also apply to staff if they are going to be able to function effectively at all times. Additionally, it will be necessary to provide effective and efficient administrative support both centrally and locally to ensure an effective VLE.

Concluding Remarks

This paper has attempted to begin the process of raising awareness to the emerging nature and concept of eLearning and some of the issues and implications for learning, teaching and training within a virtual learning environment.

If eLearning is to be successful then it will be important for everyone involved to recognise and prepare for the cultural shift that underlies this revolution in learning, teaching and training. We should be wary of thinking of this new concept from a purely technological stance, a mistake made by many of the innovators and early adopters of ICT in learning and teaching. Instead, we should be guided by the outcomes of research and evaluation, which propose that we exploit the unique qualities of these technologies to enable new and diverse ways of supporting learning and always ensuring 'fitness for purpose'. (Laurillard, 1995)

Change does not mean turning our backs on tried, tested and successful models of learning and teaching. To jump on the technological bandwagon and try to deliver everything via the web would be a mistake. Web technologies are still evolving. They are in their infancy and whilst great strides have been made over recent years they probably have a long way to go before they mature – if indeed they ever do before we are overwhelmed by the next technological breakthrough!

The degree to which an institution is able to prepare all participants for this shift of emphasis and address the issues and concerns of all parties will inevitably determine the success of any project, including that of a virtual university. Staff development will be a major contributor to addressing these issues for tutors, alongside on-going support and development by key personnel. Steps must also be taken to ensure that students are supported through this transition from traditional to virtual learning and teaching or institutions risk losing their share of the growing eLearning market. In a virtual learning world there must be some compelling reason for a student to be persuaded to undertake a course of study at one institution rather than another.

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Die Neue Lehre: An On-line Course in Schenkerian Analysis

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Abstract: The interactive nature of music classes at the university level have traditionally necessitated a face-to-face learning environment. New digital technology and the increasing acceptance and use of the internet have made it possible to create effective interactive, multi-media activities for students to access and utilize on-line. In the music discipline, computers have been used effectively to augment undergraduate courses, providing computer-assisted drills and delivery of facts and knowledge mostly for music history and appreciation, and elementary music theory and aural skills. With the opportunity to connect professor to student using the internet, other more advanced courses may now be offered to remote students. Here a course in Schenkerian Analysis, an advanced type of graphic music analysis, developed by Austrian music theorist, Heinrich Schenker (1868-1935), has been adapted for the web using WebCT, a platform for delivering courses on-line. Noteworthy are the innovative method for displaying the Schenkerian graphs, employing notation software, Music Press, the animations which manipulate the graphs, and the unique opportunity for students in other counties to interact with top Schenkerian scholars at the University of North Texas.

Introduction

Heinrich Schenker (1868-1935) was an Austrian music theorist who developed a method of analyzing music in terms of structural levels and their relationship to one another (foreground, middleground, and background). Since most of the authorities on Schenkerian analysis reside in America, a course had been proposed to expose students in other countries to this unique form of analysis. The pedagogy of Schenkerian analysis itself is complex. It is generally agreed that a teacher or facilitator is necessary in order for students to grasp the basic concepts and graphing techniques. Previously, such interaction has been difficult in any but a face-to-face arrangement with students, but with the distance learning options presently available via the Internet and related technologies, more advanced courses that require direct interaction with a teacher are now possible. Through this project I have developed a distributed learning course to teach Schenkerian analysis to students anywhere in the world.

With the proliferation of Schenkerian theory in the US, Great Britain, Israel, Finland, for – increasingly – mainland Europe in the past quarter century, the pedagogy of Schenkerian analysis has become an important issue. Schenker himself was suspicious of textbooks with their tendency for artificial codification and over-simplification; rather, he recognized that his "New Teaching" ("Die neue Lehre") - as he and his students referred to it – would require a different, more "organic" pedagogical approach that was both personal and yet accessible to a wide audience.

New digital technologies have made it possible to disseminate Schenker's pedagogical approach, not through textbooks, but by adapting interactive techniques of Web-based instruction. In practice, Schenker's "new teaching" was as organic as his theory itself - and as novel in the connections it sought to draw between the individuated disciplines of theory, musicology, composition, and performance. The interactive and multi-media components of Web-based instruction enable us to realize Schenker's own pedagogical approach to instruction in Schenkerian analysis.

I have created an online course with a variety of components to make learning Schenkerian analysis possible. The webpage, created for use with WebCT version 3.0 (Web Course Tools), a platform for distributed learning courses, contains Schenkerian graphs with explanation and study questions by celebrated Schenkerian scholar, Dr. Timothy Jackson, professor of music theory at the University of North Texas. I have set his original graphs using a graphic notation program called Music Press, and then converted them to web-ready graphics files of unparalleled superior visual quality. Students learn about basic graphing techniques through musical examples, and they practice applying these techniques in their assignments with interactive activities created using Flash software.

Assignments are begun with initial guidance from the instructor, and then scanned in and sent to the instructor as email attachments or faxed. The instructor posts the graphs in the public forum with critiques, and the class is encouraged to participate in a virtual discussion in periodic scheduled "chat" events. There are also pre-recorded videos of the instructor explaining certain concepts, and students are able to communicate with the instructor through WebCT-unique email. Grade evaluation is based on class participation, that is comments posted and assignments submitted, as well as an individual research and analysis paper presented at the end of the term. Students also complete timed multiple-choice quizzes which are graded automatically using WebCT software, emphasizing time-on-task qualifications, as well as immediate feedback, two crucial elements to the mastery of a new technique. Each of these components add to the student's progress in the field of Schenkerian analysis.

Project Goals

The main goal of this project is to provide training, unencumbered by restrictions of time and space, in Schenkerian analysis to anyone unable to come to our campus.

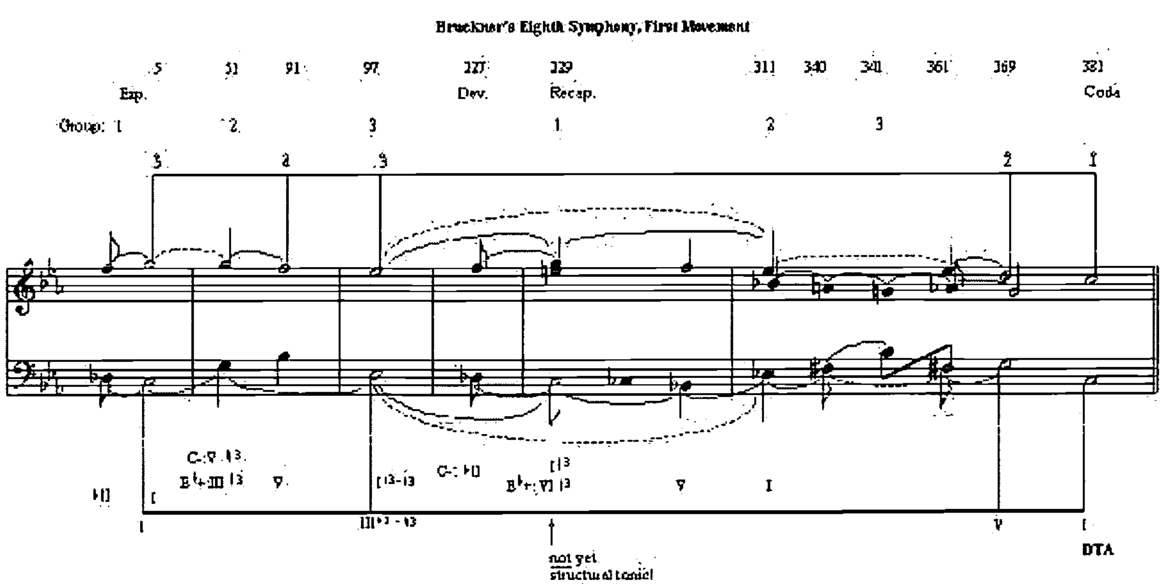
Course Objectives

1. The students will create Schenkerian style graphs for the purpose of analyzing and interpreting music.
2. Students will recognize and describe the work of Heinrich Schenker, commentaries on his work, and recent field work in the area of Schenkerian thought.
3. Students will be able to apply analytical elements of Schenkerian thought to the literature of the established musical canon, and critically evaluate Schenkerian graphs.

Web Site Content (WebCT)

- Syllabus
- Interactive class calendar
- Interactive assignments
- "Hands-on" activities
- Real-time net chat "events" and bulliten board postings
- Schenkerian graphs made with Music Press converted to .PDF format

Figure 1: Example of a Schenkerian Graph



Course Procedures

- Students register online for the class through UNT according to the normal Center for Distributed Learning registration process.
- Net chat "events" are scheduled; students' graphs will be scanned in, posted, and discussed with students and professor in real-time and with bulliten board postings.
- Students send homework assignments to professor via fax, sent as saved PDF files in email as attachments, or in the mail.
- Professor posts assignments online with critiques for the whole class to see and posts his own graph with explanation.

Conclusion

There are two primary reasons for creating a distributed-learning course for Schenkerian analysis. It allows people in remote locations, who may not normally have the opportunity to do so, to learn Schenkerian analysis, and local students have the option of working at their own pace, and access to Schenkerian graphs and course materials anytime, day or night, from any computer that has an Internet connection.

System Integration Tools for Working and Learning Environment: Universal Clip Board, Find Commander and ExMouse

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Abstract With the spread of low-priced computer, almost all students of our university own a laptop computer and bring it into the classes. In this situation, it is getting more required that how students can smoothly integrate their laptop with the existing university facilities such as CALL and computer laboratory. This paper describes three tools for system integration, which provide user integration of data, actions, and operation among different applications and computers. This integration allows user to use more than one computer as if they were unified as one system.

Introduction

With the spread of low-priced computer, in our university ownership of computer is obligatory for all students. Since this obligation started, students have always brought their own computer into university, placed it by the side of computer of computer laboratory, and done their work, operating two computers at the same time. In this situation, it is getting more required that how students can smoothly integrate their own computer with those of computer lab, even if the two computers differ in OS (operating system), and do their work efficiently. However actually intending to do so, various problems arise such as the inconvenient exchange of data by difference in OS, a double operation of mice and keyboards by using two computers, unsynchronized execution of software working on different computers etc.. Therefore we propose three support tools for system integration, which were designed for users who operate more than one computer simultaneously. Final goals of our tools are four types of system integration as follows:

1. to smooth the way of data exchange among different OS computers without using FTP and file share. (Integration of Data)
2. to operate all computers, which user is using, with only one mouse and one keyboard. (Integration of Device)
3. to use some application software on different computers simultaneously, connecting one application with another. (Integration of Software)
4. to control operations of different OS computers with simple script. (Integration of operation)

Tools for System Integration

Universal ClipBoard

Universal ClipBoard allows user to exchange data easily among some different OS computers without using FTP and file share. This system is implemented in JAVA RMI and consists of one server and some clients, which are working on more than one computer.

FindCommander

Find Commander provides user automatic flow control among Java applications with simple script. This system consists of one server and some clients (See. Fig.1) , and the exchanging data is sent to the clients via the server. By using Java reflection class FindCommander can firstly detect methods from the given application programs, execute them, write data, and operate their buttons without changing any Java programs, in accordance with user's script program. The script program can control the actions of applications and transfer the data from one application to another applications on the remote computer. FindCommander realizes the integration of Java applications, which are working on several computers.

ExMouse -- Unified mouse and keyboard operation

ExMouse enables user to operate more than one computer with only one keyboard and one mouse, even if input devices are for different operating system. This system consists of two components as shown in Fig.2:

MouseControl and ExMouse. These components are connected by Java socket interface. MouseControl detects the actions of the mouse and keyboard, and ExMouse operates the mouse and keyboard by using Java Robot class. Clipboards of both computers can exchange some data with simple command such as "set remote / get remote". Since the actions of mouse and keyboard can be also recorded, user can replay them any time. Moreover user can put some MemoTags to the recorded actions on the screen and can replay the recorded actions by pushing on the MemoTags.

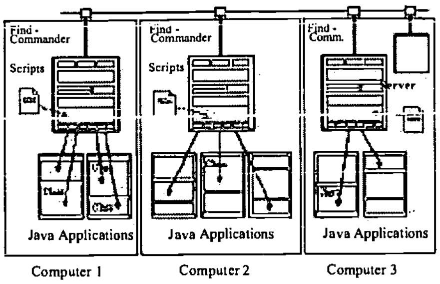

Fig.1 FindCommander System Architecture

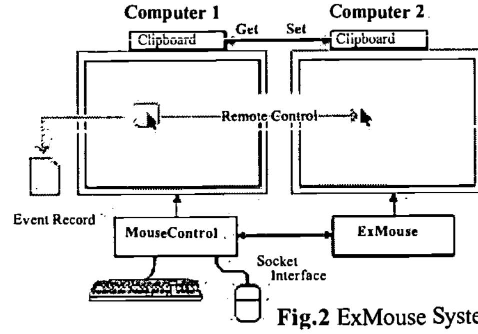

Fig.2 ExMouse System

Applications

There are many possibilities of using the three tools in working and learning environments. In order to make use of resources more efficiently, learners can integrate their own laptop to the computers of CALL and computer lab as shown in Fig.4. By using ExMouse learners can operate the learning materials and WWW browser

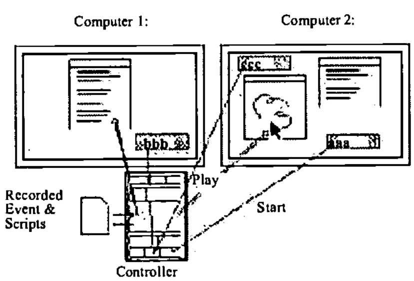

Fig. 3 Recording and MemoTag of ExMouse

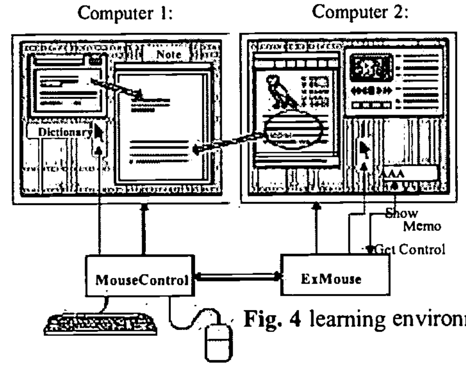

Fig. 4 learning environment

of Computer 2 with the mouse and keyboard of Computer 1. Finding a new word and useful expressions in the materials and WWW, learners can easily transfer such texts from the Computer2 to their laptop of Computer1 with three simple operations: Copy, Get remote, and Paste. Moreover, the function of event recorder allows learners to transfer data and to look up dictionary automatically. Learners can put the MemoTags at any place on the screen and take notes on them. Teacher can also give learners some instructions by using MemoTags. MemoTags can be also used as the start button for the recorded action sequences.

Conclusion

In this paper, three kinds of support tools for system integration were introduced. These tools facilitate integration of data, operation, and action among different applications and computers. Since they are written in Java, integration is also realized among different operating systems. This integration is particularly useful for constructing working and learning environment, and moreover for using more than one computers and many application programs.

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Potential Energy Courseware:
A Prototype for Scientific Experiments utilizing the WWLab System

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Abstract: This paper describes a web-based laboratory system and courseware for potential energy experiments. It reports results which students achieved operating the system through the LAN at a local public university. The system utilizes experimental apparatus and courseware written in the HTML language to conduct various scientific experiments through the Internet. This system, called the WWLab system, allows learners to conduct live experiments using a robot arm. Surveyed afterwards, all 15 students involved in testing the system expressed interest, and concluded that the WWLab was useful for independent studies. However, we have found that lag time before screen display of live experimental work is long, approximately 20 seconds. So, in order to avoid entry of redundant commands during lag time, we plan to display complementary explanations of experiments, instead of command screens.

1. Introduction

As use of the Internet increases, so does the use of the Internet for teaching and research purposes. On-line teaching using the Internet used to consist mainly of communication from teachers to learners, namely, in one direction only. However, learners could deepen their understanding especially in the field of science by performing experiments themselves via the Internet. Therefore, Saisho et al. (1998, 1999) proposed the World Wide Laboratory (WWLab) system in which learners could operate experimental apparatus through the Web, and have been developing it on an experimental basis as described in this paper.

We have developed experimental apparatus and courseware written in HTML language for scientific experiments on the WWLab system. In this paper, we describe the system and courseware designed for potential energy experiments using the system.

2. Outline of the WWLab

The WWLab, shown in Figure 1, consists of a Web server machine, a video camera and experimental apparatus including a robot arm. The web server machine controls the video camera and the robot arm. We have developed a few experimental apparatus, such as a refractive index (Saisho et al. 1998), for this system.

At first, a learner opens our courseware using an Internet browser, such as Netscape Navigator or Internet Explorer. After the learner reads about the courseware, the learner may conduct live experiments, which are actually done in real time using the robot arm. At the same time, the learner can both observe the live experiment by video image transmissions and control directions of the video camera on our courseware. In addition, we provide a pre-recorded experiment which may be viewed as a movie file in advance.

In this system, anyone can freely access our courseware through the Web. However, if many learners try to work simultaneously, operation of the live experiment and the video camera is disrupted. Therefore, we have developed a scheme that enables only one learner at time to operate the live experiment and the video camera via the WWLab system. Yet learners other than the one operating the apparatus can see the state of the live experiment and replay the recorded experiment through the Web at any time.

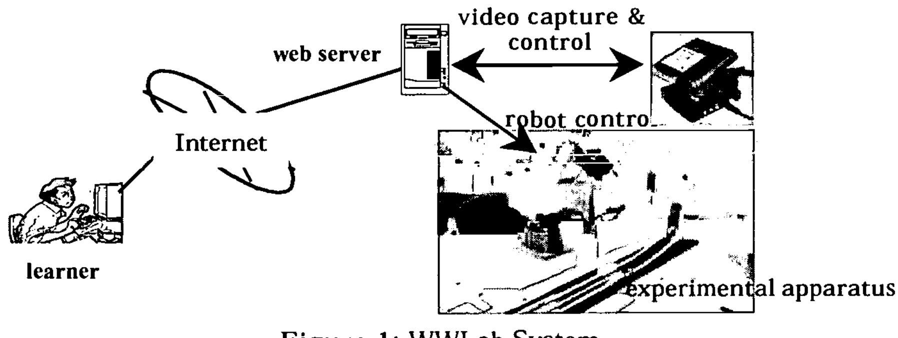

Figure 1: WWLab System

3. Software configuration for the WWLab system

The WWLab's software configuration consists of control software and courseware. Additionally, we use RealServer and RealProducer (RealNetworks, Inc.) to broadcast the live experiment for learners. Learners need RealPlayer (RealNetworks, Inc.) to observe various aspects of the live and the recorded experiments.

3.1 Control software for the WWLab system

In this system, control software is a set of programs to operate the video camera and to control the robot arm for live experiments. The program for operating the video camera is on a Web server, and it functions to change camera angles (tilt & pan) and the size of the video image (zoom). The program for operating the robot arm is also on the Web server. It consists of several commands, including the open-close command for robot finger movement which coordinates the positions of the fingertips. It is necessary to write special programs for each experiment.

3.2 Courseware for potential energy experiments

Courseware is on the Web server machine and is written in the HTML language. The courseware on potential energy consists of (1) an experimental overview section (an explanation for the potential energy of an object with a figure); (2) a section of an image of the experimental apparatus and an experimental method: A ball is rolled from the upper end of a track, to collide with a wooden block placed on the lower part of the track. The potential energy of the ball is determined by the measuring a distance that the ball moves the block; (3) a section of instructions for three kinds of experiments: (a) the comparison of small and large metal balls (b) the comparison of the same size of metal balls (c) the comparison of plastic and metal balls; and (4) a section of instructions for an operation of the video camera.

In addition to a video view of the live experiment, there are video views of pre-recorded experiments. Learners can replay the pre-recorded experiment if their live experiment fails, or if learners want to determine whether their live experiment was successful.

4. Experiment

We used Personal Web Server (Microsoft, Inc.) as software on the web server. Fifteen students from the Prefectural University of Kumamoto tried to operate the system using the LAN at the university. All students were interested in this system, and agreed to use it for independent studies. Their comments are as follows:

(1) It was interesting that a learner could operate the experimental apparatus by oneself, and observe the state of the live experiment using the video camera.
(2) A learner can use this system as a review of a class.
(3) After a learner took out one of the instructions for the live experiment, the time until the screen of the live experiment began to work was long.
(4) Connections with the Web server machine did not work well when more than a few students tried to access the recorded file of the experiment at the same time.

5. Discussion

We discovered a problem with this system, which is that the response time from the Web server machine is long, approximately 20 seconds. We guess that one cause of the problem is the web server. We currently use Personal Web Server software, but have found that its processing function is not satisfactory because it serves only basic functions. We expect to achieve functional improvements by changing from Personal Web Server to Windows NT server (Microsoft, Inc.).

Though it may be reduced, the problem of lag time will not disappear, because much of the response time is required to encode image data and move it to client computers. It is counter-productive for the learner to get bored by the same screen, or to click the control buttons again and again. As alternatives during lag time, we plan to display complementary explanations of the experiment. We expect alternatives displays to avoid entry of redundant commands.

6. Conclusion

In this paper, we have presented an outline of the WWlab system and courseware for experiments in potential energy, and confirmed operation of the system on a LAN. What developments remain to be seen are as follows:

(1) ways to use this system from outside the university;
(2) additional functions that learners can use for communication with each other by audio or keyboard input;
(3) applications of our system for actual learners; and
(4) developments of other experimental apparatus and courseware of experiments.

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Some Educational Approaches Using Multimedia Technologies

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Abstract: Multimedia technologies can modify the learning environment. This paper describes the results of three different experiences which involve the use of multimedia technologies in cognitive and educational processes (in High Schools and in Universities). First experience is an example of the application of multimedia technologies in the didactic path to help the students to reach the educational and cognitive goals, to support the traditional educational methods. It has been developed for a first-year and a fourth-year undergraduate courses of Mathematics at the Academy of Architecture of Mendrisio, University of Italian Switzerland. Second activity is an example where the multimedia technologies substitute the traditional tools (e.g. overhead projector or the blackboard) in the field of computer based training in electronic instrumentation and measurements. Third activity is an example of the use of the multimedia technologies to develop a new learning environment which involves the constructivist approach and the cooperative learning.

1. Multimedia technologies to support the traditional educational methods

At the Academy of Architecture of Mendrisio (University of Italian Switzerland) there are two courses of Mathematics (first and fourth year) that use the multimedia technologies in the didactic path to help the students to reach the educational and cognitive goals. The computer plays a central role in this process. These courses of Mathematics, named Mathematical thought (first year) and Computer Graphics and New Media (fourth year), are presented as 20 lectures, given weekly throughout the academic year. We have used some multimedia technologies (e.g. CD-ROM, computer-aided design (CAD) tools, scientific documentaries, educational hypermedia, Virtual Reality, Internet sites) in support to the traditional educational tools (overhead projector or blackboard) to introduce the interconnections between Mathematics, Arts and Architecture. During the use of the new technologies we have noted that the hypermedia facilitate the application and transfer of complex knowledge to new situations. Such cognitive flexibility requires the representation of knowledge along multiple rather than single conceptual dimensions. Hypertext facilitates this cognitive flexibility because it allows a topic to be explored in multiple ways using a number of different concepts or themes. It is possible to identify the existence of a similarity between navigation in the real world and navigation in a virtual world (Calvi, 1997; Sala, 1999). We have used some educational hypertexts because we have noted that hypertext supports the connection of ideas (Brown, 2000). In fact the use of hypertext-linked documents (and reference links) allows the readers to jump from content to content (idea to idea, at the whim of the reader). The comparison between statistical results on then learning rate using traditional methods and multimedia technologies will be available in the next future.

2. Multimedia technologies in substitution to the traditional educational methods

Prof. Umberto Pisani (Department of Electronic - Politecnico of Torino, Italy) has reorganized his course of Electronic Measurements, based on lectures and successive laboratory practice, using multimedia tools which combine two different learning phases: a theoretical phase, and a practice phase in a single tutorial stage self-managed by the student (Sala, 1999). This project was inside to the important Italian Distance Learning Project named "Nettuno". The project's goal was to developed a new approach in the Laboratory of Electronic Measurements where the students could carry out a pre-training activity outside the laboratory and possibly at home; each student could thus individually adapt the learning rate to his own capabilities. After this pre-training phase, students who enter the laboratory require reduced assistance and less time to complete the training activity. In these activities the author was an subject matter expert. The multimedia modules have been developed to expose students to a comprehensive range of electronic instruments and basic measurements techniques, and to allow students to give practice on the particular instrument whose front panel is simulated on the monitor and the behaviour is emulated by computer. This multimedia course, oriented to defined objectives of knowledge, is structured on a set of modules each containing a particular topic or instrument in form of a self – contained multimedia presentation. Each module has been developed using Multimedia Toolbook ™ (with the aid of several thesis students), and contains different media (e.g., animation techniques, digital television camera images, audio supports, etc.). Each module includes several tests to verify the level of the acquired knowledge on the educational objectives and lesson subjects. Examinations include the laboratory quizzes by multiple choices, some simple projects (which could require few data processing), some puzzles (where student must rebuild an instrument block diagram or measurement procedures). In all exercises, the data are randomly selected to always generate new projects entry points. The test results are stored into a database file, which can be processed by an external DBMS program with the possibility to extract statistical indicators on the class by DBMS query. Virtual instruments are implemented in the multimedia packages (developed in the VisualBasic ™ environment with the exception of a minor part written in Microsoft C++ ™), in order to allow simple simulations of the real instruments during the self-training phase. For example, when learning the spectrum analyser, the student, after setting a particular input signal, can evaluate the effects of different instrument configurations on the simulated screen. The idea is to design a laboratory that is simultaneously and remotely accessible to several students, who concurrently share the same instrumentation, but not necessarily the same experiment. The instrumentation is accessible in a sort of time sharing process, which is managed by a server and transparent to the user.

3. Multimedia technologies in a constructivist environment

Hypertext is considered by many researchers to facilitate human learning. Hypertext also mimics the way the brain works, by association. In educational process the students generally realized hypertexts or hypermedia on topics which they know (multimedia authoring). Their teachers control and give them all information to include in hypertext. Using this approach the role of the students is passive, because they transfer, on digital support, information furnished by the teachers. For this reason we have thought to control two groups of students that have researched, selected information, and produced an hypermedia on the Neural Networks (a subject which they didn't know before). The project "Learning by Doing and Creating" (LCD) has been developed in the Laboratory of System and Techniques of Transmission (3 hours in the week throughout the school year) in a high school (it is a technical institute) in Italy (specialization course in Information Technologies). We have controlled two different samples of students. The first sample (school year 1997 - 98), was composed from 15 students (aged 18 - 20), second group (school year 1998/99) was composed from 14 students (aged 18 - 20). We have proposed to the students a multiple choices test, before to start the project, to control their knowledge on the Neural Networks. The statistical analyses of the test have demonstrated that the students didn't know this subject. For this reason they were a reliable sample to study this "Learning by Doing" approach. After the students have created the hypermedia using the HTML language (with Java-Script procedures). In the final part of this educational research we have controlled the knowledge on Neural Networks of my students using multiple choices test, and we have proposed to the students a test to evaluate my contribution (e.g., information on my interaction with the classroom, my contribution to the project , and so forth). Results of this analysis have been encouraging, because 64% of the first sample and 75% of the second students have achieved the educational goals (Bloom's taxonomy), and our contribution to the project has been well evaluated. In the months of October and November, school year 1999/2000, we have chosen another sample of 15 students to explain the Neural Networks using the traditional educational methods (some lectures using blackboard and overhead projector). We have dedicated to this phase ten hours. Afterwards we have controlled the students' learning rate using a multiple choice test (the same of the other two samples), and we have compared the statistical data of the three different samples. It has been necessary to evaluate the effectiveness of the "Learning by Doing and Creating" (LDC) approach.

4. Conclusions

The use of multimedia solutions in degree level courses or in college has proved to be effective in several different fields. In the courses of Mathematics at the Academy of Architecture of Mendrisio the use of the multimedia technologies have allowed to study in depth the platonic solids, to apply to isometry and the perspective, to observe the fractal forms, to manipulate some virtual objects (e.g, virtual fullereni or platonic solids). The solution designed by the Politecnico of Torino, for the Electronic Measurement course, is an example of an integrated solution in which the theoretical part is made available through a hypermedia and the laboratory part can be carried out by accessing real instruments through a network connection. This solution can reduce the training cost on the electronic instrumentation. Third our experience is an example of "Learning by Doing" environment where some students build an educational hypermedia and they learn while build it; it is also cooperative environment. The final comparisons between the three samples have permitted to determine some important considerations on the use of the new media in a constructivist approach. In particular way, in the active role of the students. Some researchers have emphasized the active role learners must play in order to learn in hypertext-based learning environments (Spiro & Jehng, 1990). This approach is in agreement with Seymour Papert that says "Better learning will not come from finding better ways for the teacher to instruct but from giving the learner better opportunities to construct" (Papert, 1990, p.3). The students exhibited strong motivation in this multimedia development, and this is encouraging for the future application of multimedia technologies in educational process. Finally, it is important to remember that the teacher must be a facilitator in this cooperative learning environment, and not to fall into the trap of letting students totally "construct" their knowledge on their own. The teacher is still a very important resource and the computer is also a resource that will be used to help students in the acquisition of knowledge.

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Learning with Multimedia Technologies: some examples

Nicoletta Sala, University of Italian Switzerland ,

This work presents the results of three different educational experiences, which involve High Schools and Universities, where the multimedia technologies play a central role.

First experience is an example of the application of multimedia technologies to support the traditional educational methods. It has been developed for a first-year and a fourth-year undergraduate courses of Mathematics at the Academy of Architecture of Mendrisio, University of Italian Switzerland (Switzerland).

Second activity is an example where the multimedia technologies substitute the traditional tools (e.g. overhead projector or the blackboard) in the field of computer based training. Multimedia modules have been developed for a distance course to introduce the electronic instrumentation and the measurement techniques. Virtual instruments are implemented in order to allow simple simulations of the real instruments during the self-training phase A client-server system has been designed in order to allow the students to operate on a remote laboratory for experimental training.

Third activity is an example of the use of the multimedia technologies to develop a new learning environment which uses the constructivist approach and the cooperative learning in a High School (a technical Institute in Italy).

Differences in Learning with Multimedia vs Non-Multimedia Presentation Formats

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A national United States research study was conducted with college freshman students from five different university campuses in Northern California and Illinois. The research study included freshman students from California State University, the California Community College system, a private University offering undergraduate, graduate, and doctorate degrees, and a campus from the Illinois State University system, also offering undergraduate and graduate degrees (See Chart No. 1, Instrument and Media Development Process).

A flexible distance teaching project in higher education: Campus Extens

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The UIB began in 1997 a flexible distance teaching experience that incorporates the use of the telematics in the university teaching. Campus Extens widens and extends the facilities of the campus improving access to higher education, and to continually improve professional competence.

Developing technology-supported inquiry practices in two comprehensive school classrooms

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Abstract: There is indication that Computer Supported Collaborative Learning (CSCL) and accompanicd inquiry-based pedagogical practices can enhance student learning. The aim of this study is to experiment CSCL and inquiry-based approach in real classroom situations and to analyse students' approaches in inquiry process in terms of cognitive and motivational engagement. Two elementary school classes participated in the study. The one of them was lower elementary school class (21 students, age 10-11) who participated in CSCL inquiry in natural science and the other was upper elementary school class (18 students, age 13-14) who participated in CSCL inquiry in literature. The data consists of students' written computer notes, students' interviews, video -reported motivational orientations. The results indicate the possibilities of enhancing students learning in literature and in natural sciences by CSCL inquiries. However, the results also reveal failings in students' inquiries, e.g. dominance of superficial approach to inquiry.

Introduction

Computer Supported Collaborative Learning (CSCL) combines learning theoretical approaches that emphasise the meaning of individual knowledge processing and views that highlight the meaning of collaborative discourse in knowledge acquisition (Koschmann, 1996). CSCL seems to be one of the promising innovations to improve teaching and learning with advanced communication technology (Järvelä, Hakkarainen, Lipponen & Lehtinen, 2000). CSCL tools are usually accompanied with inquiry based pedagogical approaches to fulfil the ideas of individual and collaborative settings of learning (Roschelle & Pea, 1999). By participating in inquiries students can reach models from expert working cultures and learn in apprenticeship like manner (Glaser, 1991; Roschelle, 1996). Through inquiries students can improve their understanding of both the content and the scientific practices, which are essential skills for lifelong learning (Hakkarainen, 1998).

There is indication that CSCL can support students' learning cognitively by helping them to structure their activity and to reflect their actions in metalevel (Scardamalia & Bereiter, 1993). CSCL has also potentials in providing tools for organising, representing and visualising knowledge (e.g. Pea, Tinker, Linn, Means, Bransford, Roschelle, Hsi, Brophy, & Songer, 1999; Rochelle & Pea, 1999). Furthermore, by means of technology CSCL applications can offer embedded process supports and multiple resources for student learning (e.g Barron, Swartz, Vye, Moore, Petrosino, Zech, Bransford, & CTGV, 1998; Lin, Hmelo, Kinzer & Secules, 1999). In addition to cognitive benefits of CSCL, it is suggested that technology supported social interaction and collaborative learning could lead students to engage themselves in novel forms of knowledge construction (Koschmann, 1996; Dede, 1998). Successful collaboration involves mutual engagement and effort to solve problems together with collaborating participants (Dillenbourg, 1999). Collaborative learning situations afford multiple opportunities for students to create rich representations of problems and apply a variety of problem-solving strategies (Barron, 2000). CSCL can be a powerful tool in creating learning communities where students have a chance to collaboratively make representations, develop explanations of the subject studied and analyse knowledge (Scardamalia & Bereiter, 1993). Above cognitive and social potentials of CSCL, there is also indication of possible benefits to student motivation that it may offer. A study by Järvelä (1996) and Rahikainen, Järvelä & Salovaara (2000) suggest that CSCL might restructure elementary school students' motivational orientation among non-task-oriented students.

There are, however, at leas two caveats in implementation of technology-supported inquiry-based learning. First, there is a need for complementary empirical evidence of benefits of CSCL and inquiry-based activities. Many of the studies conducted in CSCL settings are based on short period of data collection and are implemented outside of real classroom situations. There are only few reports of broader dissemination of these novel practices (Roschelle & Pea, 1999). It is evident that more precise evidence of learning processes that involved in CSCL and inquiry situations is needed. For example, according to Rochelle & Pea (1999) collaborative processes are overemphasized, generalized, and their technology-specific features are not explicated enough. Second, CSCL practices need to be developed concurrently with pedagogical approaches so that technology, classroom activities and learning culture mutually support each other (Edelson, Gordin & Pea, 1999). It should be noted that students may not benefit from CSCL if they are not accustomed in the practices of new learning culture produced by CSCL and inquiry-based activities (Hakkarainen, Järvelä, Lipponen & Lehtinen, 1998).

Aims of the study

This work was motivated by a challenge to experiment CSCL and inquiry-based approach in real classroom situations and gather longitudinal experience in implementing collaborative inquiry culture to classroom. The aim is to examine students' approaches in CSCL-based inquiry process in terms of cognitive and motivational engagement.

Procedures and method

The study was participated by two elementary school classrooms. One of them was lower elementary classroom (n=21) where CSCL and inquiry-based approach was used in natural science lessons. The other was upper elementary classroom (n=18) where CSCL was used in literature lessons. Pedagogical approach in both classrooms was inquiry-based. Topics for learning projects were derived from general curriculum of science and literature. Basically, each class participated on 4-8 weeks learning projects three times. Students had project lessons 2-3 times a week. Teachers supported students' inquiries by instructing them when needed and presenting supporting activities.

CSCL tools, CSILE (Computer Supported Intentional Learning Environment) (Scardamalia & Bereiter, 1994), its' further developed version KnowledgeForum (http://csile.oise.utoronto.ca/) were used to help students to conduct their own investigations and to create forums for social knowledge construction. The environments support students' learning by providing tools for inquiry-based activities, discussion and knowledge production. Basically, they consist of empty hypermedia databases in which the students produce the contents. Student present their own research questions, intuitive working theories and new knowledge in the form of textual, graphical and discussion notes. The basic assumption is that all notes are open to the other members of learning community and all students have equal possibilities to participate to the activity. The applications contain tools for producing, storing, seeking, classifying and linking knowledge by text and graphic processing and discussion tools. Student learning is supported cognitively by helping them to articulate, explore and structure knowledge. Applications also include tools for generating discussion on the topics and possibilities for commenting each other's notes so that students, teachers and experts can collaboratively work with knowledge.

Student learning was examined by gathering data in general level by self-report questionnaires of student motivation, learning strategies and self-regulation. More specific data from CSCL situations consisted of on-line interviews, databases of students' postings and video recordings. The following table (Table 1.) presents an overview of the data collection in both experimental classrooms.

	1st project	2nd project	3rd project
Lower comprehensive school natural science class	- Self-reports - Computer database - Video recordings	- Self-reports - Computer database - Interviews - Video recordings	- Self-reports - Computer database - Interviews - Video recordings
Upper comprehensive school literature class	- Self-reports - Computer database - Interviews	- Self-reports - Computer database - Interviews - Video recordings	- Self-reports - Computer database - Interviews - Video recordings

Table 1. Data collection in experimental classrooms during the project

Student self-reports that included several sub scales were analysed in order to reveal students' general motivational tendencies (Niemivirta, 1996). Following a pattern-oriented approach in studying individual differences in motivation, the students in both studies were grouped by using a K-means cluster analysis into four different groups emphasising different goal orientation, means-ends beliefs and learning strategy use.

Students' actual situational behaviours were examined by database, interviews and video analyses. The content of databases was analysed according to principles of content analysis (Chi, 1997). The categories were based on earlier studies conducted in CSCL settings (e.g. Lipponen & Hakkarainen, 1997; Lipponen, 2000). The videotaped lessons were analysed by drawing a time-line diagram with on-task and off-task dimensions and interaction phases with the teacher and the other students (Rahikainen et al., 1999). This procedure enabled to make a profile of different students' activities as well as to see what were the patterns that formed the whole learning process. Videos were also used to provide authentic case examples of students' situation-specific behaviours during inquiry-based CSCL activities. The interviews were used to provide students' own situation-specific interpretations. Interview transcripts were also analysed by content analyses although the categories were based on motivational and self-regulatory constructs. In the following results are reported by integrating evidence derived from different analyses.

Results – Development of inquiry-based CSCL culture

Students' cognitive approaches in the process of inquiry

The results indicate slight dominance of superficial approach to inquiry especially among the upper elementary school students. Literature class students produced, in all, 367 notes with an average 20.39 ($SD = 9.38$) notes per student. On the contrary, in the natural science class all students participated to some extent and produced, in all, 662 notes with an average 31.52 ($SD = 10.22$) notes per a student. The quality of driving question that students phrase in the beginning of inquiry process is crucial to learning (see Hakkarainen, 1998). Particularly in literature class the driving questions that students formulated in the beginning of the learning projects were not complex enough to generate deep inquiries. The results derived from upper elementary school literature class show that 79.6% of the research questions were fact-oriented and only 20.4% of the questions were explanation seeking in nature. Accordingly, information that students wrote to the literature databases in order to provide an answer to research question failed in its purpose in terms of coherency, quality or information value. Only 8.7% of the noted labelled as new knowledge were student-generated explanations that presented a conceptually coherent explanation related to the research question. 91.3% of the inquiry notes included surface-level information. In science class, the quality of the information posted was slightly deeper: 51 % of the questions were explanation oriented. In both classes there were, however, substantial individual differences in the participation rates. In science five students were the most active participants in the class, and wrote 41 to 51 notes, whereas the most non-active participant wrote only 15 notes. In literature most there were only four students who wrote over 30 notes and two most non-active students who wrote only 8 notes. Reasons for uneven participation can be examined by looking students' motivational profiles

Students motivational approaches in CSCL- based inquiries

The results indicate that students' self-reported preference for certain type of motivational orientation clearly corresponded to their actual engagement in a novel learning environment. This is seen for example in video analyses from lower elementary school biology class. A selection of the videotapes was analysed by drawing a time-line diagram with on-task-off-task dimensions (Rahikainen, 1999). The results show that the learning oriented students' off-tasks periods were minor and they generally involved in progressive knowledge building process. There were two major findings concerning the non-learning oriented students. Firstly, a part of the non-learning oriented students indicated progressive motivation: episodes of high task-involvement and progressive knowledge building processes. However, the other non-learning oriented students created only few meaningful notes and their motivational coping was regressive. The video-data showed that the non-learning oriented students had difficulties to cope with the demands of a knowledge building procedure. However, it was possible to notice that even the extreme cases of non-learning oriented students accepted the working procedures involved in progressive inquiry, even if it was extremely slowly. That is to say that there is minor indication that working with CSCL project may cause qualitative changes in students' motivational interpretations. The novel instructional setting seemed to encourage some students to abandon behavioral patterns that might be expected in basis of their self-reported motivational orientation. There were students who presented clearly different strategic patterns of inquiry and engagement on knowledge construction discussion in different projects. The interview data provides possible explanations for students' context specific motivational coping behaviours. Students expressed factors that may have cause qualitative modifications in their motivational and cognitive approaches in different projects. These were such as task interest, cognitive demands of the environment (e.g. demands for self-regulative actions), and novel cognitive possibilities provided by the CSCL environments (distributed knowledge building processes) and a change of a classroom culture.

The potentials of collaborative knowledge construction discussion

Whereas the student inquiry notes referred to superficial engagement on inquiry the results indicate evident benefits of the collaborative knowledge construction discussion. Almost 69 % of the students' comments were relevant to the inquiry process in science class. In literature class 88.4% of the comments were related to the content of the learning. Students evidently developed practices of commenting each other's work and thereby developed collaborative knowledge building practices. Furthermore, the interviews indicate that students were aware of the possible benefits of collaborative work. The following excerpt presents an example of this.

> INT: Could you please describe how did you work with other students in this project?
> STU: Well, we commented each other's work in CSILE.
> INT: Why was that?
> STU: They provided me some new ideas.
> INT: What kind of ideas?
> STU: Well, for example some suggestions what I could do next.

The analysis of the computer notes collected from the projects showed that there were some unique discussions in databases in which students asked questions from each other and collaboratively created explanations of the phenomena under investigation. The following excerpt from the upper elementary literature class presents an example of students' collaborative knowledge construction activity in the CSILE environment.

> ANNA: Where does time come from?
> ANTTI: It comes from a clock!!!!
> HEIDI Time comes from sun.
> ANTTI: As far as I know sun is not in a clock!!! What do you mead by saying that time comes form sun? It would mean that when the sun explodes the time stops.
> LAURA: How is it possible that the sun would explode?
> ANNA: How does the time come from the sun? Why? Does it not come from a clock? If the time does not come from a clock, where does it come from? How does the time come to the clock? From the sun or from where?
> HEIDI:- People make clocks. Don't ask me how, ask a clockmaker. Let's assume that all the clocks on the earth would be broken. Does the time stop? No.

HEIDI: When the earth goes one time around the sun, it is a year. When the moon goes one time around the earth, it is a month. When the earth rotates once round its axis, it is a day. Do you understand? The time does not come from a clock, time is only measured by a clock.
ANNA: The most common conception is that time comes from a clock. But how does the time come to the clock? From the sun, I was told. Log time ago the calendar was developed and it is still used. I think that the calendar can be explained like this: The earth goes around the sun once and it is a year. The moon goes around the earth once and it is a month. When the earth rotates once around its axis, it is a day. It become clear to me that the exact length of a moon year is 354 3/8 days. It corresponds so called full rotation of the sun from a spring equinox to another spring equinox. The almost recurrence of natural phenomena creates a base for calendar and thereby so-called astronomic chronology is developed. --- But would the time stop or end if the sun would explode. Let's assume that time comes from a clock. If all clocks on the earth would be broken at once, would the time stop? NO. Time can't stop.

Progressive discourse, which comes from science tradition, can be seen as a core of knowledge building (e.g. Chan, Burtis & Bereiter, 1997). This example illustrated how the students participating in this study collaboratively processed an explanation of time, constructed a representation and advanced in explaining the phenomena. Building knowledge requires the students to consciously confront their previous knowledge and the possible misconceptions, and develop more coherent and examined explanations by considering the new evidence presented in the learning situation. Bereiter (2001) sees that scientific progress is not a matter of getting closer to the truth but a matter of improving existing knowledge. As characteristic to progressive discourse, the students mutually advanced in understanding and reflected upon the problem openly. The overall focus of the progressive discourse is on pursuing understanding and on seeing knowledge as problematic and something that needs to be explained.

Conclusions

The results of this study indicate the possibilities of enhancing students learning in literature and in natural sciences by CSCL inquiries. The research is in progress, but it can be stated that students need help in planning and conducting their own CSCL inquiries. Students should be advised to consider the information value and objectivity of the data or information that they use in their inquiries and to construct more coherent explanations to their inquiry questions. It is also evident that inquiry based approaches should be tailored specifically by considering the nature of the subject matter. Inquiry-based learning is generally considered to be an appropriate way of learning science, and it is frequently used in studying physics, chemistry or biology. However, there are not so many studies in which the inquiry-based learning would have been used in teaching social sciences or humanities, such as literature. From a curricular point of view, the challenge seems to be in finding meaningful connections between subject matter specific curriculum and inquiry practices that create possibilities to students to get close to expert working cultures. In next phases of this study it is essential to examine students long-term adaptation to the pedagogical culture of CSCL.

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Anthropology 491: Teaching an on-line laboratory course.

Abstract

This paper presents a review of an upper division class on archaeological stone tool analysis. The goal of the course is to recreate the objectives, resources, and outcomes required of a typical laboratory analysis class, but in a completely on-line context. The on-line class components include syllabus, supporting material, specific lessons (with goals, objectives, and projects), and links to on-line research. Students access quizzes and exams, chatrooms, and bulletin boards, and are required to submit the results of their analyses, including data tables and digital images on-line to the instructor. The "text" for the class is a CD-ROM, *Digital Stones*. Compelling elements of the class are (1) the attempt to create a laboratory class on-line that will be available to any student around the world and (2) the invitation to recognized experts in the field to discuss their research live with the students in chatrooms. Problems encountered during the initial offering of the class included: working with the university bureaucracy, overestimating the students' self-discipline and motivation, time zone differences between Idaho and our international students and invited guests, and the computer literacy of both the students and guests.

Introduction

This paper presents a review of Anthropology 491, an archaeological stone tool analysis class for upper undergraduates and graduate students. The goal of the course is to recreate the objectives, resources, and outcomes required of a typical laboratory analysis class, but to do so in a completely on-line context. The "text" for the class is a CD-ROM, *Digital Stones* (Lohse and Sammons, 1998), in which the analytical system, terminology, and history of research are presented in a multibranching format. Line drawings, digital photographs, microscopic views, and videos provide visual references for the text. Portions of the CD-ROM have been converted to HTML format so that they may be viewed over the World Wide Web. The on-line course includes syllabus, supporting material, specific lessons (with goals, objectives, and projects), and links to relevant on-line articles and research. Most of these are available to anyone. Registered students may also access the quizzes and exams, chatrooms, and bulletin boards; these students are also required to submit the results of their analyses, including data tables and digital images on-line to the instructor. Compelling elements of the class are (1) the attempt to create a laboratory class on-line that will be available to any student around the world and (2) the invitation to recognized experts in the field to discuss their research live with the students in chatrooms. Experts from England, the United States, and Australia came into the chatroom for two-hours sessions with the students. Problems encountered during the initial offering of the class included: working with the university bureaucracy, overestimating the students' self-discipline and motivation, time zone differences between Idaho and our international students and invited guests, and the computer literacy of both the students and guests.

Overview of Anthropology 491

Many universities are offering on-line archaeology courses as part of national and international trends to deliver instruction over the Internet. Most of these courses supplement traditional lecture or laboratory instruction with syllabi, class notes, exercises, assigned readings, chatrooms, and email contact with the instruction. While these classes make effective use of electronic resources, their primary role is to support traditional classroom instruction, rather than to replace it. Virtual classrooms allow students to use their own initiative, proceed at their own pace, and to move through the content as quickly as their own motivation and the academic infrastructure will allow.

In Anthropology 491, many of the supporting elements of a web class were present: syllabi, lessons, exercises, assignments, readings, and links. Because this is a laboratory analysis class, however, there were significant differences between this and other web-supplemented classes. First, the students' text was the *Digital Stones* CD-ROM, which demonstrated the concepts, terms, and research of stone tool analysis through text, images, and video. Secondly, recognized experts in the field of archaeological stone tool analysis were invited to discuss their research with the students. Researchers from England, the United States, and Australia joined us and the students for two-hour sessions in the chatroom. Prior to the chats, the researchers also linked us to, or allowed us to post, their current research. Some of this research represented work-in-progress, and so our students had the unique opportunity to review and discuss leading edge research with the researchers themselves. Finally, a third unique element of the class was the assessment of the students' mastery of the concepts. Two forms of assessment were used. On-line quizzes and examinations were required, using WebCT's course tools. Students were also required to create and use stone tools at their home sites, perform certain analyses (described and outlined on both the CD and the course lessons), and then post the results of their analyses as data and images back to the instructor.

Instructional Issues

The creation of the *Digital Stones* CD incorporated several issues, including instructional design, content, authoring, and dissemination. *Digital Stones* was designed in accordance with standard procedures of instructional design (Kemp, et al., 1996). Instructional design model encompass many steps, including assessing the needs and characteristics of the learners, identifying specific tasks which the learners must perform, stating the objectives of the instruction, sequencing the instruction, and evaluation.

The pedagogical issues faced during the creation of *Digital Stones* have been fully described in a paper presented at the Computer Applications in Archaeology conference (Lohse and Sammons 1999). The impetus for creating the CD was our assessment of our learners, their needs, the learning context, and our own needs to train competent stone tool analysts in an environment which had limited facilities for students to perform replicative experiments. Therefore, we determined to create a multimedia, multibranching resource that would allow students to review the analytical system (Lohse, 1998) while simultaneously encountering terms and visual examples of the analytical variables. For example, if the analytical system required a student to identify "polish" on a stone tool (which may indicate that the tool has been used to scrape soft leather), then the CD allows the student to click on the "polish" field of the data table, read the definition, and zoom in on macro and micro views of polish.

The pedagogical issues influenced our design decisions, including the development of different topical sections, the choice between line drawings or digital images, the number and look of buttons or hyperlinks, and the use of fonts, animation, sound, and movies. And, in the dynamic process which is multimedia development, authoring issues influenced and were influenced by the design decisions. For example, Macromedia Director 6.5, in which the CD was created, did not support hypertexting and we had to devise a way around the problem. Our solution was to color code words or figure references in the text to signal the user that more information could be found in the Glossary or Figures buttons. These buttons opened new windows, such as the Glossary window, through which the user could scroll until the desired information was located. This was an awkward but workable compromise to the lack of hypertext ability (hypertext is easier to create in the current version, Macromedia Director 8.0).

The choice of Macromedia Director as our authoring tool also influenced delivery of *Digital Stones*, especially its conversion to a web-based format. Although current versions of Director will convert to a Shockwave movie or other web format more easily, at the time, conversion would have required more time and resources than were available. Therefore, for Anthropology 491,the *Digital Stones* CD was required as a separate text, rather than made available on-line.

Anthropology 491 was designed as an advanced, in-depth overview of research in stone tool manufacture and use. Theory and method were integrated into a hands-on approach that emphasized completion of projects, data compilation and synthesis. Course structure included a front-end menu with links to the introduction, suggested reading lists, lesson plans, hands-on exercises, chatrooms, bulletin boards, exams, email (to the instructor and the web wizard), the glossary, and lists of upcoming conferences.

Formative Evaluation

Anthropology 491 in its first year was a success on many levels. Several problems were encountered which must be resolved before the class can be offered to off-campus students consistently. An early problem was dealing with the University bureaucracy. Like many institutions just extending into electronic offerings, the University was not equipped to deal with normal functions (such as student registration) outside of its normal range. Off-campus students were required to pay several fees (including out-of-state tuition) even though they were not using University facilities for the class. Additionally, the University only registers students at the beginning of each semester. Although an on-line course theoretically is set to the student's pace, beginning with the student's interest and ending with their completion of course requirements, the University is set up for courses to begin and end with the semester. It was extremely difficult to register students who wished to enter the class after the semester's starting date.

The students themselves posed several problems. Some did not have the requisite computer literacy to navigate through the course requirements easily. Several weeks at the beginning were spent in remediation; a better solution would have been to require computer literacy as a prerequisite. A second problem was a universal one with students: their tendency to leave things to the last minute. For some students, "at their own pace" meant that all assignments would be completed during the last week of class. The solution we have determined will be to require certain assignments at certain times.

However, most aspects of the class were very successful. The WebCT program provided us with an environment that allowed students to access the class materials, quizzes, chats, and email easily. Quizzes and tests could be taken without involving a proctor or assistant.

The chatroom, once the students mastered the technique, was the most successful and important elements of the class. Several stone tool analysts, known throughout the archaeological world for their research in stone tool manufacture and use, agreed to participate in the chatroom with the students. These researchers logged on to the chat from England, the United States and Australia, with a different researcher joining us each week. Their current research (published and unpublished) was posted or linked to the Anthropology 491 site for the students to read prior to the chat. Once both students and guests were comfortable using the chatroom, several excellent discussions ensued. The gracious participation of these researchers was a unique resource for our students: it took very little of the experts time, yet allowed them to share their knowledge with students who ordinarily would not have had this opportunity.

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EM^2 - an Educational Meta-data Management tool

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Abstract. This paper presents EM^2,a tool for managing educational meta-data. EM^2 facilitates, through a user-friendly graphical user interface, the creation of new, and the modification of existing XML-based educational meta-data files, which can be based on any specification/standard, or user-defined set of educational meta-data.

Introduction

The rapid evolution of information and telecommunication technologies facilitate mouse-click access to enormous knowledge repositories and educational resources, unconstrained from time, location, etc. The full exploitation of this mass body of knowledge - which is continuously and exponentially expanding - is being, however, limited by a number of barriers, including the difficulty in describing, classifying and maintaining these knowledge sources in such a way that they can be searched, identified and retrieved in an "educationally efficient and effective way" (Karagiannidis, et al, 2001; Wiley 2000).

In this context, a number of international efforts have been initiated during the past few years, aiming to define educational meta-data sets for the common description of educational resources. These specifications and standards include fields that are considered necessary for the description of educational resources - such as the type of the resource (i.e. whether it is an experiment, simulation, questionnaire, assessment, etc), the target learner age, difficulty level, estimated learning time, etc - as opposed to "general purpose" meta-data specifications and standards (e.g. the Dublin Core, http://purl.org/dc), or those that have been developed for different fields of knowledge (e.g. geo-spatial meta-data standards, http://badger.state.wi.us/agencies/wlib/sco/metatool/mtools.htm). The most well-known educational meta-data specifications are produced by organisations and committees such as the IEEE LTSC (Learning Technologies Standardisation Committee, http://ltsc.ieee.org), the IMS (Instructional Management Systems Project, http://www.imsproject.org), the CEN/ISSS LTW (Learning Technologies Workshop, http://www.cenorm.be/isss/Workshop/lt/Default.htm), ARIADNE (Alliance Remote Instructional Authoring and Distribution Networks for Europe, http://ariadne.unil.ch/Metadata), etc (Bacsich et al, 1999; Bourda & Helier, 2000).

At the same time, a number of software tools are being developed for the effective and efficient management of educational meta-data. *Meta-data Editors* is one such category, including tools which are mainly used for the creation of new meta-data files. Meta-data editors usually provide a graphical user interface for entering values in the meta-data fields, and save meta-data files in different formats; examples of meta-data editors include the Reggie Meta-Data Editor, the Dublin Core Meta-data Editor Template, the META Builder, the DIF-Writing Tool, etc. *Meta-data Generators* is another category of educational meta-data management tools, which can automatically create meta-data files for selected educational resources. The automatic generation of meta-data is usually based on the frequency of different words in an educational resource, or in the heading of the resource, etc; examples of meta-data generators include DC-dot, Klarity Software Program, etc; more information on meta-data editors and meta-data generators can be found at http://www.ifla.org/II/metadata.htm. Finally, there a number of tools which can support several different features which fall into more than one of the above categories - one example tool that falls in this category is the Intraleaf tool - http://www.interleaf.com (Day, 1999; Greenberg, 2000). These tools can, in principle, employ different formats for the representation of educational meta-data, however, the most common format that emerges as a standard in this field is the XML format - http://www.w3.org/XML/.

This paper presents EM^2, a tool for management educational meta-data files. The EM^2 tool can be used by ***educational content authors***, to describe their content so that it can be easily searched and retrieved; by ***tutors***, to describe a pool of educational resources, as well as their relationships, so that their students can easily search and retrieve them; by ***publishers***, to describe their educational resources (including copyright and cost), so that they can be easily be searched and retrieved by their customers; by ***Vertical Learning Portal (VLP) administrators***, for describing the educational resources including in the VLP, so that it can be effectively retrieved by VLP users; etc.

The next section presents the functionality of the EM^2 tool, and exemplifies its use by the above main target user categories.

The EM^2 Tool

The EM^2 tool facilitates the creation of new, and the modification of existing XML-based educational meta-data files, through a user-friendly, graphical user interface. The initial screen of the EM^2 tool is shown in Figure 1, and the description of the EM^2 functionality is provided in the following paragraphs.

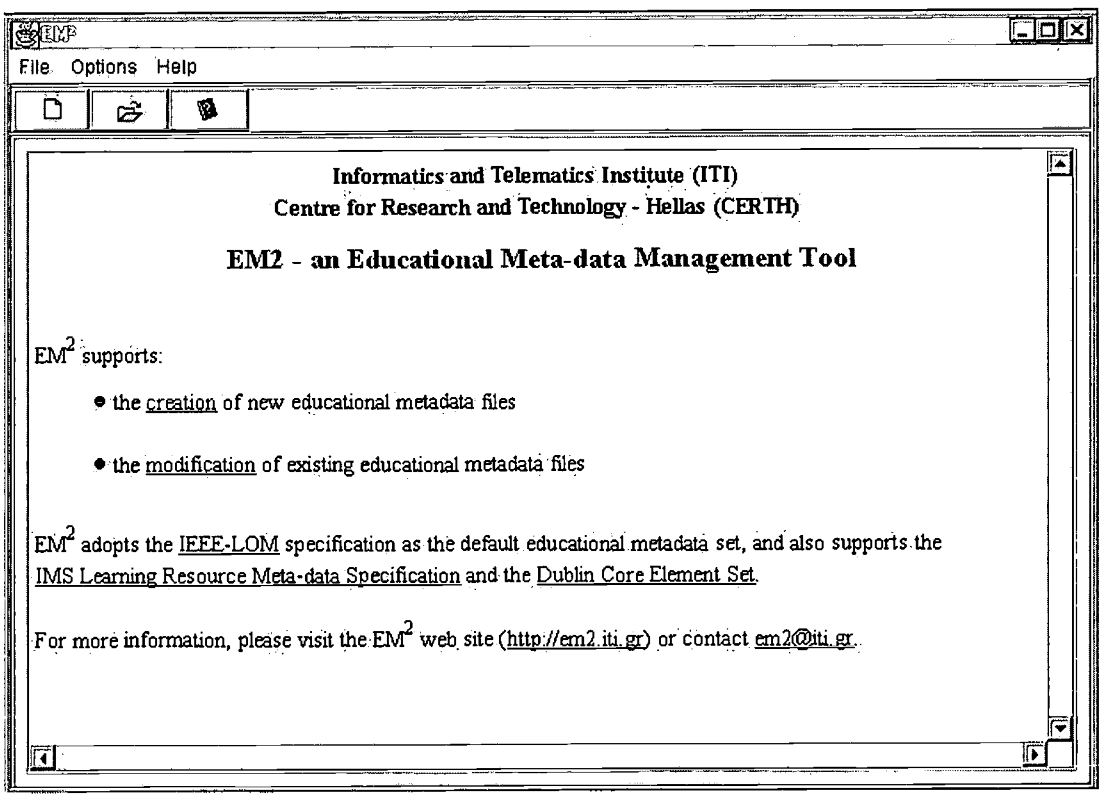

Figure 1: EM^2 initial screen

Creation of new Meta-Data Files

For each educational resource, the user can create a new educational meta-data XML file for describing its content. For example, an author of an educational resource (e.g. a textbook) can use the EM^2 tool for creating an XML meta-data file which describes this book, and upload it on a public repository, so that learners can search, identify and retrieve it. The author can define which is the content of the book, the date of publication, the target learners, level of difficulty, etc.

EM^2 enables the user to define / select the educational meta-data set that will be used for the description of the educational resource. Currently, EM^2 supports IEEE LOM as the default specification, which appears to be the most widely adopted specification. In addition, EM^2 supports the IMS Learning Resource Meta-Data Specification (basically identical to IEEE LOM, categorising elements into "Core" and "Standard Extension Library"), and the Dublin Core Element Set (which, as mentioned earlier, is more generic, and applicable to different domains).

Subsequently, the user can enter values in the fields of the selected meta-data set. EM^2 presents at the left-hand side of the screen the tree representation of the selected meta-data set. For each meta-data field, EM^2 uses a different visual notation (colour, fonts, highlighting, etc), depending on whether the respective field belongs to the core or the extended set of the IMS specification, and whether the user has already inserted values in the respective field. Similarly, at the right-hand side of the screen the respective fields of the meta-data set are displayed (see Figure 2).

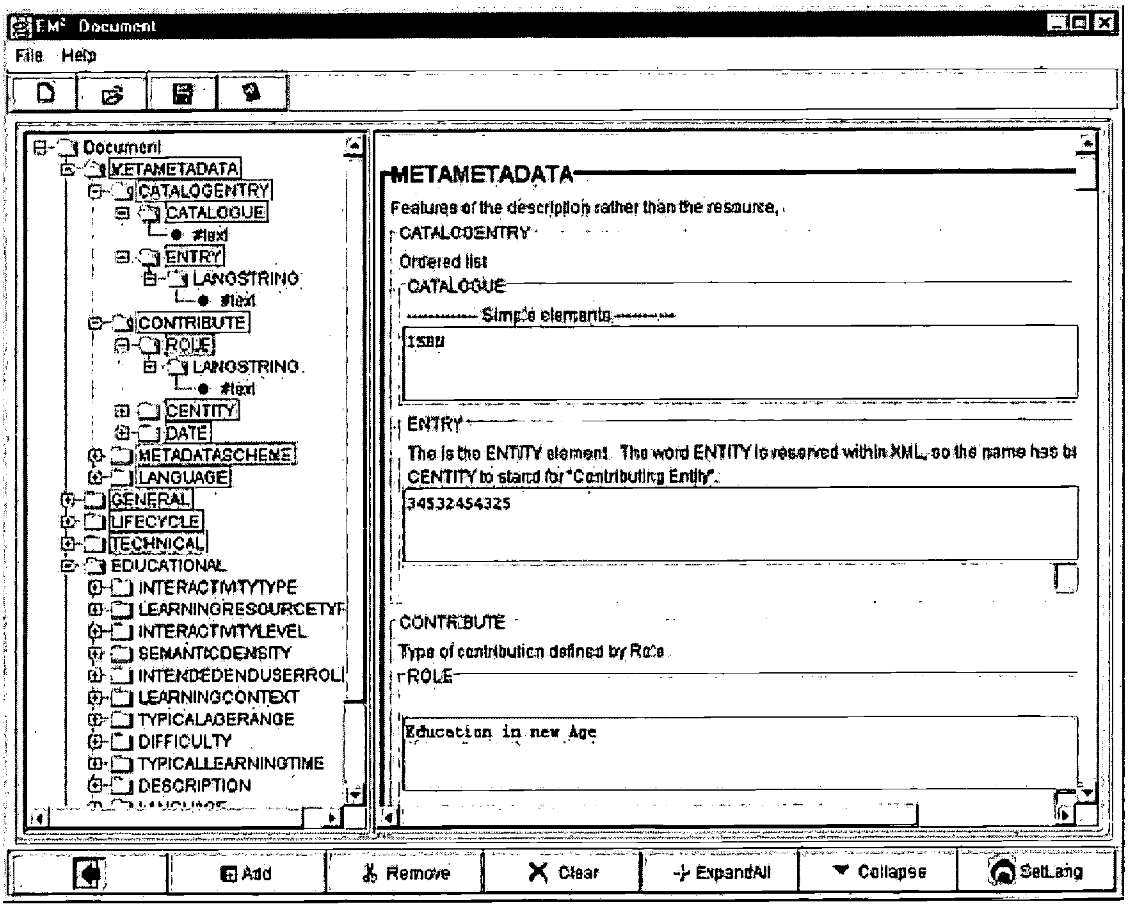

Figure 2: EM^2 tree representation of educational meta-data

Modification of Existing Meta-Data Files

Along the same lines, the user can modify an existing educational meta-data XML file, which has either been created through EM^2, or by any other educational meta-data management tool. After the user specifies a filename, the same representation described above is being displayed, and the user can modify the meta-data set, as well as the respective values, and then save the modified file. For example, after authors have created meta-data files for describing their content, the on-line publisher of this material can modify the description of each educational resource, adding, for example, information about cost, copyright issues, etc.

Modification of Meta-Data Set

In both of the above cases, the user can also define a new educational meta-data set. In particular, the user can add new fields in each node of the meta-data set, or remove existing fields. Subsequently, the user can save the modified educational meta-data set with a different name, so that it can be used in subsequent phases.

For example, the content administrator of a Vertical Knowledge Portal which is targeted to a specific country can add a new meta-data field, describing the specific secondary level grade of the respective National Curriculum that the resource is appropriate for. Then, the administrator can specify the range of values that are valid for this field (e.g. for the Greek National Curriculum, grade 1-6), and subsequently save the modified set of educational meta-data with a different name for future use.

Additional Features

EM^2 provides a set of additional features which aim to assist the user in the management of meta-data files, as well as improve the interaction with the system, including:

(i) *expand/collapse meta-data set tree*: the user can expand the tree representing the meta-data set and make all nodes and leaves visible, or select that only "level 1" nodes are visible

(ii) *add/remove field*: the user can add a new, or remove an existing field in the meta-data set; for these specific cases, EM^2 requires that the user confirms these actions, since they modify the meta-data set that is used for the description of the educational resource (e.g., it may result in the file not being "IEEE LOM-compliant" anymore)

(iii) *view values*: for the fields that are included in standard educational meta-data sets (e.g. the IEEE LOM), EM^2 displays the list of proposed values that are appropriate for this field, when available; for example, the IEEE LOM specification proposes that the value for the "difficulty level" field is in the range 0-4; the EM^2 tool displays these values so that the user can select among them

(iv) *define default language*: the user can define the default language that is to be used for the description of all meta-data fields

(v) *options*: the user can select and modify a number of attributes of the visual presentation of the tool, such as the general look-and-feel (selecting between standard windows and Java look-and-feel), the visual characteristics of the different fields of the meta-data set (e.g. how the core elements of the IMS specification should be displayed, etc)

Discussion and Conclusions

Educational meta-data can significantly improve the effectiveness and efficiency of the description, search and retrieval of educational resources available at the Internet, and educational meta-data management tools are, in turn attracting considerable attention worldwide.

This paper has presented EM^2, an educational meta-data management environment, which facilitates, through a user-friendly graphical user interface, the creation of new, and the modification of existing XML-based educational meta-data files. EM^2 also enables the user to define alternative educational meta-data sets, thus the tool can be easily customised and used with different meta-data sets which could emerge in the future.

EM^2 facilitates the creation of educational meta-data files, which can describe the educational resources available from educational organisations, educational content providers, etc, so that these resources can be easily described, searched and retrieved either by "general-purpose" search engines, or by dedicated educational applications.

The EM^2 tool will be used by a number of European R&D Projects in the field of Learning Technologies for Education and Training. It has been developed within the context of the IST No 12503 Project "KOD - Knowledge on Demand" for the description of the educational resources, so that the KOD system can determine which resources are appropriate for a specific learner. In addition, EM^2 will be used by the 3DE "Design, Development, and Delivery Electronic Environment for Educational MultiMedia" IST project (www.3deproject.com). The 3DE project aims to develop a methodology for the design, building and delivery of courses which can be customised to the needs of different learners; again, EM^2 will be used for the description of educational resources, so that it can be determined whether each resource is suitable to be included in the course developed for a specific learner.

Our current and future work in this field involve a number of extensions to the EM^2 tool. Our aim is that EM^2 will form the basis for the development of an integrated educational meta-data management environment, which will provide added-value services for the management and administration of Vertical Learning Portals (VLPs). This environment will support a number of features which are considered necessary for educational meta-data management, apart from the creation of new and modification of existing educational meta-data files, including:

(i) validation of meta-data information
(ii) creation of *new* meta-data specifications for specific requirements (e.g. extending existing specifications for including additional fields which are necessary for a specific application)
(iii) support of different meta-data technologies, i.e. managing educational meta-data files which have been created by different tools
(iv) mapping of educational meta-data files between different specifications/standards
(v) manipulation of *sets* of educational meta-data files; for example, supporting the task of inserting a value for the "author" field to many educational meta-data files together; or to modify the description of a set of educational meta-data files, e.g. the files which include the same value for the "author" field; etc.

To this end, we have already proposed a architecture for supporting the above features (Papaioannou, et al, 2001), and we are currently working on the implementation of this architecture towards the development of a full educational meta-data management environment.

Acknowledgements

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More information about the EM^2 tool can be found at http://em2.iti.gr.

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Information and Knowledge Society: An interdisciplinary and International PhD Programme through Internet

Teresa Sancho, UOC, Spain; Eduard Aibar, UOC, Spain

The UOC started its first PhD Programme on the Information and Knowledge Society last October. This programme offers a systematic approach both to the impact of Information and Communication Technologies (ICT) on the different social spheres and to the global transformations which occur alongside the current emergence of an information and knowledge society.

Learner Led Learning: The case of Business-to-Business Marketing

Sicco santema, delft Univ. of Technology, the Netherlands; Ralph Genang, Delft Univ. of Technology, The Netherlands

In this case study we described the process of getting to a digital classroom around the B2B-marketing classes within the Delft University of Technology.

Experiences upto 2000:

1. Interaction with the teacher via E-Mail outside the classroom
2. Integration of video in the classroom
3. Use of real media (including first life course on the internet in the Netherlands)
4. Division of the book into 100 bodies of knowledge, each supported by video, text, PowerPoint, links to other universities etc.
5. Generate questions
6. Change FAQ lists into FGA list (and use them)

All steps truly improved the learning results and the learning habits of learners.

Announcement:

Join our experiments.

SYSTEMATIC PLANNING FOR ONLINE TEACHING TO SUPPORT FACULTY'S NEW ROLE

Rowena Santiago, California State University San Bernardino, USA

Faculty faces many questions and issues as they embark to do online teaching. Faculty development centers are also faced with the task of supporting faculty's new role as online teachers. To address these issues, the Teaching Resource Center (TRC) of California State University San Bernardino (CSUSB) developed an overall plan that identifies the major steps involved in course development as applied to online teaching. This systematic and holistic plan serves both as the map and the glue that holds the various phases and players together. It can be a useful tool to both individual faculty and a faculty development center. This presentation will feature this systematic plan and will also summarize, in the form of a checklist, the instructional and non-instructional issues that need to be addressed to do online teaching. Finally, it will present results of a survey that evaluated faculty and student experiences with online courses.

Students' Assessment in Computer-Supported Cooperative Project-Based Learning Environments

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Abstract: Computer-supported cooperative learning (CSCL) environments arise as one of the most powerful Internet-based applications. Moreover, CSCL holds many-sided features, and its classroom use faces problems. To solve reported problems, we built a model of cooperation, expressed as process patterns and we have developed a pedagogical and computational infrastructure to support project-based cooperative learning. In this paper, the assessment in CSCL environment is discussed, in order to establish the appropriate background to describe the procedures presented in the infrastructure.

Introduction

In the last few years, the Internet has become the most up-to-date way of structuring innovative educational settings. In this scenario, Computer-Supported Cooperative Learning (CSCL) has experienced rapid growth. The analysis of CSCL area shows that there are few references to individual and group assessment in this kind of environment. Moreover, to assess students' performance is an important component of the learning process.

The primary purpose of assessment is to improve the student's learning (Taylor and Maor, 2000). Practices, in agreement with learning goals, curriculum, instruction, and the students' knowledge level, should be employed to provide information about goal achievement and students' progress. Good educators assess the student progress through such methods as structured and informal observation and interviews, projects, tasks, tests and experiments. In face-to-face approaches, assessing students is not an easy task. In computer-based environments, it is even more complex. Traditional apparatus, such as mastering learning and criterion-referenced measurement, do not seem to be good approaches for assessing students in CSCL environments. The mastery of learning is a systematic approach to instruction based on students' performance on a pre-specified criterion level in a given unit of instruction before moving to the next unit. Cooperative learning settings usually do not deal with a rigid unit of instruction. Criterion-referenced measurements are techniques for determining the mastery of learning a pre-specified content. Not always are the intended goals in virtual environments closely related with the achievement of individual mastery of specified contents.

Dochy (1992, in www1) proposed an assessment model initially conceptualized for distance education, but it can also be suitable for assessment in CSCL environments. The model aims at integrating formal and informal assessment, and learning. It comes in five steps: (1) learners start by stating their learning goals; (2) learners prior knowledge state is estimated; (3) after having taken a pre-test, learning goals can be redefined; (4) learners can begin with the appropriate learning tasks; and (5) during the learning process, learners frequently take tests to check learning progress in order to see if additional guidance is needed, and to determine subsequent learning tasks.

The model suggests that cooperative learning tasks carried out on CSCL environments can be enhanced via formative assessment. This assessment is conducted during learning activities to appraise the students' learning progress, to identify goals, which have not been met, and to ascertain whether students have enough prior knowledge to cope with subsequent stages of a particular learning subject.

On the other hand, many educators have embraced Internet communication tools like listservs, e-mail, newsgroups, and real-time chat programs for their apparent potential to enhance, record and assess traditional classroom activities. Specifically, the use of these tools is believed to enrich the three major activities of all teachers: to counsel students individually, to deliver information, and to encourage classroom discussion. (Bennett, 2000). Online assessment became a promised and a controversial point. Although the most common uses of online technologies are for communication and assignment submission via email, there is an increasing adoption of structured online assessment processes (O'Reilly, 2000). These include group discussions to support individual assignment preparation, collaboration in a common project or presentation, peer-review and self-review, and problem-based approaches to cases and scenarios, to name just a few.

We designed a pedagogical and computational infrastructure in the domain of cooperative project-based learning, starting from the hypothesis that CSCL environment designers do not know how to handle the educational domain and teachers do not know how to handle computational technologies. Moreover, they need a flexible environment, allowing them to figure out different cooperative projects according to their pedagogical viewpoint, concerning individual student and group specific characteristics. The infrastructure offers a cooperative work environment and a tool framework. Within the cooperative environment, teachers can define cooperative educational processes, and students can carry out group activities supported by tailored tools. From this background, the article aims at describing how students' assessment is understood and supported in our infrastructure. With this purpose, the next section discusses the assessment process in CSCL environments. Section 3 describes our infrastructure and outlines its assessment procedures and instruments. The last section presents the conclusions and future works.

Assessment in an Infrastructure for Cooperative Project-based Learning Environments

The infrastructure was designed to allow teachers to determine the main aspects involved in cooperative teaching and learning activities. Therefore, we first determine a domain for carrying on cooperative tasks - the domain of cooperative project-based learning. Next, we modeled cooperation. The model embraces problems and their solutions in the form of a system of process and design patterns. According to our model, the main issues involved in cooperation are mediated by Culture, Stimulus and learning Context, which in turn depend on the available Technology. Culture, Stimulus and Context strongly stress the educational Objectives and the collaborative Process. Learning Theories, Previous Knowledge, Cultural Aspects and Collaboration Forms influence the educational Objective. A Collaborative Process is related to Activities, Roles, Coordination, Group Memory, Awareness and Learning Assessment. For details, see Santoro, Borges e Santos (2000a, 2000b). The model works as a repository of software components and theoretical and practice guidelines. The system of patterns provided useful requirements to the development of the infrastructure components (Fig. 1). It embodies a cooperative environment, a project database, a reference library, support for students' assessment and a framework of tools. The cooperative environment is the student and teacher's workplace, and is the starting point for planning and executing project activities. The environment is based on a client-server architecture, which accesses two centralized databases. The server side is represented by the Project Server, which activates secondary servers, and maintains the project database, composed of documents related to the projects, and the reference library, composed of consulting documents. The secondary servers are responsible for the services available within the infrastructure.

The Process Server is responsible for the execution of the process, working as a kind of workflow machine. An editing tool is necessary to design the cooperation processes. The tool adopts symbols and conventions that might represent all process important components: activities, roles, agents, flow, rules, descriptions, and how these components are linked. The process server interprets the symbols, discharges the execution of the process in the beginning of the project, and maintains status and important information about the activities. The adopted conventions agree with the infrastructure requirements: they create conditions for the teacher to define cooperative educational situations. The Document Servers establish connections with the tools that make use of a document and treat the multiple events generated within the environment, according to a client request.

The Agent Server manages people and teams registration and maintains information on the active user sessions. The Tool Server maintains the registration of the tools and of the active servers within the environment. The Assessment Server disposes services of gathering information about the work process, and features for building assessment instruments of learning. The Searcher Server accomplishes the connection with the Library of References, offering services to search documents requested by the users.

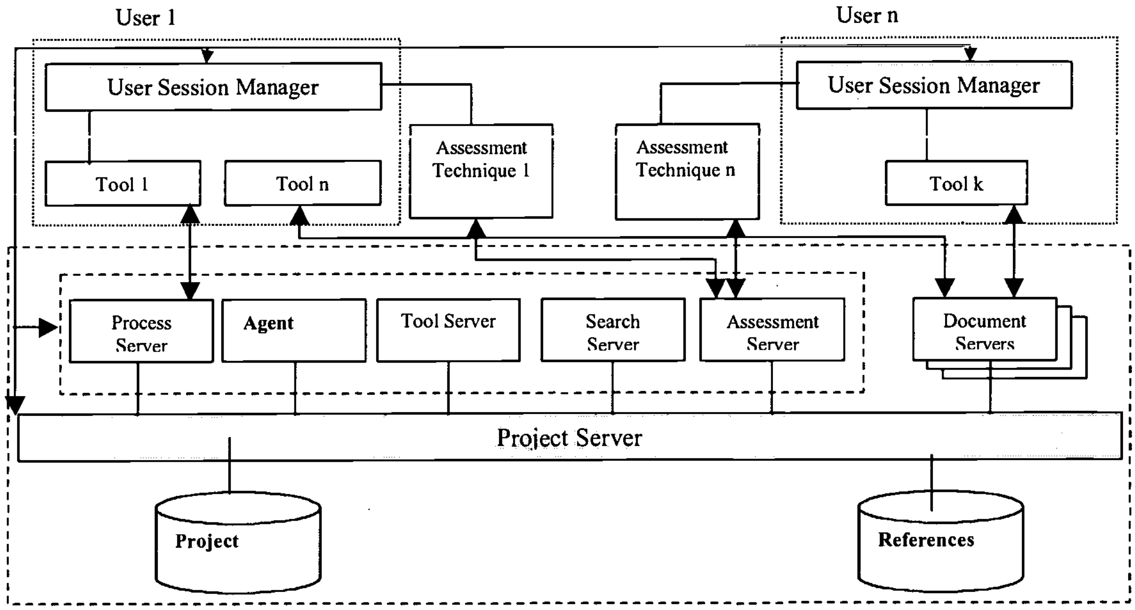

Fig 1 - Infrastructure for Computer-Supported Cooperative Project-Based Learning Environments

The client side is represented by the applications "User Session Managers", whose functions are: (1) to connect the user to the main server and the secondary servers; (2) to provide the status of the project; (3) to manage personal information; and (4) to activate tools, according to the process that is being executed. There are also available groupware tools to support the accomplishment of activities defined in the process. The tools establish connections with document servers related to the activities through which they were invoked. The Database of Projects stores the information about the process of the projects. The Library of References is a multimedia database that stores documents of any type (images, HTML pages, finished projects), which can be consulted by groups during the project. Several types of projects can be developed in the context of the cooperative environment, indicating the need of different tools to support their activities. Thus, the infrastructure must be flexible enough to allow the increment of new services (servers) and new groupware tools (client applications) to be added to the infrastructure context. The Tools Framework allows the development of both the server and the client applications.

Designing the Assessment Server considered the main assessment problems found in CSCL environment context and reported solutions. Problems and solutions were comprised in three process patterns: Process of Educational Assessment, Individual Assessment and Group Assessment. The first pattern, Process of Educational Assessment, defines a learning assessing process and its stages. Generally, the starting point to define an assessment process is the choice of a learning approach and its underlying theory. Based on it, teachers describe the learning goals and design their pedagogical strategies, which will result in specific tasks. After that, they can plan the assessment procedures, comprising goals, strategies and tasks. If the teacher understands that the better strategy to achieve learning goals is the cooperative learning approach, he/she must define specific procedures to assess both individuals and group performance and attitudes.

The two other patterns, *Individual* Assessment and *Group Assessment*, point to the need for some kind of assessing procedures. The infrastructure provides facilities to support both the qualitative and the quantitative assessment approach along all stages of the cooperative project development. Even when the learning goal is to improve social behaviors, some procedures and instruments to assess individual progress must be designed. According to Constructivist theory, each student builds his personal knowledge, bringing his own perspectives to the learning activity. Standardized tests do not allow teachers to assess student perspective. Individualized tests or tasks can better reflect the personal development. In a Socio-Cultural-based environment, both knowledge acquisition and social attitude improvement are relevant outcomes. Some kind of qualitative instrument must assess the group's progress. Structured observations and interviews can give appropriate data to ensure the group's progress. It is important to keep records of each student's participation in cooperative tasks and his contribution to find the solutions. The analysis of data files of group interactions working with the Internet communication tools can offer relevant information to teachers. In addition, CSCL environments could provide an electronic space where teachers store their comments and notes about the individual and group behavior and progress. Self and peer assessment can be proposed when students are mature enough to carry on their own assessing. Teachers must also assess the group as a single entity, observing both academic outcomes and social behavior. Several kinds of instruments can give support to the assessment process, such as group reports, group testing, formal or informal observations, and interviews. Groups can assess their own work, in their peer assessment approach. These issues are reported in patterns format, as shown below.

PATTERN NAME: PROCESS OF EDUCATIONAL ASSESSMENT

Problem: How to define an assessment process in CSCL context and relate it to an underlying learning theory?

Context: Assessment is a process to verify the extent of CSCL experiences and make sure they are actually producing the desirable effects. Educational goals (the concepts and abilities taught and the designed activities) are part of the context.

Forces: The assessment process starts with the definition of program goals. In other words, its main aim is to determine to what degree the desirable goals are actually being accomplished. It is directly related to proposed educational activities, and consequently to the learning theory they are based on. In the view of a social-cultural and constructivist theory, it is not possible to evaluate the knowledge construction disassociated from the process, which enable it. Therefore, assessment should be continuous and allow the teacher to identify and create zones of proximal development. In the constructivist educational space, processes are even more relevant than products. Qualitative assessment should go beyond the quantitative assessment, without disregarding it though.

Solution: The assessment process of learning in a cooperative environment can be defined in four steps:

- Educational goals can be used as a first step to the definition of items to be evaluated, including the learning of the cooperation process itself. To map the relationship between the educational goals and the validation variables we can use some method for knowledge representation.
- The next step is to identify situations, which allow the students to manifest their expected behavior as derived from the educational goals. These situations should occur during the entire working process developed within the environmental context. The environment should provide means for tutor intervention anytime he decides that this is necessary for the assessment purposes. These interventions should be inserted in the activity development and should be used according to the need of each group member.
- The instruments for assessment should be examined. It can either use those already available or develop them. These instruments should be capable of collecting, storing and analyzing the data about the progress of each member and of the group as a whole.
- The definition of quantitative and qualitative measures, which represent the result of the assessment. For qualitative measures, we can use a set of concepts aimed to represent the student progress, such as: cognition, social relationships, participation, argumentation capability, criticism and creativeness.

Related patterns: Individual Assessment and Group Assessment.

Known uses: Studies in the educational area (Tyler, 1974), identified classical methods for the assessment process, establishing a direct relation to educational goals. Some computer-supported learning environments adopt these methods, either in part or as a whole. They developed specific solutions to help the representation of goals and supporting tools in some of the stages of these methods (Leite & Omar, 1999; Tarouco & Hack, 1999).

Fig. 2 - Example of a Conceptual Pattern

Assessment solutions were expressed as *conceptual guidelines*, *services* and *templates*. *Conceptual guidelines* provide theoretical principles, practical guiding and help about how solutions can be implemented. *Services* are available in a special Assessment Server, allowing services of gathering data concerned with the cooperation process. It also associates teacher's comments to documents produced by a group, and to certain events related to the activities, modeling and presenting assessment results through specific reports.

Teachers use the Process Server (see Fig.1 1) that works as a workflow machine, to design and propose a process for the cooperative project development. During an activity operation, students use some kind of tool, which has also been previously defined to assist them. Using educational groupware tools, students exchange messages, contribute to other members work through comments and annotations; and teachers can grade students' participation and contributions. The tool sends all the information about the interaction process to the Assessment Server, which stores and creates a kind of activity log. There are specific reports to format and present this information to the learning evaluators.

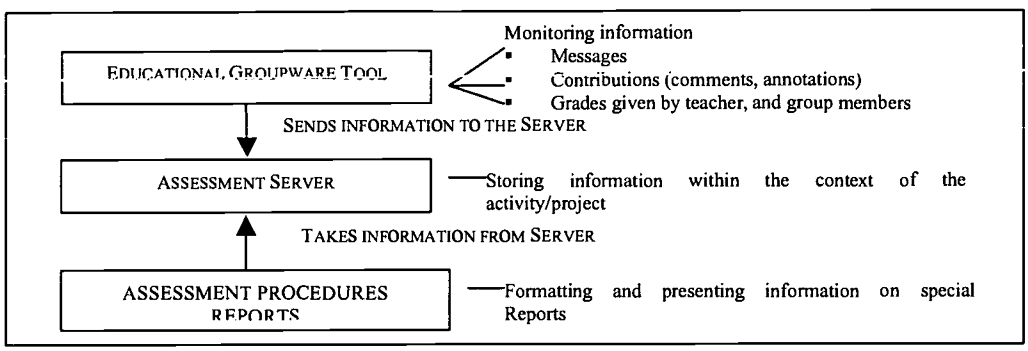

Fig. 3 – Representation of the Information Gathering in the Infrastructure

New services can be attached to the Assessment Server aiming at giving teachers personal support. Besides the server, the infrastructure also presents *templates* for the main assessment apparatus described in the patterns. Templates are empty structures previously defined, where details can be changed and adapted to specific situations. The apparatus both for quantitative and qualitative analysis is summarized below.

➲ QUANTITATIVE INSTRUMENTS

The goals of the Individual Assessment are to verify each student's progress, according to his/her own profile. In this case, the template generates tests that may include questions and exercises prepared by the teachers. Any test can be associated to a specific student and project activity. Teachers can program tests that can be presented to students at any moment of the process.

- QUESTIONNAIRES AND INTERVIEWS - there is a template that teachers can use to build questionnaires and interviews. It can be useful to evaluate how people feel about the work process and then compare it with the generated products. They are also useful to evaluate the background knowledge and group interests.
- SELF-ASSESSING - this template produces a questionnaire of self-assessing organized by topics. Teachers or students can be responsible for the creation of the structure of topics to be appraised.
- GROUP EXAMS - according to the assessment issue defined in the patterns, it is important to dispose some kind of group exams, since the work context is the cooperative approach. Teacher can compose a three step cooperative test: (i) students receive the test carry on a discussion about the questions, using a special tool to support the discussion; (ii) students answer the questions in group and send the results to the teacher; (iii) each student evaluates the group's result as a whole (members participation, contributions and identification of difficulties about some topic). Two templates are available: one to generate a group test that can be accessed by each group member, and the other to generate the assessment of the group results that is individually accessed by all members of the group.

➲ QUALITATIVE INSTRUMENTS

- OBSERVATIONS ABOUT THE INTERACTIONS DURING THE WORK PROCESS - this is a template that helps to format and present information gathered during the work process as described in Fig. 1. Teachers can determinate how to organize the messages and contributions of the students per activity/ per process stage / per some kind of pre-defined structure (type of message, contribution content). Thus, they can better analyze the collected data.
- ANNOTATIONS OR STRUCTURED COMMENTS - this template also helps to format and present information gathered during the work process as described in Figure 1. It is possible for the teacher to insert structured comments or

annotations on the students' work or even add grades for specific events in a project. This is done within the context of the tool usage, which is associated to the project activities. The template gathers and organizes these specific comments/grades and generates a report with this information. The possibility of group members to evaluate the accomplished tasks and their members, according to their participation and cooperation in the project, is an important aspect in cooperative settings. Teachers and teamwork can use the questionnaires and interviews to address this requirement.

Conclusions

The process of assessment usually requires a higher level of analysis than merely performance measuring task. Teachers should collect information about student performance, as the data allow them to determine the students' levels of achievement, evaluate the effectiveness of instruction, and identify topics that require additional support (Miller, 1999). The assessment of students' progress is an important aspect of the teacher's role, since its process is many-sided. All faces of the process show that the assessment cannot be done in an automatic or electronic way. Apart of the learning environment, students' assessment is a teacher's job. In our infrastructure, the assessment of individuals and groups belongs to the teacher, but it also offers additional kinds of support to continuous assessment of each student and of the whole group.

Up to now, we have just finished the implementation of environment prototype. To verify the infrastructure behavior, the next step is to start a real collaborative environment, tailored to the undergraduate Science Computer students' needs. Experimental findings will provide useful guides to refine some components of the infrastructure, including the Assessment Server.

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A VIRTUAL COMMUNITY UNDER CONSTRUCTION: BEGINNING OF AN ENCHANTMENT

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Abstract: In this paper we bring up some thoughts over a virtual environment generated in the Virtual World (Cibercidade-Sitecria/LEC-UFRGS/OEA) - Community coupling based on the epistemology of enchantment, where each participant (teacher, student and researcher) is an observer, an investigator, a learner in charge of constituting this space. Our analyses are based on the experience of two groups of students and teachers at the elementary level from public schools in Porto Alegre/RS and Novo Hamburgo/RS. The initial data collected indicate the constitution of a space of distinction by a living together. We "photographed" two moments where we analysed different manners of acting/"dwelling" (in) this space so as to create these distinctions. This process of self-organization makes us think of the emergence of a hybrid phenomenon, of the creation of an artifice a blend of human nature, culture and technique.

In fairy tales, the characters may be animals, plants and other inanimate beings, they have voice, will, attitude, desire... Enchanting has to do with this, to give voice and action to the object. It is the eyes of the observer that considers the object a live entity, a dynamic one, one that transforms and is transformed by and in the interaction.

> For the utter dreamer, nature is only the dream that may more attentively be studied - the dream that lasts enough so we find rules, laws, that perhaps each other person dreams is ours, or the world of our inner dreams has people dream ours, or the world of our inner dreams has, had we time and abilities for this science of /shadow/. Nature is not real anymore; it is more vivid than dreams. Nature is the dream that all souls dream together. (Pessoa, 1999)

But how would be the building of this dream, this enchantment in a virtual world of Internet? We invite the reader to travel with us in this adventure of thoughts and questioning from the establishment of a community...

Once upon a time...

The Virtual World: A Scenery To Be Enchanted

The virtual worlds, as informational devices, have a reticular and fluid space, in which the user is considered an explorer who will inhabit that environment. It could be the explorer him/herself, as an navigator or his/her representative, an avatar who obeys his/her commands. It is "a digital reserve of sensorial and informatioanl virtualities which are updated only in the interaction with human beings". (Levy, 1999).

Depending on the devices employed, this updating may be more or less interactive, unpredictable, leaving a variable share to the initiatives of those who immerse in it. The virtual worlds can be enriched if inhabited collectively. It becomes, in this case, a meeting point and a communication means between its participants. The virtual world of which we speak here is the Cibercidade-Sitecria (or, in English, Cybercity-Sitecria) - http://oea.psico.ufrgs.br/sitecria.

Initially, this space was created to facilitate the interaction for the active learning of students. Its creation is based on the *fractalized* idea, in which the teacher being trained via telematics, who is developing shared projects, taking part on the construction of the virtual community with his/her peers, also watches the students in the same process of cooperative learning. Consequently, the teacher can observe, apply, experience, reflect the various forms of interaction and building of knowledge in the development of cooperative projects in Distance Learning - DL - with other students and teachers, thus improving his/her development and contributing to the building of students' knowledge.

Its layout has been developed on a metaphor: the city. Initially, it is necessary that the user register, accepting to be a dweller of Cibercidade-Sitecria and soon the user is invited to help us unveil a "Great Mistery". This is the way we found to create in the user the need to interact in this space, an initial challenge.

This virtual world contains some "social institutions": the city hall, a post office, the assembly hall, a news/communications site, an art studio, a sports area and a bookstore. These sub-environments are mainly based on the users' interaction, i.e., they are updated, rebuilt, reconfigurated at each interaction. Each inhabitant receives a persoanl mailbox, a notebook for personal notes and a space for publishing anything. Initially this set of resources was named house-kit, as it was our plan to offer the possibility that each participant build his/her own "house" homepage).

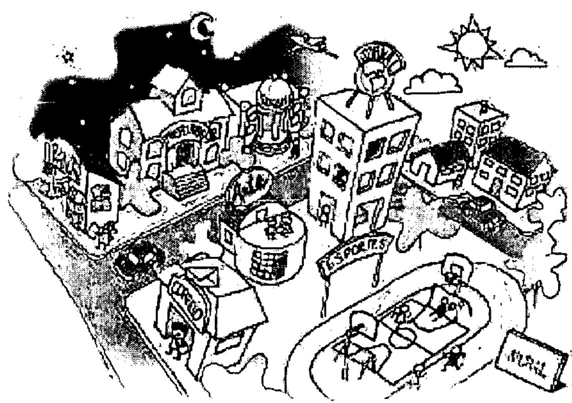

Fig. 1: The "doorway" of the Sitecria

In that manner, the "starters"[1] tried to offer the most interactive possibilities, in a fun and enjoyable way, based on three pillars:

- a *design* that gives students the possibility of feeling invited to take part on the building of a virtual community, exchanging experiences and giving priority to interactions which favor relationship cooperation and autonomy in them;
- systematic sinchronous communications sites such as IRC and ICQ and assinchronous such as e-mail, forms and discussion lists.
- sites/moments in which students may participate on challenges made up by other students, teachers and researchers as well as building them themselves;

It might be said that Cybercity-Sitecria is a kind of 'skin', a scenery that will have its dyanmics maanged by the community itself. What dyanmics can emerge from the interactions of the participants with this virtual world

[1] We used, 'starters' or 'world engineers' from Levy (1999) referring to the developers of Cyibercity-Sitecria in the sense of not being the authors of a finished work, but of a world that is in essence, unfinished.

and between them? What is missing for this world to be enchanted and become an environment upon which a community can be built? The participants[2] and their interactions, of course!

Bewitching

The epistemology of enchantement (Chrislieb, 1994) seems to be a trail to travel over in this study:

> " once the object is considered to be able to have its own qualities, and it is allowed that it behaves according to its will, then it is possible to interact with it (...) What the subject did was to bewitch the object: the subject put a spell on people, animals and things around so that they are converted into live entities. "(Chrislieb in: Montiero, 1994, pg. 25)

In that manner, the objectivity necessarily is secondary. It means that in the experience, we cannot distinguish between illusion and perception. The experience is a condition characteristic of the observer and this is the reason why a group of observers cannot make such distinction either (Maturaan, 1999). A single reality is not considered, but the possibility of several distinctive realities and distinguished by the view/action of the observer.
If we consider each participant an observer, a curious investigator of the "world's misteries", a scientific researcher, we could say that each of them is also responsible for the enchantment. All - teachers, students, researchers - are learners.

Thus, the object is alive, dynamic and collective, it stops being MINE (the researchers') and becomes OURS (the collective of participants of the community). It is a digital virtual community being constituted. A community is alive and there is no way to study it without somehow modifying it.

Even in the making of science, all that happens is produced by the observer in his/her praxis of living as primary condition, and any explaantion results secondary. Every explanation - including the scientific one - is a generative mechanism that originates the experience by explaining with the use of other experiences different from that which is being explained (Maturana, 1999).

> " (...) A thorough analysis shows that science does no know 'bare facts', as the facts that we acknowledge are already seen from a certain point of view, being, as a consequence, essentially ideative. If that is so, science history will be so complex, chaotic, permeated by mistakes and diverse as much as the ideas within it (...) Each person will read the words in his/her own way and according to the tradition to which this person is affiliated" (Feyerabend, 1989, pg.34)

Making science, as living, is a continuous process of transformation of the researched object and of the researcher him/herself. It is a constant process of deconstructing oneself, as if going back to childhood, in which it is necessary to confess our ignorance, to start studying science from its very beginning, its genesis. It is also a process of enchantment, as a life experience and passioante one.

> " [a scientist] began as a child, as childhood comes before adulthood in every men, including the primitive. As for knowing what the scientist takes from his/her first years, it is not a collection of innate ideas, once there are trials and errors in both cases, but a constructive power, and among us someone came up and said that a physicist of genius is a man who knew how to preserve the creativity proper of his childhood instead of losing it at school " (Piaget & Garcia, 1982, pg. 64)

It is in this trial of deconstructing a perspective to build another that we see the need of this enchantment which allows a dialogue at the same moment when the object makes itself come to existence. And it appears that there is no other way for us. We can only build it as the creative process is occurring, because it is in the means where we are moving:

> " Facing the individual's reality and facing the reality of systemic institutions, it appears then a reality that is not within the individuals and institutions... not even in groups, but it is embodied in a third nature, not quantifiable and impeccably real, made of communication... This is the third reality, the one of the means, of the intersubjectivity" (Chrislieb in: Montiero, 1994, pg.51)

The Enchantment: Beginning of a Self-Organization

[2] Participants in the sense given by Levy (1999) for the 'explorers' of the virtual world, that will not just build the viable, multiple, unexpected sense, but also the order of operation and the form of appropriation.

According to our conception of virtual environment, it is only with the very interactions of participants with the virtual world and between each other that it is possible that a dynamics of functioning emerges.

This virtual (digital) environment builds itself in the interaction between subjects-subjects and subjects-objects, it changes as interactions occur, as the participants engage on cognitive activity. It is updated at every action/operation and its virtuality is changed at every questioning. In the same manner, the subjects are transformed in/by the interaction. There are no strict limits between what is means, object and subject. A virtual environment under the constructivist perspective, it is constituted mainly by the relations that occur in it. It is in living together, through the interactions, questionings, actions/operations that this world is being built/inhabited. *It is a space of distinction by a living together of a community.*

This collective object, enchanted, will only remain enchanted while we, observers, consider it to be in movement, what Maturana names drift. It means that every moment is a different moment, that will be determined by the history of interactions that occur, but, at the same time, always being updated in its structures. At each moment, one happening, one experience.

The virtual community constitutes itself in the gathering around centers of common interests, about the cooperative learning, about open processes of collaboration. (Shaw, 1995; Levy, 1999). The construction of social ties occurs much more over affinities of interests, knowledge, mutual projects, in a cooperation or exchange process than over relations or geographical proximity, institutional affiliations or power relations (which does not mean that they do not exist).

In this sense, the process of constituting virtual communities can give us elements to reflect about how our social relations in and out of the cyberspace have been changed and change intellectual technologies.

> " virtual communities perform de facto a true updating (in the sense of creation of an effective contact) of human groups that were only potentials before the appearance of the cyberspace. The expression current community would be, essentially, much more adequate to describe the phenomena of collective communication in the cyberspace than virtual community" (Levy, 1999, pg 130)

From this perspective, the community becomes active in its own development process, and it is possible to say that it develops its own dyanmics of functioning, it organizes itself. This Collective Intelligence is updated more as a problems section than as a solution, more as a "way of accomplishment of mankind that the universal digital network fortunately favors, without us knowing a priori to which direction and to which results the organizations that put their intellectual resources in synergy tend to". (Levy, 1999)

This participants-virtual world imbrication makes us ask, which are the borders between subjects and objects, human and techniques? Would it be, then, the appearance of a hybrid phenomenon, the creation of an artifice, mix of human nature (?), culture and technique, as tells us Pedro (1998).

Let us see some "photographs", of moments that can make us think over the possibilities of "dwelling"[3] the Cybercidade-Sitecria, of constituting the community and, who knows, think of the construction of an artifice?

A Moment: A Way To Occupy Space

Our explorers are part of a group of students of a public municipal school of Porto Alegre/RS, with ages ranging between 10 and 14 years old.

As soon as they accessed Cybercidade-Sitecria, these participants tried to occupy the space in a way that had not been thought of (at least in the beginning of the process) by the starters of this virtual world.

We could say that most of the children were more worried in "occupying " the space verifying that sub-environments were not being offered and they considered important in a city: "Hey... there are no trees in this town!"; "That's true... it's missing a soccer field for us to play"; " There's no cemetery either. Where are people

Henceforth, each one started planning how to implement his/her own sub-environment.

It was at this point that they realized that cemeteries, garages , video rental places in the cyberspace cannot be the same as in the real world.

[3] We understand dwelling here in the sense of "feeling at home", to be at ease, to appropriate space, in opposition to the notion of settling down, to take root somewhere.

Fig. 2: Cemetery - Environment under construction by inhabitants-students

Another quesiton then arose: building spaces that could be interesting and useful for the other classmates.They started looking for solutions to these questions: "I can put one of those to fill up [forms], asking what the problem of his car is. Then, I analyse its problem, and I answer how to fix it... and then I send it back!" ; "We could make a park with many trees and with information on each one. Then people will know how to plant, what kind of climate it likes, if it likes water, things like that..." and so on.

This way of interacting with Cibercidade-Sitecria established a dynamics that disturbed and "forced" the environment to change, as the proposed initial challenges in each sub-environment, at least at this moment, were not the focus of main interest of these explorers.

Proposing new public, collective areas was not in the initial proposal. But it became the guidance of this virtual world, together with the interaction between inhabitants. The individual - virtual world coupling occurred in this manner at this moment with these participants. Would we be able to say that this newly constituted system points to a clue of a self-organization process?

And how was this disturbance taken? Each inhabitant now had the possibility of proposing his/her way of living in the virtual world - his/her project on Cibercidade-Sitecria - and to contribute that from this environment emerged a community. The initial conception of "house-kit" was considered individualistic and the option was the living collectively.

In order to make the environment adapt itself to the proposal of the participants, some changes and transformations were made. Four other sites were created: the Moon Corner, the Space Corner, the Mountain Corner and the Ocean Corner. These sites are available so the explorers can choose where they want to develop their projects.

So, as interactions occur, social relations that change and are changed by the virtual world appear. It is in this hybridization that we see the possibility of indicating an area for living together.

Another Moment: How To Interact

We see this space as a domain of differentiations created from the experiences that occur so that the community constitutes itself and changes its own space.

In that manner, in another moment, another group of participants chose to use the interaction sites of the Cibercidade-Sitecria. In this group, there were students and teachers of a municipal public school of Novo Hamburgo/RS, aged between 8 and 11.

These participants are still, most of them, oriented by their domains of daily habits. It means that the messages exchanged are related to their daily life and is directed to other inhabitants who they already know physically (party invitations, poetries and jokes about physical characteristics of each other, etc.)

> *"Hi, you ,Taliba, skinny guy, if you don't eat you dizapear, allright?"*
> *"Baby please send this message to Taliba. Hey taliba you are too ugly, what about a plastic surgery?*
> *"little girl, you are really cool"*
> *A POEM!*
> *I DON'T GIVE YOU A ROSE BECAUSE*
> *IT'S FULL OF THORNS BUT I GIVE YOU*
> *MY HEART WHICH IS FILLED WITH LOVE"*

The community is delimiting their space through this construction and the interactions between its participants. In this "photograph" of the dynamics, differentiations have not yet been made. When we talk about differentiations, we refer to the distinctions that will be built with relation to the cyberspace in general and related to the other domains of existence that each participant is part of.

In this case, the domain of daily life existence still is the predominant regarding the life in the Cybercity. The individual dimension still prevails, there is no notion of insertion in a collective of participants: a great number of messages have explicitly a private notion and have an idea that nobody else has access besides the receiver him/herself. It is clear this dynamics for the site of preferential interaction: the Post Office, as there is still the possibility of sending persoanl messages.

The Enchanted World

The world will be enchanted whenever it is possible to update it. Whenever it is updated, new differentiations will be made and the community constitutes its space of living together. We could even say that a new domain is created for its participants, a digital domain. The "digital life" does not eliminate the other domains of existence. Very much on the contrary, it can enlarge and change its ways of occupying the non-digital world... and vice-versa. How to analyse, for instance, the different moments in the cognitive development or the different ages of the participants? Are they aspects of the domain of existence that interfere in the way that each one bewitches the virtual world in which they interact?

This process of self-organization by which the community builds itself is *autopoièsis* in the sense that it is because of its own inner dynamics that the domain will be built; it is a system that produces itself.

In this sense, one of the ideas that permeates "behind" all our thoughts is that any knowledge is built from the interaction of the subjects with the objects (whatever it is, "things" or people), and both will be built from that point. It is a process that happens in this intergame of the subjective as the objective reality. And, we could even say, an artifice is created, because it is a result and resulting of a process of hybridization of subjects/objects, of the human/technical.

With this epistemologic concept, its construction has to be dyanmic and in process. The end here cannot be "... and they lived happily ever after". Like nature dreamt by Fernando Pessoa, though, every moment is time for virtual, digital, all kinds of enchantments. What is important is to experience and share this experience... it is to create environments for living together.

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PROPOSAL OF AN INTEGRATED TOOL INVOLVING MULTIPLE TECHNOLOGIES FOR THE DEVELOPMENT OF COURSES ON THE WEB

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This work is a proposal of an Integrated Hypermedia Environment for the development and management of distance education courses. The environment is composed by modules which are fully integrated. All modules are managed by a unique interface manager. These modules use different technologies, like palmtop programming (for Palm Pilot handhelds), multimedia data synchronization and databases. The main objective of this environment is to make instructors able to create and manage online courses, using the most advanced technologies available. The system is based on templates, which make it very easy to use by non-experts. The environment is composed of three modules. The WebCourse module is a hierarchical web-based tool for the creation and management of courses carried via the Web. It is composed by three submodules, which are interconnected: WebCourse Instructor, WebCourse Teacher Assistant and WebCourse Student. Each one of these modules has specific tools and are integrated on the system.

Teacher Guidance to Digital Lectures

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Abstract: An innovative approach is introduced that guides teachers to modern ways of teaching with new media technology. The basic idea is to integrate teachers into the production process of a particular kind of teachware, which provides digital lectures in a virtual learning environment. So far, most of the teachers are rather passive presenters of knowledge. They are filmed giving lectures in front of real students. The outlined approach forces teachers to play a more active role while learning to teach by using an electronic environment. One major aim is to teach teachers how to use new technologies during their lectures and to promote didactical effectiveness of teaching with new media.

Lecture on Demand

The basic idea of lecture on demand (LoD) is to provide the students with lecture content at any time and any place. This is done by recording video and audio streams of lectures, editing the recordings, and linking additional teaching resources (slides, annotations, diagrams, animations, questions, exercises, tests, ...) to the lecture video. These teaching resources together with recorded lectures build up the LoDs offered to the students via a LoD server. The first step of the LoD authoring process is to record and digitize the lecture given by the teacher. The digital video material is combined with additional teaching resources such as presentation slides, graphics, diagrams or animations to display complex or dynamic content. Hyperlinks to Websites give direct access to external information and are suitable for illustrative examples. FAQ sites and annotations offer help in difficult situations. Quizzes and tests are integrated to enrich the LoD with interactive elements. The LoD authoring tool allows to create quizzes including different types of questions, such as multiple choice, true-or-false or technical term questions. The students access the LoD packages via a web browser. The screen is divided into two frames. The left frame shows the video stream and the main control panel including a list-box of time-links to additional resources. When the video stream reaches a timing specified in the list-box the corresponding resource is displayed in the right frame. On the other hand if a resource is selected from the list, the video stream is positioned to the corresponding minute and second.

Teaching in Lecture-on-Demand-Scenarios

There are different ways a teacher can participate in the production process of a LoD package depending on how positive he/she is about using educational technology. Common and least straining for the teacher is the passive role of simply teaching in front of a class and being recorded by the LoD producers. This type of LoD teaching is more likely to motivate sceptical teachers, whose attitude towards using new media technology during their lessons is rather reluctant. Nevertheless, even having a passive role in the production process of a certain piece of LoD teachware there are at least two positive effects. First, the teaching material (e.g. blackboard drawings, overhead transparencies) has to be transformed into digital form. Either the teacher transforms his material by himself or at least uses content that is easy to digitize. Second, within a LoD teaching scenario the teacher has to be aware of teaching in front of a camera. Another position is given by the enthusiastic kind of teacher who is eager to bring all sorts of technical enrichment into his or her classes. These teachers are used to experiment with information technology as soon as new developments take place. The support they need is not in a technological or didactical scope. They usually just need more manpower to realize all their ideas. But even without direct support the results of their endeavors are raising in quality every time they create a new LoD package simply by habit formation. The most interesting group is the 'in between' teacher. This teacher is interested in new ways of teaching, but he or she is rather conservative in extending the own style of teaching by using electronic media.

Training Program "Teaching With Media"

During the past five years more than 60 LoD packages have been produced. A development team consisting of up to four members cared about the whole production process. Teachers kept their hands off the technical realization of the electronic teachware. Apparently one major cause of substantial didactical and pedagogical deficiencies is the insufficient integration of teachers in the design, preparation, and implementation of electronic lectures. As a result a training program is being developed to make teachers ready to meet the challenges of high-tech education environments. Each teacher's attitude towards media-teaching needs particular assistance. To achieve this a single teacher is assigned to a selected level within the program (reluctant teacher to level 'novice', 'in between' teacher to level 'advanced', enthusiastic teacher to level 'expert'). One cycle of the program consists of four steps. In each of these steps certain tasks can be handed over to the teacher.

	level 'novice'	level 'advanced'	level 'expert'
media preparation	use content that is easy to digitize	transform own analogous content into digital form	create digital content using enhanced digital options
course draft creation	N/A	divide content into well-defined topics	adjust course draft to teachware story-board
teaching	N/A	N/A	adjust teaching style to LoD production
LoD-authoring	N/A	N/A	perform complete authoring process

Table 1: **Steps and Levels of the Media-Teaching Training Program**

In order to illustrate these steps and levels the following example describes a fictitious teacher, whose lectures are transformed into LoD-packages, using the teaching-with-media training program. This teacher doesn't use any digital content so far. He makes his presentations with chalk and blackboard most of the time. His curriculum is rather flexible, he tends to go into detail spontaneously. The training program might look like as follows: Instead of using chalk and blackboard a liveboard is made available to the teacher. The liveboard is connected to a computer so that every annotation is digitally recorded. The teacher doesn't change his course draft and his teaching style (1st level cycle). The teacher designs an own set of digital content using standard presentation tools (e.g. MS PowerPoint™). On the one hand this accelerates the media preparation sub-process within the LoD authoring process. On the other hand while creating his course draft the teacher is motivated to define clear sections which can be used to structure the LoD package later in the authoring process (2nd level cycle). Getting used to digital content creation the teacher extends his efforts to multiple visualization forms, like animations, audio sequences, video sequences (plus slow/fast motion), simulations, etc. As he learns how to author a LoD package he modifies his course draft accordingly. Likewise he adapts to teach in front of the camera and to address his 'virtual' learning community. Finally he performs the LoD authoring process completely by himself. At the time when he decides to use a desktop camera to record himself he is not even depending on the camera team any more (3rd level cycle). After each particular training cycle the teacher has to decide whether he is ready to perform the tasks belonging to the next level of the training program or not. In the latter case he might want to repeat the tasks of the current program level in a new cycle before going on with the next level.

Conclusion

The challenge of teaching within media rich environments is often reduced to technical problems. Pedagogical and didactical aspects evoke interest only as far as the learners are concerned. As a result many teachers are not prepared for a paradigm shift claimed by theoretical and technical visions of future education. One way to meet these requirements are training programs like the one described in this paper. By performing a whole program of training cycles definite improvements in quality can be reached, for example: mature, clear and well-structured visualizations of teaching material (media preparation), clusters referring to particular topics in content and structure (creating course draft), straightforward, focussed and media supported lectures (teaching), complete, content-driven and multifarious enriched lecture-on-demand-packages (LoD-authoring), over-all sensitization for the whole LoD-production process and the impact of each teacher's action on this process.

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Designing Collaborative Teaching and Learning in Virtual Environments for Large Scale International Participation

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Abstract: This paper looks at the design of an Online Learning environment focusing on the collaborative aspects, both from an educator's viewpoint and from a student's viewpoint. The design is based on socially constructed needs with flexibility as main concern.

Introduction

In times of financial restrictions, the demand for more efficiency and effectiveness in the Higher Education system is often connected to the potential of tele-supported university teaching. Whereas it is becoming more popular to use the Internet as the technical platform for the distribution of on-line study offers, a lot of surveys, (self-) descriptions, reports, etc., promote the thesis of almost unlimited possibilities in education that just have to be implemented. Frequently, a positive view is held which pushes the discussion of problematic areas of (interactive) on-line offers into the background. The gain in relation to the effort for development and realisation is seldom mentioned.

At the Institute of Law and Computer Sciences (Institut für Rechtsinformatik) of the Saarland University (Universität des Saarlandes), international on-line courses on the Internet have been offered regularly since 1996 (http://seminar.jura.uni-sb.de). The didactic concept is communication-oriented and is based to a vast extent on discussions and group work via the exchange of electronic messages through the WWW. Technical specialities, like an extensive media integration (e.g. audio/video), were not incorporated and the programming was reduced to a necessary minimum. Nonetheless, a vast investment of time during the development and the realisation of such on-line courses had to be noticed mainly due to organisational and support activities.

Implementation

Submitted works and responses of the participants show that it is a valuable course. The rising acceptance hints to the fact that the people value the advantages of studying independently of time and place and they appreciate the communication-oriented approach where participants have to be actively involved and are taken care of daily. Experience also shows that it is necessary to count in the economic factor as well. If one wants to try to simulate all-important elements of conventional teaching in a virtual environment, then new requirements have to be followed:

- the development and implementation of a course with specific didactic concept is usually more work intensive than in ordinary courses. Details have to be prepared before the course, the sequence and interaction have to be planned completely.
- the teaching concept has to come with a technical realisation concept, which makes forward planning and test runs necessary.

- the organisation is extensive: processing of requests, collection of participants data, log-in and user identification distribution and updating data require much more time.
- the support of participants is done around the clock, even on weekends and cannot be seen to be an inadequate relation to that of conventional seminars. With the number of messages reading and answering them exceeds the time available for conventional courses including office hours. It is noticeable that the students have higher expectation in their support than usually, the reasons still have to be empirically researched.
- technical, didactic, and content developments require the delegation of assignments which creates new dependencies and requires a lot of co-ordination efforts. Although high international participation lifts the quality level, limitation of participant numbers has to be considered, and the question of where to find additional resources has to reconsidered. Since the course offer is not limited to students of the particular university, sharing of cost with the other has to be discussed. Whereas this is already done in other countries, the German university system does not offer the necessary legal base for such actions yet.

A reasonable conclusion of this is that there currently are a need for integrative concepts for the implementation of open and distance learning via IT in Higher Education that can demonstrate a methodology of good practice for educational needs. Problems relating to this lack of a full and encompassing concept has to be seen from different perspectives and within different contexts of education. The implementation therefore depends from pedagogical, sociological, legal, technological and organisational as well as other disciplines.

Taking these obstacles into account co-operation among institutions was needed in integrating different domains of expertise in research and demonstrating a collaborative approach for the implementation of a model for Virtual studies in Higher Education.

One advantage of online courses is the potential for communication, collaboration, and the constant exchange of knowledge between students and educators, which brings them closer to (and perhaps supersedes) "real life" teaching. The Online Seminars has opened up new possibilities for students and teachers, and permit interdisciplinary and international collaboration. Our experience also points in the direction of that online teaching with international cooperation and participation are far more time and personnel intensive than regular courses.

The design of collaborative learning

Collaboration and co-operation needs to be designed on an institutional level too. Co-operation involves determining the settings and the implementation. Collaboration is applied practice in the field.

The online seminar is a co-operative international venture. Hence, the results of the analysis faze helps guide the roles of each of the co-operating institutions dependent on the focus, resources, personnel, and disciplines of those institutions. Currently (Summer 2000) this co-operative venture involves collaboration between Higher Education institutions in Germany, Austria, Sweden and Kazakhstan. Each of these institutions may have additional collaboration from local institutions. Co-operative decisions are based on common educational and research interests, competence, persons in charge, technical resources and the cultural background. Educational interests can therefore be implemented in ways not known before IT and the Internet were available.

Collaboration

Collaboration takes place among students, between students and teams, and among team-members. Student collaboration needs to be organised and co-ordinated too. No learning environments are known in Higher Education, where students meet voluntarily in order to collaborate for performing certain certified tasks.

Taking a closer look at the role of collaboration will show considerations to be globally viewed on four levels. These are:
- on the students level within the course
- on the team level within the course
- on a local level and finally
- on an institutional level: collaboration between international universities.

The Online Seminar-environment teams consist of 30 individuals from many different countries. These team members are lecturers, agents, volunteers, former seminar participants and students doing research work. Most of today's volunteers in the moderation of group discussions are former students of the seminar. Several tightly bonded groups have been formed as a result of the seminar on varying levels. For example, "Cyber Grannies" was formed by some of the student cohort during the 1999 seminar. Learning processes are also encouraged for the team – currently we are developing training for moderators.

Learning within the environment is structured to be multi-levelled and complex. Learners are learning from the team, but also from other learners. The team is learning from learners and other team members and participating institutions are learning from learners, teams and other institutions. This complex web of different learning levels are intimately related to the collaboration taking place across all these levels. Meta-learning is built into the design. Feedback has shown that learners rate this collaboration structure highly.

The design

The issue of designing an environment for collaborative learning are complex and varied. Some of the requirements needed to attend to are motivation and affording interactivity. A vast investment of time and energy during the design, development and the realisation of such online courses are mandated to ensure organisational and support activities to ward off potential problems. One central role in the Online Seminar is moderators for group work, the moderator to a very high degree are in fact mentors. Mentors not only in the task at hand but also in handling the media itself. Online VLEs present technical, transitional and pedagogical concerns. As Harasim [4] notes, "an online mentor is a professional in a particular subject area who provides on-going feedback until the apprentice (student) masters the learning task. At that point the mentor fades away, and the apprentice engages in the exploration of expert practice." The VLE presents a new atmosphere that the student and teacher must learn how to navigate. This melding of mentorship and purpose begins to reshape the face of learning and education. Without the active help of professors and lecturers (occupied with content support, management and didactics) as well as a number of student moderators who volunteered to assist during the online course the high goals set for the course could not heave been reached.

In an online environment, you can expect mentoring to take on a new dimension. Here we are challenged to mentor in ways that Feuerstein [3] and others define as mediation. Dialogue and inquiry become a powerful medium for collaborative learning. Discussion begins to carry a flow a meaning. Threads of conversation can be woven together. Opinions and points of view become circulated as observations, assumptions and interpretations become visible. Effective guidance and mentoring can be achieved through selective intervention. A skilled moderator is a mentor who can keep the fragile balance between advocacy and inquiry. The moderator must facilitate rather than dominate the discussion. When we focus on Vygotskys [8] [9] idea of the learner's zone of proximal development, scaffolding, and dialogue, we have to turn our attention to fostering learning via virtual discussions, using strategies that include "voice", address learning and writing styles, and utilise Socratic dialogue. These ideas require us to tend to both the individual and group learning process. If we want to further online discourse, it is important not to forget that this learning process is complex, social and interactive. Research in social collaboration and negotiation in the vein of Slavin [7] and others, calls attention to the design and support of what these learning environments require. Responsibilities for discussion become shared, feedback becomes integral, and all participants, including the moderator, are equal. Both instructor and learner are challenged to grow and develop in this environment. Instructors grow to become moderators and guides and students grow as learners.

Online collaboration as well as effective moderating *must* be designed if it is to have comparable impact to face-to-face instruction. Through conscious effort and application, "virtual" moderators can bring voice and tone into an otherwise sterile and distant environment, accompanying the learner as a reflective guide or maybe even much like a personal muse. Moderators are mediators and facilitators; generative guides and conceptual facilitators. The same issues that can be a weakness in a virtual learning environment can be exploited creatively to make learning come alive.

Active learning is at the heart of the design of the Online Seminar. Designing activities that ensure active participation is part of the moderation and discussion process. Facilitating the discussion is one aspect. Another aspect is making the discussants responsible for their own learning by sharing the responsibility and leading group discussion and work. All participants in the course are provided the opportunity to experience being facilitators in discussion, team leaders, presenters of information, observers, and all are responsible to provide feedback and input into the learning process. However, for any of this to occur, a certain amount of control needs to be relinquished and turned over to the group. Moderators must stay in the shadows allowing the learner to shine.

However, perhaps at the heart of design is the feedback, feedback that the moderator needs to provide in order to support the learning process. Feedback that promotes and encourages continued growth as a learner and encourages collaboration. Substantive feedback not only needs to be built into the course design, but also needs to be modelled by the facilitators if we are to expect quality feedback from students. Feedback needs to be constructive. Connections need to form between participants; commonalties as well as differences need to be discussed. A shared interdependence creates a collaborative environment.

Our goal was that course design and development would reflect a commitment to high quality related to state of the art research for teaching and learning. Hence, "active learning" and a focus on the "communicative process" between and among students and teachers were considered to be essential as we investigated designing "rich online learning communities". Since it is a virtual environment to be implemented based on the Internet, it was clear that quality could be enhanced if the potentials of the Internet could be exploited. Those potentials include information and communication potential; the flexibility of time and space of learning; and access for everyone without the need of additional financial investments in equipment or tele-communication.

As McGreal [6] notes that commercially available integrated distributed learning environments such as CourseInfo (http://www.blackboard.com/) are popular given: the lack of sustained yields for individual course development within curriculum, the high time investment for instructors, and the lack of a supportive technology infrastructure. Despite the administrative and implementation advantages these course management systems offer, these packages lessen the authoring power of the instructor, assume specific pedagogical approaches, confine in some ways the delivery of instruction, and limit the control of the instructor over the learning environment. Given our requirements and needs, we wanted control over the tools and delivery method to be able to be responsive and adaptive to learner and instructor needs relative to the content being presented.

We wanted the learning environment to be able to evolve and grow. We also wanted the environment to be learner centred and learner driven – hence our focus on creating community and a collaborative learning environment. Subsequently design looked to the aforementioned needs for input rather than limiting the design and development to adhere to a singular learning theory. Rather, we focused on developing a set of tools for the learners and designed how we asked that learner to engage the information to create the kind of interactivity and the level of ownership needed within the learning process. We intended to create a "rich" learning environment, which Wilson describes as a setting in which the student is "engaged in multiple activities in pursuit of multiple learning goals, with a teacher serving the role of coach or facilitator" [10].

Since the idea is the building of "learning communities" to achieve better and more active learning processes by the students a definition of constructivist learning environments given by Wilson [10] would fit best to the Online Seminar environment: "a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities". However, not all tasks performed within the courses are constructivist. It is apparent within the design the influences of other learning theories and pedagogical assumptions e.g. such as cognitivism and social constructivism. Cunningham et al. [2] listed several principles for the design of a learning environment: a) provide experience with the knowledge construction process b) provide experience in and appreciation for multiple perspectives c) embed learning in realistic and relevant contexts d) encourage ownership and voice in the learning process e) embed learning in social experience f) encourage the use of multiple modes of representation g) encourage self-awareness of the knowledge construction process.

Results

Learner profile of participants in the 1999 summer term Online Seminar in short are; 224 students from 46 different universities, 19 academic specialties were represented from humanities to technology, 88 participants held some form of employment, 37 countries were represented an the ages ranged from 20 to 64. Preliminary statistics for the summer 2000 seminar is 521 participants registering, more then 30 countries from all continents are represented.

As the seminar has evolved so has our awareness of the importance of this intellectual role of the moderator. In our situation, given the nature of distance learning, the characteristics of our learners, and the number and nature of the seminar participants, it was necessary to augment the instructional support for the course to provide the feedback and guidance that is critical to participant success. That augmented instructional support is present in the seminar in the presence of volunteers who moderate, co-ordinate and mentor the discussion groups. As we have mentioned these individuals come from a variety of perspective and backgrounds. One of our current challenges is providing the support and training necessary to ensure quality moderation and mentoring of the upcoming cohort of participants. We are in the process of establishing some concrete guidelines to facilitate this process. A few aspects of these guidelines follow.

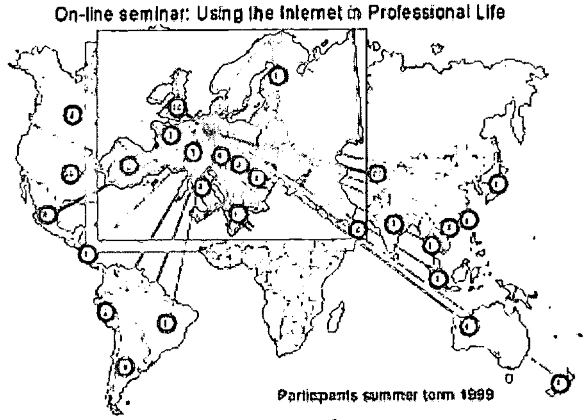

Figure 1: International participation

Facilitation of student learning needs to be a scaffolded process – especially given the obstacles of a virtual learning environment. In brief some of the obstacles that need to be considered and overcome by the moderation and mentoring process include: individuals may not be familiar or experienced with technology; learning in a virtual environment is very different from face to learning – there is the potential isolation of the student, the unfamiliarity of the electronic classroom, and the challenge of communication in an international environment in a text based medium. Our concerns for guidelines can be centred around the need to bring relative novices up to speed rather quickly – but our concerns focus on skills that will provide a quality experience for the participants.

Specific considerations for the moderators include how to scaffold this learning process in order to guide and enhance the quality of the discussion. Issues that we are currently dealing with include:

- How much moderation is called for
- Course organisation needs to define the roles and goals of moderation
- How to specifically scaffold the learning process
- How do we distribute the responsibility between moderators and learners

For example: if part of the learning objectives for the students to learn how to collaborate and engage in group collaboration part of the objectives for the course, then it is the moderators duty to explain and scaffold those activities through the course. Necessarily then the moderators participation and influence as the course progresses changes as the students become more self-sufficient.

Concluding remarks

We have investigated several aspects related to creating a socially constructed course design model. We have also reflected on, and asked if teachers and learners are flexible enough to adapt to these innovative forms of education. Active learning needs to be encouraged and facilitated through supportive design. This design needs to have structure and clearly demarcated support, the learner, especially within the current education system, cannot solely construct it. But there need to be guidance for teachers as well in order to get acquainted with and used to new methods and attitudes of learning.

The future of learning is still to be found by exploring the connection between organisation and collaboration. Organisation will be facilitated through carefully constructed collaboration. There are still questions to be answered. How are media selections for communications viewed and preferred by participants – and why? The research related to administrative functions is sparse. Collaboration needs to be organised on three levels: institutional, conceptual, and on an individual level. Investments of time, money, and effort need to be considered.

As we consider the Online Seminar, several things have become apparent to the team in the design, development and delivery of this course. Current work and research has been based on face-to-face instruction, we are only just beginning to compile information and experience for virtual learning environments. Adapting pedagogy from face to face instruction to virtual environments is first step in the emergence of a pedagogy that is rooted in VLE's. For example, research in computer-mediated discussion in quasi-synchronous environments has found that the learner assumptions and interpretations are very different in a VLE because their assumptions and interpretations are based on face-to-face interactions. Continued efforts and investigations will help refine the research process.

The courses within this collaborative learning environment demonstrate that there is no need to discuss whether there will be a future for teacher's profession competing with online courses. The concept of this environment foresees a very active role of the teacher as an organiser, mentor and/or moderator. But there are still strides to be made in the research on applying effective methods for teaching in collaborative learning environments.

What has the Online Seminar accomplished so far? It is believed that progress to date has produced a very good test bed for investigation of the following aspects: the organisational methods for this kind of activity, methods of training teachers in online teaching, and how to use available resources more effectively.

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Implementing a Digital Campus: Nuisance or Nirvana

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Abstract: Many universities are moving to a notebook computer environment for their students. The University of Wisconsin-Stout is one of these universities. This paper presents an overview of a pilot implementation and steps required to move to a full implementation, from a department chair's perspective.

Introduction

There has been a movement to requiring students to obtain their own computers, when enrolling in university programs. There are numerous universities that have been requiring students to purchase or lease notebook computers. The Chancellor at the University of Wisconsin-Stout (UW-Stout) has charged the University to become a Digital Campus. One of the major goals of this initiative is to require all incoming students to have notebook computers by the fall of 2002 [http://www.uwstout.edu/laptop].

Background

Many universities are moving to either require or support the use of notebooks computing [http://www.vcsu.nodak.edu/offices/itc/notebooks/other_notebook_us/] and that number is growing. UW-Stout studied the following three schools in the most depth: the University of Minnesota-Crookston, which became the first notebook university in 1993 [http://www.crk.umn.edu/technology/thinkpadu/thinkpadu.htm], Winona State University [http://course1.winona.msus.edu/luniac/], and Northern Michigan University [http://www.nmu.edu/laptop.htm].

UW-Stout is located in Menomonie, Wisconsin and one of 13 University of Wisconsin System four-year campuses. During the fall of 2000, UW-Stout had an enrollment of 7,162 undergraduate students and 540 graduate students [http://www.uwstout.edu/geninfo/facts.html]. The University has 27 undergraduate programs and18 graduate programs [http://www.uwstout.edu/programs]. The author is chair of the Communications, Education, and Training Department (CET) [http://www.uwstout.edu/ctem/cet]. The CET department offers the core courses for five of these undergraduate programs and four of the graduate programs, plus several service courses. In the fall of 2000, one of these programs, Graphics Communication Management required incoming freshman to have (Apple) notebook computers. In the fall of 2001, another of the programs, Telecommunications Systems will require incoming freshman to have (PC) notebooks. One other program, outside of the CET Department, Technical Communications required Apple notebooks in the fall of 2000. For an estimate of numbers of student in program see Figure 1.

	2000	2001	2002	2003	2004	2005
Technical Communications	10	15	NA	NA	NA	NA
Graphic Communications Management	50	60	NA	NA	NA	NA
Telecommunications Systems	NA	60	NA	NA	NA	NA
New Freshman	NA	NA	1300	1300	1300	1300
Transfer	NA	NA	500	500	500	500
Continuing Students	NA	55	175	1975	3775	5565
Total	60	190	1975	3775	5575	7365

Figure 1. Estimate of Student Numbers in Implementation.

Purpose

There are many reasons that a university would decide to require students to invest in notebook computers. One of the basic reasons is that mobile computing is a technology that students will be required to use when they enter the workforce. The number of businesses moving mobile computing solutions is increasing dramatically and the students who have skills in a mobile computing environment will have an advantage working in them [http://www.mobilecomputing.com/] [http://www.survey.com/idcmac/idcmacnd.html]. Beyond using the computer as a tool there are curricular, and pedagogical reasons for moving to a digital campus.

Technology

To prepare for the transition to a mobile digital campus several steps were taken. Over the past several years the university has updated the campus network and installed an integrated relational database system [http://www.uwstout.edu/infotech.shtml]. Prior to the fall of 2000, the CET Department prepared for the transition by making sure all classrooms were wired for instructor access to Ethernet and that two classrooms had wired access for students. In addition to wired access wireless access was installed. Seven classrooms were equipped with permanent computer projection equipment mounted in them and there are two additional projectors available for checkout. All thirty-seven department members that have appointments relating to instruction have been assigned notebook computers. Included in these notebook computers are Apple PowerBooks, Apple iBooks, IBM ThinkPads, Gateways, Dells, Microns and Toshibas.

Findings of the Fall 2000 Implementation

The first implementation had several positive outcomes. It was decided to use block scheduling for several required courses including: English 101, Communications and Information Technology, Electronic Prepress and Chemistry. This scheduling brought several faculty together who knew that they would have the same students. This interaction led to discussions on ways to more effectively have the students use the computers in the classroom. As an outcome of these meetings a grant proposal to study innovative ways to redesign the classroom experience was written. The availability of the new tool let students set up better management systems for themselves. It also allowed the instructors to provide improved testing, communications, and web enhancements to create a learning environment not available with typical computer labs.

There were some early problems with the network infrastructure and some students had problems maintaining their computers which caused some difficulty for instructors and students. There was at least one student that was unhappy with the experience, but overall student satisfaction was high. Originally, there was to be an orientation session for notebook students that was not conducted because of scheduling conflicts.

Moving to a Full Implementation

Using the information from the first pilot several things have transpired to add to the success of the fall of 2002 roll out. Several committees have been formed, including a steering committee, a request for proposal committee, a committee looking at pedagogical issues, and implementation teams for both PC and Mac implementations for the fall of 2001. The University hired a notebook computer implementation project manager, who is a consultant with Compuware Corporation.

Summary

The move to a mobile digital campus is neither a nuisance nor nirvana, but an exciting journey that has the much potential for faculty, staff, and students. It is journey that is in constant fluctuation and one must remember that the goal is to provide an enhanced experience for students and not implement a particular device.

References

All web sites sited were current as of February 25, 2001. An updated reference www page including these and other references can be found at: http://www.uwstout.edu/ctem/cet/schlough/dc.htm

Preparing Oral Examinations of Mathematical Domains with the Help of a Knowledge-Based Dialogue System

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Abstract: A conception of discussing mathematical material in the domain of calculus is outlined. Applications include that university students work at their knowledge and prepare for their oral examinations by utilizing the dialogue system. The conception is based upon three pillars. One central pillar is a knowledge base containing collections of mathematical objects: theorems and their proofs, concepts, and task types. Manifold attributes complement the object specifications including attributes related to categorization, to didactics, to applications, to transition to other objects, and to error handling. The second pillar consists of question types, of dialogue strategies, and of a user model. To formulate the answers a restricted natural language is used. The selection and the order of the questions may be controlled by an explicit specification or implicitly by the choice of a dialogue strategy including an exploration dialogue, a spot check dialogue, or a problem solving dialogue. The third pillar consists of procedural knowledge to monitor and verify the answers. For that, techniques of the fields of theorem proving and of formula manipulation are employed.

Introduction

Mathematics is a part of many branches of study in the universities. Oral and written examinations are regular events which challenge the students, but also burden the students. The students employ a bunch of strategies to cope with the examinations. Success or failure of the students depend upon a large set of variables including the nature of the individuals, their learning history, the quality and conscientiousness of the instruction, and many more characteristics.

We here suggest conceptions of discussing mathematical material to serve several applications: University students may work at their knowledge and prepare for their oral examinations by utilizing the knowledge-based system. Or universities may use the system to replace oral or other written examinations. For that purpose, we describe the representation of the mathematical knowledge, a list of possible questions and the monitoring of the answers, some dialogue strategies to discuss the knowledge, and a scaffold of a student model. We chose the domain of calculus (see e.g. Smith 1983) to study dialogues because of the importance of calculus for the edifice of mathematics and for many practical applications and because calculus belongs to the first mathematical fields which are studied at the universities.

There are some typical characteristics of oral examinations which our conception takes into account: The subjects of an examination in the field of mathematics are the theorems, proofs, concepts, applications, and problem solutions of one or more domains. An examination should cover the whole material. Therefore the examiners employ typical dialogue strategies. Some of the topics are discussed in a detailed way and the rest of the material is covered by a series of spot check questions. The transition from one question to another is generally controlled by mathematical connections or by the answers of the student. The time which is spent on the detailed exploration of a topic essentially depends on the performance of the examinee. When the student shows knowledge gaps or insecurities with a topic the examiner will further inquire to clarify the background knowledge and abilities of the student, e.g. by sticking to the the central points, by asking additional questions related to the foreknowledge, or by giving another problem to solve. In that case, the reaction of the examiner is strongly triggered by the answers. Usually, the rating of the examinee's performance does not only depend on the ratio of correctly answered questions and wrongly answered questions, but also on the flexibility and easiness with which the student deals with the questions and hints during the dialogue.

Mathematical Knowledge Base

The mathematical knowledge groups around the following objects: concepts, theorems, and task types. The specification of the objects includes a series of attributes referring to the object itself and its use of holding a dialogue. We will describe the representation of theorems in a more detailed way and mention only a few details related to concepts and task types because of space limitations.

To word the premises, the conclusions, and the proof(s) of a theorem we employ a restricted natural language (see Schmidt 2000) or the website (see Schmidt 2001).

Representation of Theorems

The specification of a theorem consists of a series of attributes related to various information: Object describing information, classifying information, didactical information, application related information, transitional information, and error information. In the following we describe the attributes in the context of the specification of the mean-value theorem (Fig. 1). To represent the mathematical knowledge we use XML (see e.g. Goldfarb & Prescod 1998). The informal representation of figure 1 is chosen because of readability.

```
THEOREM
   DOMAIN: calculus
   SUBDOMAINS: differentiable functions
   CATEGORY: existence of a point
   PRIORITY: high
   FOREKNOWLEDGE: continuous, differentiable
   NAME: mean-value theorem
   PREMISES:  f: [a,b] -> R
                  f IS continuous IN [a,b]
                  f IS differentiable IN (a,b)
                     ERROR: (CONDITION "f IS differentiable IN [a,b]",
                                REACTION  "IN [a,b] is not necessary.")
   CONCLUSIONS: SOME x0 IN (a,b):   f(b)-f(a) = (b-a)*f'(x0)
   USES: (THEOREM, CONCLUSIONS, "f IS monotonously increasing IN[a,b]")
   TRANSITION: (THEOREM, generalized mean-value theorem,
                  FORMULATE(THEOREM, generalized mean-value theorem),
                  "There is a generalization of the mean-value theorem.")
   TRANSITION: (THEOREM, mean-value theorem IN R^n, ...)
```

Figure 1: Partial specification of a theorem

Object describing information. The object describing information consists of a series of attributes including the external name (if one exists) of the object, its internal name, the premises, the conclusions, and the proof(s). See the example of the figure 1.

Classifying information. Each object belongs to a domain and possibly to one or more subdomains and subsubdomains. The theorem above e.g. belongs to the subdomain of the differentiable functions. The theorems are moreover classified with regard to their conclusions; the category of the mean-value theorem is e.g. *existence of a point*. The underlying idea of that classification is that the proofs of the theorems belonging to the same category often employ a similar proof strategy and utilize related heuristics. That information becomes relevant in the context of proof related questions. Further categories of theorems among about a dozen others are e.g. *property of a function* and *uniqueness of a value, a point or a function*.

Didactical information. Didactical information among others refers to the foreknowledge and to the priority of the object. The information regarding the priority which is high in the case of the mean-value theorem is utilized to control the selection of questions.

Application related information. Application related information employs two attributes. The attribute *uses* states the use of the theorem with respect to proofs of other theorem. The example of the figure 1 shows that the mean-value theorem is used to prove a theorem which concludes about a function being monotonously increasing. The other attribute *applications* refers to practical applications.

Transitional information. Transitional information refers tò the order of questions and successors of questions in a dialogue. Transitions from one object or attribute to another are explicitly or implicitly defined by the knowledge base. Implicit transitions are e.g. triggered by the premises or the conclusions of a theorem. The specification of the figure 1 contains two explicit transitions to two other theorems, a generalization of the mean-value theorem and a version of the theorem in the case of n dimensions. The attribute *transition* takes four parameters: The object classification, the name of the object, the question (see below), and possibly a text which is used to word the transition in a dialogue.

Error information. Error information may be attached to some attributes of a specification. That information serves the purpose of specifically treating expected errors. Simple error information takes two parameters: The first one specifies the error and the second one words the reaction of the system. The *error* attribute of the figure 1 refers to the preceding statement "f IS differentiable IN (a,b)". See the discussion of errors below. Error information may be nested to cope with succeeding errors.

Representation of Concepts and Task Types

The specification of a *concept* consists of a series of attributes including among others its name , the premises, the defining statements, examples, and counter-examples.

A mathematical *task type* covers tasks which may be solved by the same or by similar methods. With the specification, we make a distinction between formula manipulation task types (e.g. the calculation of a limit or the solution of a differential equation and word problem types (e.g. extremal value problems which describe a geometrical situation). The tasks of both kinds of task types are on the top level classified into *subtypes* which may be characterized by certain patterns, by the solution methods, or by the values of certain relevant parameters of the task type.

The Questions and the Monitoring of the Answers

The various types of questions employ a certain format. There are several attributes attached to the question types including the question template, the answer directions, and possibly an answer template. In general, the questions of the system are presented in a natural language and the students word their answers by using the above-mentioned restricted natural language.

Questions Related to Theorems and Proofs

There is a list of standard question types which refer to the premises, conclusions, proofs, uses, and applications of a theorem. The following list of question types shows their formal statements. The formal statement of a question type is among others used in the context of specifying a dialogue (see below). The program system employs an XML representation as with the knowledge base.

(a) FORMULATE (THEOREM, theorem name)
(b) FORMULATE (PREMISES, statement)
(c) FORMULATE (CONCLUSIONS, statement)
(d) FORMULATE (USES, theorem name)
(e) FORMULATE (APPLICATIONS, theorem name)
(f) FORMULATE (PROOF, theorem name)

The question type **(a)** refers to the formulation of a theorem when its name is given. An example of a concrete question is "Formulate the mean-value theorem". The *answer template* consists of the words "mean-value theorem", "PREMISES", and "CONCLUSIONS". The user has to particularize the premises and the conclusions by using the above-mentioned restricted natural language. The *answer directions* consist of the format of the statements which may be used to word a theorem.

The question type **(b)** refers to the formulation of premises from which a given conclusion may be derived. An example of a concrete question is "Which premises are sufficient so that the function f:[a,b] -> R is monotonously increasing in [a,b]?".

The question type **(c)** refers to the formulation of conclusions which may be inferred, if given premises are valid. An example of a concrete question is "The function f:[a,b] -> R is continuous in [a,b]. Which properties of the function f may be inferred?

The question types **(d)** and **(e)** refer to the listing of uses and of applications of a theorem. An example of a concrete question is "Give applications of the theorem of Taylor."

The question type **(f)** refers to the formulation of a proof. An example of a concrete question is "Prove: If f is differentiable at a , then f is continuous at a."

The above-mentioned standard question types may be modified so that the answers are shorter, more specific, or easier. Some examples are: With **(a)** some parts of the theorem may be provided so that the wording of the theorem must only be completed. With **(f)** the question may refer to the proof ideas or to completing a given proof by adding e.g. lacking foundations or lacking statements. We here omit further details.

Monitoring and Verifying the Answers Related to Theorems and Proofs

To monitor and to verify the answers of a user the system employs on the one hand the knowledge base of concepts, theorems, proofs, and task types and on the other hand methods of theorem proving and of formula manipulation. In the following we assume that the reader is familiar with the basic concepts of theorem proving, especially with the transformation of a logical formula into a quantifier free form and with the process of unification (see e.g. Bibel 1987 or Chang & Lee 1973). Regarding the theorem proving techniques we utilize methods which are similar to the methods of Bledsoe, Boyer, and Henneman to automatically prove limit theorems (Bledsoe et al. 1972).

An important goal is that correct answers are recognized as correct by the system. It is known that theoretical limitations restrict the possibility of deciding whether an answer is correct (see e.g. Richardson 1968 and Bibel 1987), but such cases here are of a minor importance. The aim here is to also accept alternative, correct answers which are not identical to the correct answers which are calculated, derived, or stored by the system. One cannot expect that a computer program could compete with a human in the field of intelligently treating the answers of a user. Nevertheless a detailed knowledge base and the methods of theorem proving and of formula manipulation allow for a useful and reliable treatment of the answers.

Earlier research in the domain of Intelligent Tutoring Systems suggests that competent error handling is a difficult and tedious task even in the case of apparently simple procedural problem solving (see e.g. Wenger 1987). The framework provided by Collins and Stevens who list 24 rules in the context of the Socratic method of tutoring is helpful with respect to classifying general errors like e.g. overgeneralization bugs or overdifferentiation bugs (Collins 1977; Stevens & Collins 1977). When an answer is recognized as not being correct, several mechanisms may be applied to diagnose the error and to react in an appropriate way. The mechanisms which are used depend on the question types, on the contents of the knowledge base including the specification of errors within the concrete objects, and on the methods which are provided by the logic subsystem and by the formula manipulation subsystem. The specificity of the possible feedback of course depends on the detailedness of the knowledge base and on the error classifying possibilities of the subsystems.

In the following we will give some examples of how the answers are diagnosed and treated.

*Monitoring the questions of the question type **(a)**.* To check a user's formulation of a theorem the system employs the theorem of the knowledge base. The answer is correct when the user's premises and conclusions correspond to those of the theorem in the knowledge base. The statements are compared using a quantifier free form and the process of unification.

Some general errors which may occur are: A premise or a conclusion is lacking, a premise is not sufficient or not necessary, and the conclusion is too weak or too strong. Assume that the question refers to the mean-value theorem and the user enters "f IS differentiable IN [a,b]" as a premise instead choosing the open interval (a,b). That error can be treated by utilizing the specification of the error in the object mean-value theorem (Fig. 1). The reaction of the system succeeds the error condition (Fig. 1). In the case that the error is not specified with the mean-value theorem, the error would have been detected by comparing the user's answer with the correct answer and by establishing that the statement "f IS differentiable IN [a,b]" subsumes the statement "f IS differentiable IN (a,b)" and so is not necessary.

*Monitoring the questions of the question type **(b)**.* The basis of checking the premises from which a given conclusion may be derived are the theorems of the knowledge base which infer that conclusion. When a user e.g. enters the premises P1, P2, and P3 the system checks whether there is a theorem in the knowledge base with the premises P1, P2, and P3 and the stated conclusion. Similar considerations as in the case of **(a)** apply.

*Monitoring the questions of the question type **(c)**.* Assume that the premise P is given and the knowledge base contains several theorems inferring the conclusions C1, C2, ..., Cn from P. When the user enters one of the C's the answer is correct. Assume the user enters D which does not correspond to one of the C's. Then the theorem "P implies D" might be wrong or correct. In the correct case, the theorem is likely a marginal one, because it is not a part of the knowledge base. In the wrong case, certain errors can be detected by checking whether a theorem "D implies P" is a part of the knowledge base. If "D implies P" is a valid theorem and D and P are not equivalent, there will probably be a counter-example in the knowledge base. An concrete example of that case is the wrong conclusion "f is continuous at x0 implies f is differentiable at x0".

*Monitoring the questions of the question type **(d)** and **(e)**.* The questions referring to the uses and applications of a theorem mainly involve keywords as answers. Providing a list of synonyms is sufficient in most cases. More difficult questions may be handled by multiple choice questions.

*Monitoring the questions of the question type **(f)**.* The monitoring of a user's proof is discussed in (Schmidt 2000).

Absurd answers. A human examiner cannot only check the correctness of an answer, but also the degree with which an answer is sensible in contrast to being foolish or inadequate. The worth and the assessment of a system increases when the system can eliminate absurd answers by a corresponding reaction. One such method is based on decomposing an answer into its syntactical parts and checking whether they correspond to the correct answer. In the case of the mean-value theorem the conclusion consists of an existential quantification which is followed by a formula containing the quantified variable. An answer which does not fulfil that restriction is regarded as being not appropriate and is treated by a corresponding comment. Since the XML representation of the objects covers the decomposing, such syntactical means may be applied without adding further knowledge elements to the mathematical objects.

Questions Related to Concepts and Task Types

We here just mention some question types related to concepts and task types. We omit further information because of the lack of paper space.

The question types related to concepts are: (i) The formulation of the definition of a concept, (ii) stating examples of the concept, (iii) stating counter-examples of the concept, (iv) deciding whether a given object is an example of the concept, (v) stating equivalent definitions, and (vi) stating sufficient conditions which imply the concept.

The questions related to task types are: (i) Calculation or solution of a formula manipulation task (e.g. calculation of a limit, an integral, the solution of a differential equation). (ii) classification of a task and stating the solution method, (iii) listing classes of tasks holding a certain property, and (iv) setting up initial equations to solve a problem which is stated in a natural language (e.g. an extremal value problem).

Dialogues

The Selection and the Order of the Questions in a Dialogue Session

A dialogue consists of a series of questions and answers. The selection and the order of the questions on the top level may be controlled by three different mechanisms: (i) By an external explicit specification of the subjects of the dialogue, (ii) by several dialogue strategies which are offered by the system, and (iii) by an explicit choice of single questions by the user. In the following we briefly describe the three mechanisms.

(i) Explicit specification of the subjects of the dialogue. The selection of the questions and their order may be explicitly specified in a DIALOGUE statement. Specifications of typical dialogues are provided by the system. They may be easily joined to form a complete session. This mechanism is useful when there is information about which knowledge is relevant in the current situation. The example of figure 2 shows a part of a dialogue specification (the program system employs a corresponding XML representation). There is a sequence of questions at first asking the definition of differentiable, secondly inquiring after a counter-example of a not differentiable function, and thirdly asking the formulation of the theorem of Taylor.

```
DIALOGUE
  FORMULATE (DEFINITION, "f IS differentiable AT x0")
  FORMULATE (COUNTER-EXAMPLE, "f IS differentiable AT x0" )
  FORMULATE (THEOREM, theorem of Taylor)
```

Figure 2: Explicit specification of a dialogue

(ii) Dialogue strategies which are offered by the system. The objects which the knowledge base contains automatically trigger questions (e.g. the above-mentioned questions of the question types) and transitions to questions related to other objects (e.g. by the specified transitions or by the specified or implicitly given foreknowledge). For an implicit selection of questions we currently distinguish between the following three dialogue strategies which take into account the characteristics of oral examinations:

(a) A *spot check dialogue* relates to a domain, subdomain or subsubdomain and chooses questions so that all the parts of the subdomain are essentially covered by the questions. A corresponding statement is e.g. SPOT CHECK DIALOGUE (SUBDOMAIN, continuous functions) which triggers questions related to the subdomain of continuous functions. By the choice of additional parameters one may definitely include certain topics (e.g. all the theorems with a high priority) or exclude certain topics (e.g. task types or transitions to objects to other subdomains).

(b) An *exploration dialogue* tries to explore one or more objects or a small subdomain in a systematic way to a certain degree. E.g. the statement EXPLORATION DIALOGUE (THEOREM, mean-value theorem) triggers the questions which are explicitly or implicitly related to the mean-value theorem. By the selection of parameters one can include or exclude certain questions.

(c) A *problem solving dialogue* refers to a task type. It consists of solving problems and of answering questions related to the methods which are used to solve such problems. An example is PROBLEM SOLVING DIALOGUE (TASK TYPE , ordinary differential equations).

(iii) Explicit choice of the user. The uscr can traverse the objects of the knowledge base and get a list of the questions and problems from which he or she can choose anyone.

The Student Model

Thc scaffold of a student model is based upon the subdomains and their objects. The model stores information regarding three general aspects. *One aspect* is the material which is relevant to the student. The student may explicitly or implicitly (by selecting related questions) choose the subdomains or the objects. The *second aspect* is the self-assessment of the own knowledge. A student may state his or her own understanding or performance (good, medium, poor) with the subdomains, with single objects, and with the general categories of theorems, proofs, concepts, and solving tasks. Whereas the utility and the use of diagnostic processes are main subjects with tutoring systems, the topic of self-assessment is widely neglected as a basis of tutorial actions. That is surprising since the students may in most cases realistically assess their mathematical abilities and they usually know when they do not understand a subject and they know their deficiencies. The *third aspect* refers to the concrete dialogues and the student's performance. A trace of the details of the dialogue (e.g. questions, hints of the system, errors) is stored and abstracted to form a view of a student's knowledge and ignorance of the material of the subdomains and of the theorems, the concepts, and the task types. Another factor is the user's ability of correcting errors or utilizing hints. The contents of the user model may influence the progress of the dialogue: Wrong answers may change the order of questions (e.g. it is not sensible to discuss a concrete application of a theorem when the user does not know the theorem) or trigger additional questions (e.g. an answer may show that a user is not familiar with some foreknowledge; the system would then put some questions related to the foreknowledge).

Summary and Outlook

We outlined a conception of a knowledge-based dialogue system dealing with mathematical material in the domain of calculus. Such a dialogue system may be employed in the context of a virtual university or of a face-to-face university and the applications may include the preparation of oral examinations.

Our current prototype includes an interface to print the questions and enter the answers, some procedures of theorem proving and an own formula manipulation system. The programming language is Java including the servlet API. The program system is developed as a web application. The knowledge is represented using XML. The prototype will be further developed with respect to the methods and to the knowledge base.

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Technology to Teach the Teachers

Since the arrival of the affordable personal computer, some educators have heralded it as the vehicle for a new paradigm of education, whereas others have argued that "the use of computers as a medium of instruction and as a tool for learning is largely incompatible with the requirements of teaching."

Those who would argue against the use of technology in the classroom seem to be individuals who are not personally comfortable with utilizing it themselves and are unlikely to have experienced it applied to their own educational process. Whereas those teachers who are more at ease with information technology, and use or have experienced it themselves, are three times more likely to utilize it as a resource for their students.

Interestingly enough there also seems to be a division of educational philosophy that correlates to these two groups of educators. The former category tend to be individuals who see education as carefully planned direct instruction on narrowly defined content or skill. They believe in "standards based" assessment that seeks to provide a fair degree of accuracy regarding

The latter group generally seems to be more interested in a student's capacity to understand and the development of a sense of meaningfulness of the information and are more likely to use measures of "performance of understanding" as a means of evaluating a student's mastery of the material.

Consequently, if we are moving into a future where the use of technology in the classroom it would be integrated into the entire educational experience, the teacher would be familiar with information technology and would model its use to resolve a variety of academic problems. He or she would have had the genesis of this experience during his or her training to become a teacher.

Such training in many ways is not different than the training needs that face most major global corporations. What is needed is a central repository of critical information that can be transmitted to the end user in a "just-in-time" fashion, that does accurate user profiling as well as accurate assessment of the student's mastery of the specific subject area or skill. In addition there would be exposure to a variety of more creative thinking tasks where the student had a chance to experience simulations or develop applications of information to problems in such a way as to demonstrate a true and deep understanding of concepts. Ideally this process is tailored to a student's individual learning strengths. And the student could study any time around the clock and from any distance away.

The "technology savvy" teacher might have a 'master educator' who would start from a 'baseline' that was acquired by some form of interview or -test" that would determine the student's current understanding. This is best done in a manner that doesn't leave the student with a sense of failure or incompetence thereby diminishing self-confidence.

There might also be a strategy wherein this 'master teacher' would determine individual learning style by identifying if a student's preference would be auditory, visual, tactile, or multi-sensory. Furthermore, methods may be developed to determine an individual student's frustration tolerance in order to know how to pace the instruction as well as identifying positive reinforcers that would serve as rewards for consistent effort. Assessment techniques could evaluate broad content coverage as well as in depth on specific skills

Other variables that could be identified to maximize the student's learning could be:

- Instructional History - To remember exactly where the student left off, what was discussed, what was learned, and what needs to be covered.
- Error Analysis - To determine a student's area of weakness.
- Study Scheduling - To generate reminders about the duration and frequency of sessions required for mastering the material.

To really place demands on this 'master teacher', he or she would be available 24 hours a day, 7 days a week, 365 days a year. This teacher would never be impatient or tired and would even attempt to make learning more pleasurable by appearing as a character more to the student's liking or interest.

And finally, and perhaps most remarkably, this teacher would be able to meet all these demands for every student in the class!

Information technology and artificial intelligence research has yielded software with natural language understanding. Software robots (or 'agents') have already been developed that tors" to teachers in training and can follow them into their educational careers as their "virtual assistants". They would bring an availability that could also extend to parent's as well. There could always be an answer to "What was the homework" or "How are my child's grades?" or "Was the assignment passed in?" Depending on how 'wired' the parent is, this "virtual teacher assistant" could be accessed by computer or any wireless web device.

These smart bots have other applications as well. Anywhere that a human guide would be helpful by answering repetitive questions for information are ideal applications.

They could serve as online human resource representatives who could give information on policy and procedures or the status of retirement plans or accrued sick days. They could automate attendance or tardiness records and have them immediately available for parents to check.

Guide students through online admissions procedures or course listings. Have them take courses at their own pace, any time day or night; without having to commute. Use them to set up intellectual neighborhoods or search for information for papers and research.

And all of this is done without having to browse a website or determine the appropriate keyword for a query. You just ask the smart bot and it takes you exactly where you want to go.

This is not the future…this is now. This is the marriage of technology and education that will make not only make the computer compatible with the requirements of teaching it will make it a necessary component.

Teaching Scientific Thinking Skills: Students and Computers Coaching Each Other

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Abstract: Our attempts to improve science education have led us to analyze the thought processes needed to apply scientific principles. Using a reciprocal-teaching strategy to teach the necessary thought processes explicitly, we have developed computer programs called Guided-Practice (GP) PALs (Personal Assistants for Learning) in which computers and students alternately coach each other. These computer-implemented tutorials make it practically feasible to provide students with individual guidance and feedback ordinarily unavailable in most courses. This guided practice however is not sufficient to ensure that students develop the ability to perform independently. Accordingly, we developed Independent-Performance (IP) PALs in which students work independently, receiving only the minimal feedback necessary to complete the task. GP PALs are then frequently followed by IP PALs to create effective instruction which facilitates a gradual transition to independent performance.

In a comparative study, GP PALs were found to be nearly as effective as individual tutoring and considerably more effective than instruction provided in a well-taught course. Another study is currently being conducted to assess the added efficacy of the IP PALs — results will be reported.

Introduction

Many students emerge from science courses unable to apply the scientific principles that they ostensibly learned. This paper describes work specifically aiming to teach the application of Newton's law (a fundamentally important principle in introductory physics). To address students' difficulties in applying this principle, we analyzed the required procedural knowledge and thinking skills, including the basic skills of decision-making and assessment. By using instructional strategies for teaching these thinking skills explicitly and using computers as practical means of providing individual guidance and feedback, we devised highly interactive instruction where the computer and student take turns coaching each other. A gradual transition toward students' independent performance is also facilitated. And finally, we carried out a series of studies to assess the efficacy of this instruction.

Computer Implementation of Instructional Strategies

To help students learn to carry out the thought processes needed to apply Newton's law, we have developed a set of highly interactive computer tutorials called PALs (Personal Assistants for Learning). These PALs employ cognitively-based instructional strategies and are a practical means of providing the individual guidance and feedback lacking from most traditional instruction.

Explicit Training of component skills: "Reciprocal Teaching

We have employed a modified form of "reciprocal teaching" (Palincsar & Brown, 1984) which involves two alternating modes of interaction between a student and a tutor. (1) *Tutor coaching student:* The tutor decides what to do and gives corresponding directions, the student implements these, and the tutor assesses and corrects. (The tutor acts as a coach.) (2) *Student coaching tutor:* The student and tutor reverse roles. The student decides what to do and gives directions, the tutor implements these (but may deliberately make mistakes similar to those common among students), and the student assesses and corrects. (The student now acts as a coach.)

This strategy should be effective for the following reasons: The instruction is highly interactive and keeps the student actively engaged. The basic processes of deciding, implementing, and assessing are made highly explicit. As the tutor and student alternate in their coaching roles, the tutor repeatedly models good performance that the student can then emulate. The tutor constantly monitors student performance, providing feedback and instruction designed to remedy the student's mistakes.

Computers were used to implement this instructional strategy resulting in two types of Guided-Practice PAL tutorials (corresponding to the two modes of interaction in the reciprocal teaching strategy).

(1) Implementation Guided-Practice PALs: PAL (the computer acting as a Personal Assistant for Learning) plays the role of coach, deciding which actions the student should implement and then assessing the student's implementations.

(2) Coaching Guided-Practice PALs: Roles are reversed and the student now acts as a coach deciding on actions and assessing the implementations done by PAL (who may make mistakes).

Progressive Development of Independent Performance

The reciprocal-teaching strategy provides students with good individual guidance and feedback. But repeated guided practice alone is *not* sufficient to guarantee that students will ultimately perform well independently without external assistance. There is a need for a strategy helping students to attain such independence.

We use a strategy where guided-practice sessions, using reciprocal teaching, are frequently followed by independent-performance sessions. In these the student is asked to work independently on a somewhat similar task, while getting only the minimal feedback necessary to complete the task successfully.

This strategy has a number of advantages. The transition to independent performance is integrated throughout the instruction. Also, students are more motivated to engage in careful learning during a guided-practice session since they know they will be required to perform similar tasks independently.

Computers were used to implement this instructional strategy. In the resulting *Independent-Performance PALs*, students are presented with an entire problem to solve independently on paper. The student then enters his answers on the computer. If the student's answers are correct, PAL congratulates the student and considers the tutorial satisfactorily completed. Otherwise, PAL gives the student some feedback and asks him to try again. This cycle is repeated, with progressively more detailed suggestions, until the student manages to successfully complete the problem.

The goal of the Independent-Performance PALs is to encourage the student to complete the problem with minimal assistance. Interspersing these Independent-Performance PALs with the Guided-Practice PALs is our attempt to help the students develop the ability to perform independently.

Assessment

In the Fall of 1996, we carried out a comparative study to assess the efficacy of the Guided-Practice PALs which showed the following (Reif & Scott, 1999): (1) The Guided-Practice PALs were found to be nearly as effective as individual tutoring by experienced tutors, but required much less instructor time. (2) The Guided-Practice PALs prevented nearly all the students from failing the subsequent test (i.e., getting scores less than 65%). By contrast, about half of the equally able and motivated students failed this test when they received only the instruction provided in the course. (3) Students liked the PALs, found them helpful to their learning, and perceived they were learning useful ways to think about physics.

Another study is currently being conducted to assess the added efficacy of the Independent-Performance PALs. Results from this study will be reported in the presentation.

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Using Electronic Art to Define Navigation Paradigms for Hypermedia Communication

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Abstract: Hypermedia computer programs are an important part of today's educational curricula, and the computer interface plays a critical role in the interpretation of information in these programs. Students are fascinated with the amount of information that is available, but they often feel overwhelmed because they don't know how to organize the information into a coherent whole. The ability to synthesize information is hampered by interface designs that separate information into fixed categories and hierarchical structures rather than emphasizing relationships. Electronic artists are developing new forms of audiovisual discourse that reflect the networks of associations in interactive electronic communication. This paper discusses the parallels between the semantic structures in various forms of electronic art and the complex information matrices in electronic communication. This paper shows how electronic art can provide new perspectives for hypermedia interface design.

Introduction

With the explosion of the World Wide Web, interactive multimedia computing is fast becoming the standard for communication in the information age. In these multimedia environments, it is easy to become absorbed in the detailed process of selecting and following links, and lose sight of original goals and the relationships between individual pieces of information.

Navigation in these environments creates new semantic structures that are changing the way we organize and interpret information by enabling us to modify perspectives and restructure reality. In these discursive environments, the lines between image and language become blurred. Text takes on characteristics of visual imagery because words derive meaning from their positions in space and time. In turn, the semiotic structure of the digital image defines a new visual aesthetic in which symbols become interpretations of symbols, and multiple levels of graphic encoding take on discursive characteristics similar to linguistic syntax (Search 1993). In these environments, where conceptual links between images and text replace tactile and kinesthetic interaction, new forms of creative expression codify form, space, action, and time into diverse levels of abstraction.

However, we are just beginning to understand the power of this medium to reshape the way we communicate and interpret audiovisual information. Unfortunately, the designs of most interactive programs are still influenced by Western perspectives of space and time that emphasize logical analysis and sequential hierarchies. These perspectives are often at odds with the spatial and temporal experiences in an interactive multimedia environment where simultaneity, random access, and non-narrative communication are emphasized. Moreover, in interactive programs, the navigation process defines cycles of action and events that establish a dichotomy between the *possible* and the *actual*. In other words, there is always the actual information at hand as well as the potential for new information or associations. This tension is not accurately represented by the language and structure of electronic interface designs (Search, 1999). The interactive process represents a fluid, temporal transformation of ideas. A new audiovisual grammar that uses the holistic synthesis of audiovisual patterns is needed to represent the metastructural dynamics of this transformative process. In "The Sadeian Interface: Computers and Catharsis," Mike Phillips points out that we have no "interactive" heritage to deal with the "fifth dimension" of computer interaction. Although we can look to individual disciplines for ideas and inspiration, it is the "convergence of these design practices that should be forcing a paradigm shift to a holistic media experience rather than a fragmented mish-mash of muddled aesthetics" (Phillips, 2000, p. 28).

For many years artists working with electronic media have been experimenting with techniques that could be used to enhance multimedia interface design. This paper examines the work of some of these artists and shows how these techniques could be used in hypermedia interfaces to reduce the fractionization of information and encourage the creative synthesis of ideas.

New Navigation Aesthetics

In interactive electronic environments, text and images appear and disappear on the screen as links are selected. The changes in the spatial location of the text and graphics impact the semantic structure of the text and audiovisual information. A navigation structure emerges that defines text and images in terms of events in space and time. Text takes on graphical as well as linguistic characteristics. Conventional perceptions of space and time are easily altered depending on the "location" of the audiovisual information in a spatiotemporal matrix.

Image maps that link to other information take on additional layers of meaning. There is the semantic meaning of the image based on the context of the image, and there is the syntax of the image based on the design (layout, color, etc.). There is also the navigation structure defined by the links to other information. As a result, the visual symbols do not necessarily represent sequential logic or causation. Instead, they represent the process of transformation. These visual matrices are even more complicated when the images are abstract images because abstract images, which do not depict specific objects, represent fluid relationships that are open to interpretation.

The aesthetics of navigation in hypermedia communication has not been fully explored. Navigation paradigms should create dynamic structures that encourage the exploration of new interpretations and relationships. At the same time, the navigation structure should help the user identify the continuity between ideas and synthesize information. Links or associations between ideas create cognitive patterns based on relationships not objects. How do we identify and visualize these patterns?

Before we can learn to identify and use these patterns we need to recognize some obstacles that limit our perception of spatiotemporal events. Language and graphics are the primary methods of defining spatial and temporal relationships in computer interfaces. With the development of language in the West came linguistic categories, deductive reasoning, and diachronic logic, all of which define sequential hierarchies in space and time (Search, 1996). Current interface designs in hypermedia programs use language and graphics that reflect these cognitive hierarchies. Most navigation paradigms are defined by the Western perspective of time that represents a linear, one-directional perspective in which space is an empty area that separates objects. Windows, files, and folders separate information and isolate moments in time instead of emphasizing interrelationships. In these electronic environments, events occur in space as well as time. The space between events, which represents the links or interrelationships between ideas, is no longer empty and void of meaning. Navigation through these spaces represents the process of transformation. We need navigation structures that emphasize the fluid dynamics of these information spaces. We need structures that represent the *possible* as well as the *actual*.

Phillips defines this new area of study "Activity Theory." This theory "explores the complex feedback loops between the impact the use of a tool has on the environment and the impact the modified environment then has on the human" (Phillips, 2000, p. 80). We need audiovisual interfaces that represent this dynamic, transformative process.

The rest of this paper investigates the aesthetics of design and action in various forms of electronic art. The paper makes recommendations for incorporating some of the design elements in these works into interface designs for interactive multimedia or hypermedia programs. Many of the artworks cited in this paper can be viewed on the web sites cited in the footnotes.

The Multiplicity of Text

Artists working with electronic text have created projects that present some new opportunities to experiment with the syntax of language when there are multiple layers of meaning in text. These projects demonstrate interesting ways to use text to represent the multiple levels of interpretation that we find in interactive information spaces.

Thorne Shipley conducts theoretical research in "pattern and matrix vision" (Shipley, 1974). His work investigates the different levels of perception and cognition that are defined by visual patterns or textures in linguistic messages (Search, 1993). Shipley is exploring what he terms "heterological message duality" or "message multiplicity" (Shipley, 1993, p. 27). He illustrates this concept using words that are typographically constructed from other words. For example, in one of his illustrations, the text for the word *yes* is repeated in a pattern that forms the shapes of the letters in the word *no*. Similarly, the text for the word *you* forms the shape of an *I*, and the word *will* creates each of the letters in the word *won't*. When these typographical constructions appear in phrases like *No. I won't*, the visual patterns within each word communicate a secondary message--*Yes, you will* (Shipley, 1993). Symbols become interpretations of symbols.

The work of artist Jim Rosenberg adds another level of inquiry to these visual-linguistic maps. He uses "word clusters" to experiment with the syntax of words that occupy the same point in logical and physical space (Search, 1993). In his interactive program *Intergrams* (1990) [1], groups of phrases, made up of words that overlap each other in the same space, appear on the screen as masses of black lines. In this form, the phrases are indecipherable. However, by moving the computer mouse over the word cluster, individual phrases in the group appear one by one (Rosenberg, 1991).

Both Shipley and Rosenberg create layers of words within words in order to define new relationships and meanings. The revealing of these layers takes place in a single location, emphasizing the fact that the layers of words and meanings are related. A similar technique can be used in an interactive environment where related information, that forms a single visual entity, changes into new words or graphics and by so doing, reveals the integrated structure of the relational web. As Rosenberg points out, this syntax " . . . allows for elements that are juxtaposed without structure to be combined into a larger structural whole. . . Syntax becomes an option but not an obstacle" (Rosenberg, 1993, p. 12).

Other examples of electronic art that use text to represent different layers of interpretation can be found in hypertext fiction. In his work entitled *Hegirascope* [2], Stuart Moulthrop uses a similar visual layout on each page. This layout consists of individual textual links that surround a body of text. However, the text in the links changes on each page. The standard layout provides a coherent structure for the information while the changing text in the links results in a dynamic, open syntax that is always evolving.

In all of these examples, text maintains an inherent structure with an underlying, "original" meaning, but the text also takes on many different visual and linguistic interpretations based on events in space and time. In a hypermedia environment, we can embed text and graphics with layers of meaning and use this "message multiplicity" to represent the pluralistic meaning of complex information structures and the *possible* as well as the *actual* relationships. Plumb Design, a web site design firm, created the Visual Thesuarus which is an experiment in using linguistic syntax and text to map relationships in an information space [3]. The company's Thinkmap™ software creates Java Maplets™ that connect related words by fine lines to form a dynamic visual diagram. The diagram changes when the user conducts a new word search and/or specifies a different grammatical use of the word (noun, verb, adjective, adverb). Unfortunately, in the Visual Thesaurus and in the commercial applications created by Plumb Design, the relationships between the words are not always intuitive. Sometimes there are too many visual links in the diagrams, and the relationships are obscured. Nevertheless, these efforts by Plumb Design are a first step toward visualizing the networks of associations that exist in interactive databases.

Metastructural Dynamics of Digital Images

Computer graphics provides techniques for visualizing the fluid relationships in complex information networks. Computer-generated images can symbolize spatial structures with multiple links and layers of association. For example, highly reflective and transparent images that show the surrounding environment on their surfaces become image maps that represent the multiple dimensions of complex, integrated media spaces. The reflective and transparent surfaces show specific detail within the context of an integrated whole. In Yoichiro Kawaguchi's computer animations, these types of surfaces appear on organic, flowing forms [4].

[1] http://www.well.com/user/jer/VL.html
[2] http://raven.ubalt.edu/staff/moulthrop/hypertexts/HGS/
[3] http://www.plumbdesign.com/thesaurus/
[4] http://www.siggraph.org/artdesign/gallery/S98/pione/pione2/kawaguch.html

Visuals like these can represent the fluid structure of hypermedia computing where relationships continually change. Images with reflective surfaces, which show surrounding space and objects, embrace space and time from all directions rather than limiting the vantage point to a singular perspective. The space becomes all-inclusive and *n*th-dimensional (Search, 1993). In hypermedia environments, this type of image can symbolize the simultaneous existence of different layers of information. Because the images show detail within the whole, the images represent microcosmic as well as macrocosmic relationships.

Computer-generated images also provide new ways of visualizing navigation and the dynamic transformation of ideas. Images that integrate geometric objects with variations in texture, color, transparency, or reflection symbolize the underlying structure of the database, and at the same time, represent the fluid nature of the relationships in the database. Such works include the computer paintings of David Em (*Transjovian Pipeline*, 1979; *Zotz*, 1985) [5], William Montgomery (*Peaceful Sky*, 1996; *Rotated Sphere*, 1997) [6], and my own artwork (*Coloratura 100*, 1988; *Kaleidoscope*, 1992). In these works the geometric objects represent the continuity of ideas while changes in color, texture, transparency, and reflection create perceptual transformations that challenge the viewer to abandon the limitations of fixed hierarchies and search for new associations (Fig. 1). Because of their Gestalt-like, holistic properties, visuals similar to these types of images can be incorporated into electronic interfaces to symbolize the dynamic relationships in information networks and at the same time, help the user synthesize information into an integrated whole [7]. The potential for using computer-generated images as navigational aids in hypermedia computing is not limited to three-dimensional images with intricate surfaces. Many artists transform the lines and planes of two-dimensional art into volumetric extensions of space (Search, 1993). These types of graphical transformations have been an integral

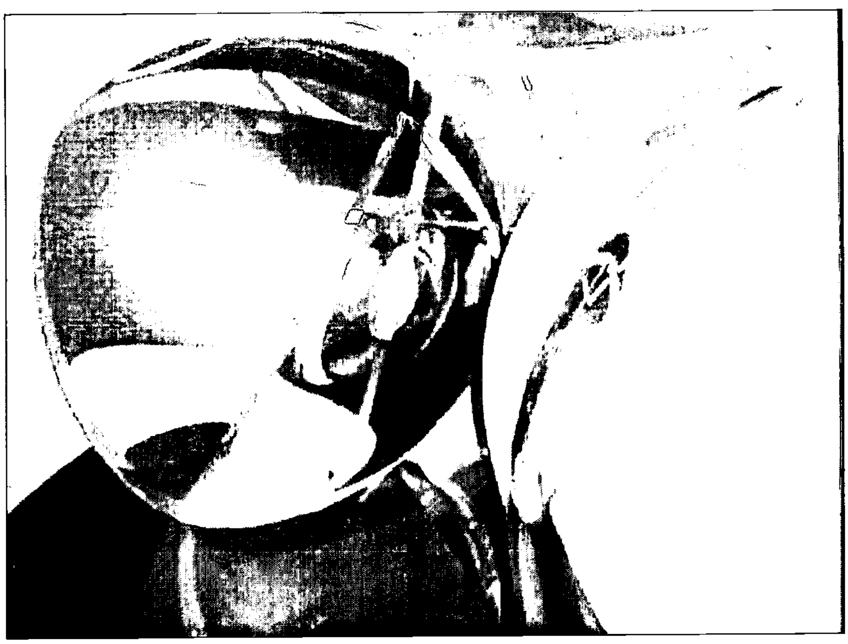

Figure 1: Geometric objects with reflective surfaces represent the continuous whole as well as the relationships between the individual components that make up the whole. *Coloratura 100* Copyright 1988 by Patricia Search. All rights reserved. http://www.rpi.edu/~searcp/coloratura.html

[5] http://www.siggraph.org/artdesign/profile/David_Em/portfolios.html

[6] http://www.treesfly.nu

[7] Geometric shapes such as circles and squares are continuous entities that represent a unified whole. Research in Gestalt Psychology has demonstrated that we visually link similar shapes, lines, colors, etc. Interface designers can use these laws of visual perception to help viewers combine individual components of the interface into an integrated whole.

part of computer graphics for many years. Examples include the works of artists such as Eudice Feder (*Homage to Mohology-Nagy*, 1979) [8], Vera Molnar (*Hypertransformations*, 1973-76), and Daniela Bertol's collage *Bending and Twisting: Hypothesis #3* (1988) [9]. By making subtle changes in the width, color, texture, and position of lines and planes, the artists transform the flat line or plane into an all-inclusive space with "ubiquitous perspectives and orientations" (Search, 1993, p. 8). Such images can represent the integration of multiple perspectives in hypermedia environments.

Finally, the medium of light in electronic media creates a metaphysical extension of space that gently encloses the surrounding areas and objects without creating hard boundaries between objects. Diffuse areas of light enable artists to visualize the spatial relationships *in* and *between* objects. Daniel Brown, a creative technologist at an Internet design agency called Amaze, is experimenting with visual interfaces that use these qualities in light. Some examples are found in a collective work called *Mr. Noodlebox* [10]. In his animated graphic titled *Colourspace*, diffuse areas of colored light slowly change shape and color. In *Sanded Curves* and *Electron Fields*, free flowing curves carve out continuous forms in various light intensities as they sweep across the screen. The potential for using these types of graphics to symbolize the temporal transformation of ideas in interactive computing is compelling. Different intensities of light can represent flexible webs of relationships. Links embedded in areas of diffuse light can represent the possible as well as the actual.

Repetition and Rhythm

The dominance of European art in contemporary culture has led to the dismissal of symmetry and repetition as significant design elements. Western cultures fail to recognize and appreciate the rhythms of repetition and the layers of multiple rhythms that occur when there are subtle variations in forms, space, or time. These subtle changes, which result in the interweaving of different levels of symmetry and rhythm, create a tapestry of space-time relationships (Search, 1999).

Interactive electronic programs provide many opportunities to explore the use of repetition and rhythm to visualize the patterns that emerge from navigating through complex information spaces. Combinations of different layers of rhythmic patterns can create a "counterpoint" of rhythms that mirrors the webs of information in the database. For example, visual patterns can help the user organize and synthesize relationships. Transitions in electronic interfaces provide opportunities to use repetitive movements, design, and sounds to create continuity in complex information spaces. By controlling the speed, rhythm, and audiovisual design of transitions, it is possible to define relationships between groups of information.

Sound also provides new ways to use rhythm in interactive computing. Musical rhythms can underscore visual rhythms and add emphasis to patterns and relationships. Finally, there is the rhythm of silence. Pauses or breaks in repetitive elements add moments for reflection that give the user an opportunity to fill in the patterns with his/her thoughts. Silence provides the space for new levels of interaction that free the user from the constraints or limitations of the database.

I am creating multimedia installations that challenge established perspectives in hypermedia interface design [11]. Repetition and rhythm are central design elements in the installation entitled *Ancient Voices in Cyberspace*. This installation explores the aesthetics of repetition and rhythm, prominent design elements in the audiovisual symbols of oral cultures, as a foundation for new perspectives in human-computer interaction. The installation contains a hypermedia program that weaves the rhythmic patterns of images and sounds derived from oral cultures, into integrated audiovisual designs that symbolize the webs of associations in hypermedia networks. Pauses in the rhythm of the audiovisual display, created by the absence of sound or visual information on the screen, give the user time to reflect on the interactive process. The installation demonstrates how repetition and rhythm in an audiovisual interface can help the user synthesize multiple perspectives into a coherent whole.

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[8] http://www.siggraph.org/artdesign/gallery/S98/pione/pione1/feder.html

[9] Daniela Bertol's work can be viewed in the *SIGGRAPH '89 Art Slide Set* published by the Association for Computing Machinery, New York, NY, 1989.

[10] http://www.noodlebox.com/classic/index2.html

[11] These installations include *Hickory Dickory Dock: The Clock Strikes One in Hyperspace* (Amos Eno Gallery, New York City, 1997) and *Ancient Voices in Cyberspace* (Amos Eno Gallery, New York City, 2000).

Conclusion

In hypermedia programs, students, educators, and researchers not only need interfaces that provide access to large amounts of information, they need interfaces that encourage them to investigate new relationships and help them integrate individual pieces of information into a coherent whole. Interactive multimedia environments consist of complex information matrices that evolve in space and time. In the nineteenth century, the linear determinism of Euclidean geometry was replaced by dynamic mathematical models that used terms like *betweenness*, *translation*, *reflection*, *projective*, *inversive*, and *hyperplanes* to describe flexible, multidimensional relationships (Search, 1993). These same terms describe today's hypermedia environments where webs of information are subject to continual change.

The artwork of artists using electronic media can provide insights into new ways to use the patterns and rhythms of the audiovisual interface to communicate dynamic information structures. We need to explore new ways to use text and images to represent flexible relationships within the context of an integrated whole. We need navigation paradigms that reflect the multiple layers of information in a hypermedia program. We need a new design syntax that represents the dynamic transformation of ideas. The audiovisual syntax of the human-computer interface should help the user visualize the *actual* as well as the *possible*. In other words, the interface should encourage the user to explore relationships that haven't been defined. The process of interaction transforms these information structures, and the interface should symbolize this transformative process.

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e-study: Web Enhanced Independent Study

William Seaton, Thomas Edison State College, USA; James Lehman, Thomas Edison State College, USA

e-Pack courses are a method of independent learning where the student studies at his or her own pace, preparing for a comprehensive assessment examination by taking a series of diagnostic tests delivered via the World Wide Web.

Panel: Designing Case-based Hypermedia Learning Environments for Problem Solving Across Professional Fields

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Abstract: This panel focuses on underlying design principles for creating case-based hypermedia learning environments for building problem solving skills in two professional practice fields—teacher preparation and medical education. The panelists provide an opportunity to actively view and compare a sample of interactive cases that integrate application scenarios, domain knowledge bases, authentic case information, expert modeling, and problem-solving activities. Similarities, differences, and design decisions will be discussed based on a set of design principles for creating practice fields in hypermedia learning formats. The audience will engage in applying these principles, concerns, and opinions to their respective areas of expertise.

Introduction

Louis Semrau

The nature of training all workers as well as professionals is changing dramatically. The increase in the sheer amount of information in our knowledge bases as well as the shifting of how these knowledge bases are employed make it critical for training to be both effective and efficient. Hypermedia case-based training, especially when electronic performance support systems (Laffey, 1995) and collaborative work activities (Barab & Duffy, 2000) are incorporated, provide such training environments for professional fields.

Hypermedia case-based learning has the potential to provide complete information, expert modeling, and challenges to be solved by the learner in his or her own situation (Fitzgerald, Semrau, & Wilson, 1997). Case-based training systems help educators develop, implement, organize and re-use multimedia cases for problem-based learning (Riedel, Singer, Leven, Geiss, & Toenshoff, 2000). Hypermedia case-based learning environments are active learning environments in which users explore case scenarios through video and audio, gather contextual information, access domain knowledge, draw on expert modeling of solutions, define contextual problems, and revise solutions based on prompts and scaffolds. Hypermedia-based training goes beyond traditional simulation models by allowing learners to take control and responsibility for their own learning through nonlinear access to information, problem identification, access to information on demand, instructional scaffolds, and feedback on problem solutions.

Design of Practice Fields

While a great deal of literature is available concerning the design of effective hypermedia case-based learning environments, until recently this information has been confusing due to subtle distinctions between instructional design models and applications to differing learning contexts. Design concepts continue to evolve to guide developers in conceptualizing and designing learning environments. The following design principles have recently been recommended for creating practice fields based on situated learning that emphasize engaging the learner in authentic tasks that require problem-oriented learning (Barab & Duffy, 2000).

- Doing Domain-Related Practices
- Ownership of the Inquiry
- Coaching and Modeling of Thinking Skills
- Opportunity for Reflection
- Dilemmas are Ill-Structured
- Support the Learner Rather than Simplify the Dilemma
- Work is Collaborative and Social
- The Learning Context is Motivating

While these principles provide a solid basis for the development of hypermedia case-based learning environments, they may not apply universally across programs with widely differing goals, activities, appearance, audience and disciplines. The principles will be discussed relative to the following demonstrations.

Demonstration #1

Instruction and Management in Emotional and Behavioral Disorders: The Case of Martelle
Gail Fitzgerald

Instruction and Management in Behavioral Disorders is the third title in an interactive training series for use in teacher education programs (Fitzgerald, Semrau, & Standifer, 1998). The program is based on case study scenarios in which the user takes the role of a teacher in planning for different youngsters with significant behavioral and emotional problems in classrooms.

The computer program contains computerized background information on a child named Martelle. Content in the program includes policies in his school, a resource information base related to behavioral interventions, a series of problem solving activities based on authentic job responsibilities, scaffolds for the user related to the activities, and 35 template tools for creating intervention plans. Multimedia material on the CD includes videos to observe Martelle in a variety of classroom settings, audio interviews with adults with information about him, mini-presentations on specialized curriculum, and commentary by experts in the field. The resources and template tools are designed as stand-alone applications for users to have following successful completion of the case study activities. Through these tools and information resources, a direct bridge is provided to support the application of knowledge and skills to real-world use through electronic performance support systems.

Figure 1 displays the main menu screen for the case study *Martelle*.
Figure 2 displays the resource site for gathering case, school, curriculum, and tool resources.
Figure 3 displays a prompted activity of assessing Martelle's classroom environment.

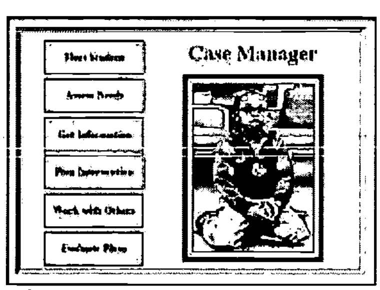

Figure 1 : main menu screen

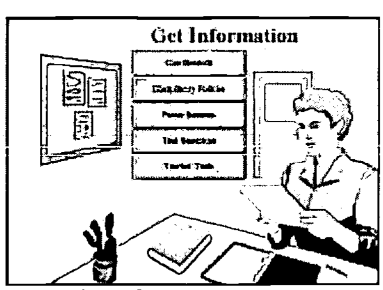

Figure 2 : information room screen

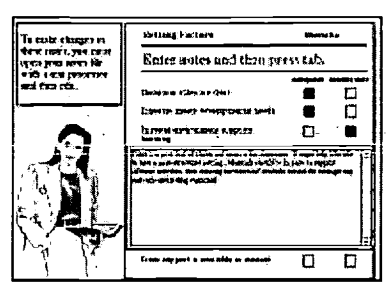
Figure 3 :problem solvivg activity

Demonstration #2

The CAMPUS Training System in Medicine
Jens Riedel

CAMPUS is a case-based, Web-based training shell system to develop, organise and (re-)use flexible, simulative medical multimedia cases to be used by educators, students and physicians at different levels (Riedel, Singer, Leven, Geiss & Toenshoff, 2000).

To minimize acceptance problems and maximize effectiveness and efficiency of case data input, CAMPUS is designed as a flexible, adaptable system that can be used by different users (medical students and physicians at different levels) in different learning scenarios (e.g. self-study, presentation, learning groups, tutorials, assessment). For medical students and physicians the improvement of the own problem- or case-solving competence is the main goal to achieve. With CAMPUS this competence can be trained by using the most realistic form of possible presentation forms. This form is simulative, meaning that the user can do about everything he wants to do (like in reality, e.g. anamnesis, physical and technical exam, lab tests) until he reaches a decision/feedback point, where he has to make diagnoses. Having made diagnoses the user gets feedback about the things he has done so far by giving a comparison between the things done by him with the things the author of the case thinks to be the right ones. At these decision/feedback points the user has to reflect his steps done so far. With the possibility to get knowledge on demand (expert comments, extern knowledge via extern digital libraries) the learner can be trained to become a knowledge manager, a competence becoming important in the medical field more and more.

CAMPUS is a system developed completely in Java using a detailed case-database. It can be used over the Web and locally (see http://www.medicase.de).

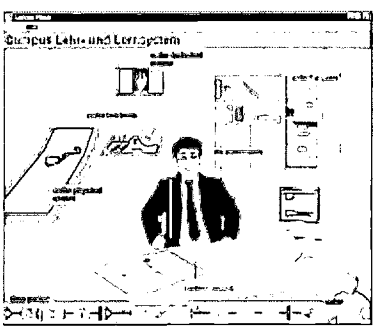
Figure 4: CAMPUS main screen

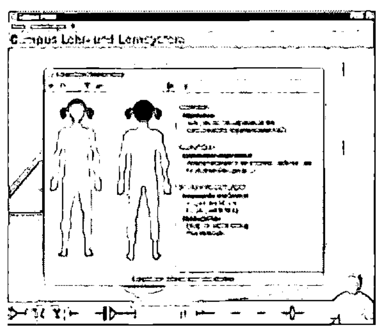
Figure 5: physical exam

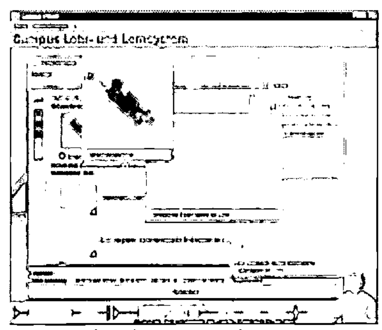
Figure 6: lab test results

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An Intelligent Tutoring System on the WWW Supporting Interactive Learning

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Web-based education is currently a hot research and development area. Thousands of Web-based courses and other educational applications have been made available on the Web, but the problem is that most of them are nothing more than a network of static hypertext pages. This paper describes the new features of an adaptive intelligent tutoring system (ITS) on the Web.

The architecture presented in this paper provides a protected learning environment to facilitate efficient learning to the students with adaptation of the learning environment to the learner's goal and capability. To produce this educational system, we distinguish three spaces:

- Adaptive navigation space to support the student's orientation and help them to find an "optimal path", with use of the case-based reasoning technique (CBR). We introduce the use of experiments which constitutes the keystone of this system of aid for learners.
- Adaptive collaboration space to use the system's knowledge about different users (stored in user models) to form a matching collaborating group. In our system, the learner is an actor of the course construction and not a consumer. The learner can do annotations on the course pages following the link included on all the pages where annotations are allowed. This, will be guide the adaptation of the collaboration between the tutor system and the learner or learner/learner or group with tutor.
- Adaptive information space to adapt the content of pages to the user's goals stored in the user model.

The architecture of our system will be presented and the implementation outlined.

Build It . . . But They May Not Come: Designing, Maintaining and Assessing a Successful University-Level, Instructional Technology Multimedia Center

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Abstract: Internationally, Multimedia Centers (MMCs) are becoming critical for enhancing instructional technology in institutions of higher learning. This paper discusses concept development, policy, and assessment of a successful MMC at Radford University. The first question concerns specific objectives of a MMC - realistic goals should be sensitive to client-specific constraints. For example, faculty may face a lack of time or motivation, students may be generally unaware of benefits, and staff may lack support for continuing education. The second question concerns policy. At Radford University, for instance, types of services and accessibility were deemed critical factors for formulating policies. The third issue concerns assessment. We used measurables such as recurring, year-end monitoring of the number of workshops and participants, most-used hardware and software, downloads of class/workshop materials and so on. Previously mentioned data are presented within the context of size, staffing, cost and facilities of the MMC at Radford University.

Introduction

On campuses across the United States and in other countries, Multimedia Centers (MMCs) for instructional technology are increasingly taking center stage. Such MMCs are viewed as a critical component of a college or university's infrastructure for meeting the instructional technology needs of faculty, students, and staff. In this paper we highlight some of the key issues that we have found to play a critical role in the eventual success or failure of such resource-intensive facilities. In addition to presenting a list of questions or planning areas, we shall also suggest possible solutions from our experience at Radford University that can be adapted by institutions for meeting their own needs.

We hope that such a sharing of ideas stemming from first-hand experiences with a successful multimedia center, such as the one at Radford University, will prove useful for other individuals involved with the design, maintenance, and assessment of similar education-oriented multimedia centers.

The Three Key Questions

This paper will focus on three primary and sequential areas pertaining to design, creation, and evaluation of MMCs in a college or a university setting: a) Articulating goals/objectives, b) Development and implementation of policies for use of the MMC, and c) Planning and implementing realistic assessment strategies.

I. Articulation of Goals/Objectives

The first step in building a successful MMC is developing a well thought out, realistic understanding and statement of goals of the center. What specific objectives does the institution hope to meet? Are those objectives compatible with the institution's strategic planning statement or mission? Do the objectives cater to each of the different stakeholders in the institution, such as faculty, staff, students, and public?

Goals for a MMC can only be achieved with a clear understanding of potential impediments faced by the different types of clients (Albright and Graf, 1992, Lamb, 1992, Rivard, 2000). For example, it may be important to recognize that faculty may find it difficult to use such a facility due to either a lack of time, or lack of incentive, or even a lack of awareness of potential benefits of such facilities in their teaching and research. Similarly, students may be unaware of resources available at a MMC or be ignorant of the benefits of mastering multimedia instructional technology both as a student and after graduation. Lastly, staff may face an unenthusiastic technology climate at their workplace coupled with a general lack of support for continuing education opportunities that a MMC may present.

II. Design and implementation of policy

The success of any MMC hinges on its set of policies that should be based on these key questions:

a) What is the size range of our intended audience?
b) What types of services will the MMC will provide for faculty, staff and students?
c) How accessible will the MMC be for members of the home institution, and where should the center be located?
d) Who will provide training, consulting or development?
e) Will the MMC be a training facility where faculty are taught *how to* use specific software and/or hardware or can faculty reasonable expect the MMC staff *to do their project work for them*?
f) Will there be any charge for select or all services?

III. Planning and implementation of realistic assessment strategies

Assessment is key to long-term viability and efficiency of any MMC (see Millar, 2001). Assessment, however, must be conducted on a day-to-day basis as well as over an extended time frame (for example each semester or academic year). With rapidly changing and evolving technology products and shifting foci of user needs, the importance of comprehensive assessment for overall efficiency of a MMC cannot be overstated. Assessment feedback can allow for a rapid response to enhance and fine-tune types of services provided by a MMC. Such data can also help in making more accurate assumptions about user profiles. Lastly, assessment data are indispensable in most, if not all, successful efforts for procuring additional funding for a MMC.

Profile of a Successful MMC: Case Study from Radford University, Virginia, U.S.A.

The following section describes some of the key features of the Radford University-Multimedia Center (RU-MMC) that we found to be particularly important in the overall success of the Center. Prior to listing such points, we feel that any such *profile* must be presented within the context of resources available. Obviously the determination of success for a MMC will likely be based on differing criteria for a public four-year college with 4,000 students and a annual budget of ten million dollars versus a public four-year college with 25,000 students and a annual budget of seventy million dollars.

The RU-MMC serves a university with approximately 8,500 students and is located in a separate section of the Library. It consists of one main lab/classroom and two sets of offices for staff. It was launched in 1999 and the total cost for the initial set-up of the MMC (excluding space and utilities) was approximately as follows (in U.S. dollars): $30,000 for equipment, $10,000 for software, $100,000 for a staff of one director and four expert instructors. The RU-MMC consists of a total of six high-speed graphics stations (each equipped with a flat-bed scanner, CD press/burner and speakers), two video-editing stations for state-of-the-art, non-linear, all-digital editing, one high-end slide scanner station and one 96-channel, digital-audio recording station.

❖ RU-MMC: Articulation of Goals/Objective

The key to designing any multimedia center is using the resources available to find a balance between supplying individual and curriculum enhancement and fulfilling the overall institutional strategic plan for technology. In order to accommodate both audiences at Radford University, the RU-MMC goal is to "Raise the level of technology usage on the RU campus. For students so that they might have a better understanding of the state of technology in their fields of study. For Staff that they might be more effective in their work environment. For Faculty to allow for professional development as their fields progress through the information / computer age."

In the case of the RU-MMC, impediments in the way of reaching specific goals were determined to be

a) Experience of clients
b) Time required for learning advanced technology
c) Time available away from work/classes
d) Attracting each of the different audiences (faculty, students, and staff).

An *action plan* was implemented that effectively addressed each of the aforementioned impediments. The plan mostly revolved around the *clients'* needs and was set in a positive attitude so that any newcomer to technology would feel at ease with the instruction. Clients with different experiences are likely to create different levels of knowledge of technology on any campus. To accommodate these varying levels, the MMC staff conducts (on an ongoing basis) a careful assessment of clients who enter the Multimedia Center and then makes appropriate recommendations depending on the client's understanding of the material. Time concern for each audience is also addressed. The result of the assessment provided the impetus for the following actions:

- A total of thirty-five, compact, 2-4 hour, workshops are offered at varying times throughout each month by seasoned professionals in the fields of multimedia.
- An information-based website has been implemented that provides calendars, downloadable class notes, presentations, illustrations, examples and "How to" movies.
- Monthly publications of new and interesting events surrounding the Multimedia Center are printed.
- Monthly printed calendars are distributed throughout the Radford University community.

Each type of audience (faculty, staff and students) needed specific *marketing plans* to attract them to the new center. Collaborative efforts between multimedia center staff and faculty allow faculty to incorporate technology into the curriculum without spending excessive time learning the material. The faculty member learns the technology as the MMC staff teaches each course. In order to attract staff more readily, the benefits for technology training are presented to supervisors who then incorporated training allocation into each job description. Students are introduced to the Multimedia Center through a series of tours arranged through faculty who teach multimedia-related subjects such as graphics, administrative systems, media studies, music and sciences.

❖ RU-MMC: Design and implementation of policy

Specifically, the creation of policies for the RU-MMC was guided by three key points: Types of services, Accessibility, Flexibility to constantly monitor and respond to shifting needs of the client base.

Types of services included

1) One-on-one expert project development/training help solely by appointment
2) Classes/workshops conducted at varying times and of varying lengths and that were in high demand (5-20 registrants)
3) Collaboration with faculty to design custom classes that would incorporate instructional technology into

their current curriculum thereby immediately empowering and impacting their students.

Policy pertaining to accessibility issue was primarily guided by the MMC's need to maximize usage as defined by at least 100 hours/week; the RU-MMC was housed within the library so that it would represent a neutral, non-departmental facility and would be secure and staffed 100% of the time.

Policies concerning use of the RU-MMC consisted of the following guidelines

a) That the RU-MMC be a facility for educational and research/professional (non-commercial), instructional technology-based multimedia projects,
b) That the RU-MMC be accessible by any member of the RU campus community,
c) That all classes, workshops, consultations be free of charge for all users, and
d) That the RU-MMC staff help be used exclusively for training and consultation purposes, and not for creation and completion of individual user projects.

❖ **RU-MMC: Planning and implementation of realistic assessment strategies**

A variety of assessment measures were utilized. The first step involved was to create a resource-rich web site highlighting the activities and resources available at the RU-MMC as shown in Figure 1. In addition, use of specific software and hardware was monitored via an online database as shown in Figure 2. Lastly, semester-end and year-end summation of data thus collected provided meaningful statistics that represented activity in all key areas of the RU-MMC operation including workshops, individual consulting and online utilization of the MMC resources and products.

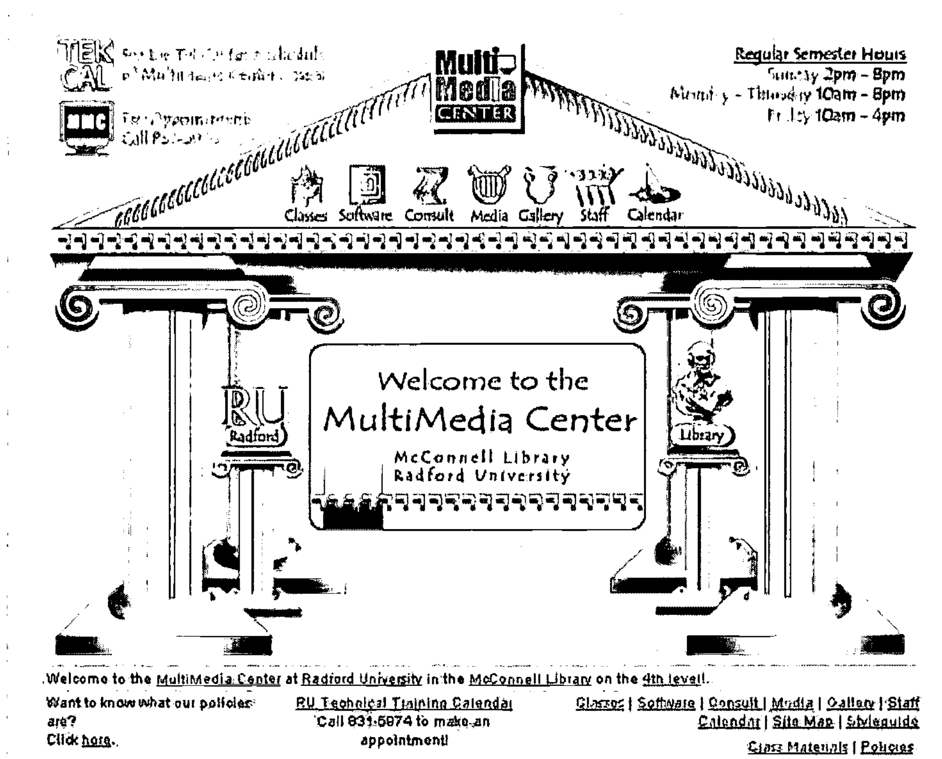

Figure 1: A screen-capture image of the main web-site screen for the Radford University Multimedia Center.

Examples of measured parameters measured for the first year of operation of the RU-MMC included –

a) total number of training workshops
b) average number of participants in a workshop

c) total number of users over a semester or academic year
d) most and least-used software and hardware
e) number of downloads of class/course/workshop materials
f) total number of 'hits' for the different web-accessible sections of the RU-MMC web-site
g) percentage breakdown of users in terms of faculty, staff and students, and so on.

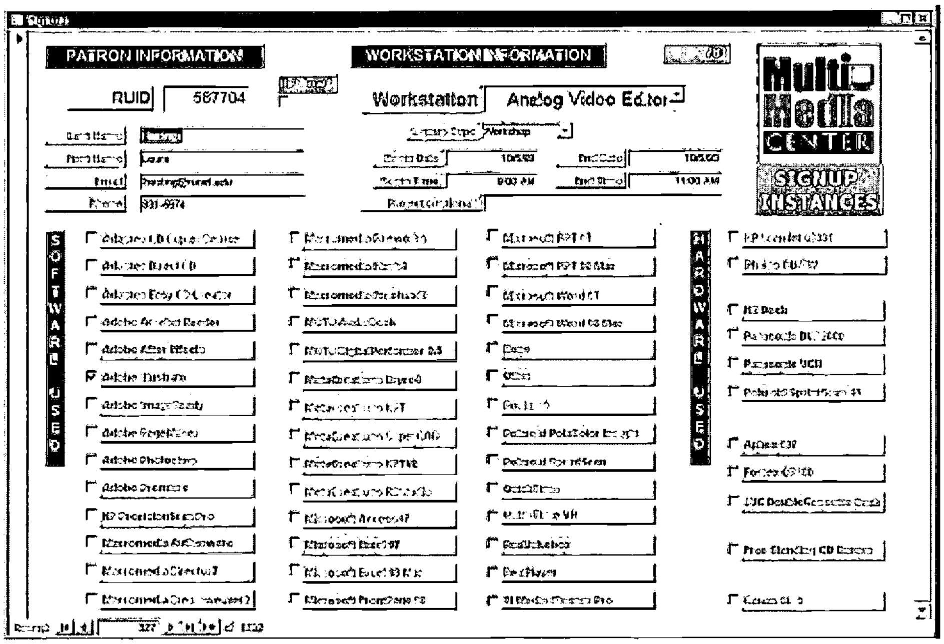

Figure 2: A screen-capture image of the online data screen used for monitoring use of specific software and hardware facilities at the Radford University Multimedia Center.

In the case of the RU-MMC, the following data were collected between May 3, 1999 and May 2, 2000 representing one year of service. The first year, Radford University's Multimedia Center saw a total of 1015 patrons with nearly 3000 visits making nearly 2000 repeat visits. The center operated for 318 days or 3589 hours and provided over 5000 hours of personnel service. The average number of visits per day was 9 with an average stay of 2 hours. The number of workshops offered was 128 in the first year while the number of hours of instruction was 226. Workshop attendance for the year was 1161 or 11% of the university population.

Analysis of data (as shown in Table 1) shows that hardware associated with the Analog Video Editing station was clearly the most utilized, closely followed by the HP ScanJet scanners, and the Philips CD-RW drives. In terms of usage of software (usage instances), Adobe Photoshop was the most used software (530 usage instances) at the RU-MMC followed by Adobe Premiere (411) and Microsoft PowerPoint (367).

Manufacturer	**Hardware**	**Usage Instances**
Hewlett Packard	ScanJet 6200C	235
Philips	CD-RW	153
	Hi8 Deck	0
Panasonic	DVD-T2000	0
Panasonic	Video Cassette Recorder AG 1980P	260
Polaroid	SprintScan 45	34
Fostex	CR300 Compact Disk Recorder	44
JVC	Double Cassette Deck TD-W354 B/J	26
Mark of the Unicorn	Aphex 107	51

Miro	miroMOTION DC-30	*260*[a]
Medea	VideoRaid scsi on Analog Video Editor	*401*[b]
Medea	VideoRaid scsi on Digital Video Editor	*77*[c]
CD Pro	Free Standing CD Copier	7
Canon	Digital Video Camcorder XL-1	17
Summary		
	Audio Editing Station	127
	Video Editing Station (a)	401
	Video Editing Station (d)	77
	Slide Scanning Station	34
	CD Copiers	204
	Scanners	235

[a] *based on the number of signups which utilized the Panasonic VCR*
[b] *based on the number of signups on the Analog Video Editor*
[c] *based on the number of signups on the Digital Video Editor*

Table 1: Data for usage of the different hardware facilities at the Radford University Multimedia Center for the first year of operation (1999-2000).

It is notable that preliminary analysis of data collected for the Spring, 2000 semester (the MMC's second year) revealed an overall 2% increase in the number of workshops and tours given (in comparison to the period between Summer 1999 and Fall 1999). The Multimedia Center also saw an 11% increase in instructional time, and a 47% increase in the number of patrons served. The number of repeat visits per patron rose from 1.5 to 2, with the average patron making a total of three visits over the course of the academic year.

Conclusion

In summary, this Multimedia Center has accomplished its goal of raising the level of technology expertise on the campus. It is likely, however, that many other multimedia centers around the world may not have seen such attendance and support from its patrons and administration. Empty chairs are a clear indication of failure on some level. The advice we offer is to follow the guidelines of this paper in the design, policy creation and assessment for your particular multimedia infrastructure. We also suggest you do something else.

- Design your multimedia center to be part of the entire university community. At Radford University, the Multimedia Center has supported every single department, college and office in some way. The administration admires this distribution of resources.
- Hire a dynamic staff that has professional standing. This will give your center the credibility it deserves.
- Finally, insist on an attitude of true 'service provider' by the staff. A good helpful attitude by the staff will increase learning by the technologically faint of heart and ensure repeat visitors.

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Infusing Interactive, Multimedia CD-ROM Technology into the First-Year College-level Geology Curriculum: Recent Examples from Radford University, United States

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Abstract: In recent years, several CD-ROM-based, instructional technology applications have been developed for use in both high school and college-level classrooms. As multimedia authoring techniques evolve as important tools for teaching, it is imperative that teachers and multimedia authors understand the importance of focusing on specifically how the CD-ROM product will be used. The concept, functionality and type of user-interface of such applications must be driven by a clear understanding of the specific manner(s) in which they are intended for use. In this paper we present a comparative study of two different types of CD-ROMs in terms of their design and use. Both CD-ROMs were recently produced for use at the college level. The "EarthShow" CD-ROM is intended for use as a 'presentation manager' whereby a teacher can seamlessly integrate images, audio, video and animation for communicating information in a sensory-saturated manner. On the other hand, the "Groundwater Pollution" CD-ROM is a self-study tool, characterized by 'situation-based learning' with practice and feedback features and designed for use by a learner on an individual, unsupervised basis.

Introduction

In recent years a significant number of educational multimedia applications have been created for use both at the high-school and college levels (Wheeless-Gore, 1997, Williams et al. 1997, Sethi, 1998). In particular, educators have become increasingly sensitive to the diversity of learner styles among students and therefore have sought ways to communicate content more effectively (Gardner, 1983, 1993, Lazear, 1991, Armstrong, 1994, Herrington and Oliver, 1997, Butler and Lamberson, 1998). A number of both web-based and stand-alone CD-ROM-based multimedia applications have been produced for use in the teaching/learning of geoscience subjects (Prothero, 1996, Steele et al., 1997, Powell, 2000). Several teaching/learning modules have been created specifically for use in General Education courses (such as for first-year, non-science major students); examples include the work by Levine, 1998, and Saini-Eidukat et al. 1998. Examples of multimedia applications for teaching specifically the upper-level geology courses include the work of Rigsby, 1998, and Sharma and Hardcastle, 1999. In addition, attention is being directed towards making such multimedia material accessible for students with disabilities (Grogger, 1999).

Often however, there seem to be disconcerting gaps between design and actual manner/mode of use of such applications across a variety of teaching and learning environments. Such discordance in the design and creation process invariably leads to failure and/or low success rates of otherwise robust educational applications. It becomes imperative, therefore, that the entire design and development process of a multimedia teaching/learning tool be tempered by sensitivity to the manner(s) in which it is intended for use.

In this paper, we present a comparative analysis of two rather different multimedia CD-ROMs, both of which were designed for use by students in the introductory-level geoscience courses in college. One of the CD-ROMs, titled *EarthShow* was designed wholly as a "presentation manager" intended for use by an instructor in a group setting and all aspects of the design and functionality of this CD-ROM are in coherence with its intended use. The second CD-ROM, titled – *Groundwater Quality Issues for the Future Decision-Maker,* is a one-on-one, situation-based, learning application that is firmly rooted in recent models of multiple intelligence types (sensu Gardner, 1983) in learners. In addition, a strong emphasis is placed on determination of learner outcomes via practice sessions and feedback opportunities to help assess success or failure of a specific interactive learning session.

This paper will focus on two issues: 1) the importance of rooting interactive, multimedia applications on established models of learner styles and learning psychology, and 2) a presentation and analysis of some of the key interactive, multimedia screens from both of the aforementioned CD-ROMs.

Models of Learning Styles as a Basis for Designing Multimedia Applications

Howard Gardner's revolutionary work on recognizing multiple intelligence types in learners (Gardner, 1983, 1993) can provide for a logical and a firm footing for design and use of interactive, multimedia applications. Insofar as Gardner's multiple intelligence (MI) theory highlights a total of eight basic intelligence types in learners, it forces teachers to ask a fundamental question: "*Is my teaching style reaching out to the diversity of intelligences in the classroom?*" Another relevant question that needs to be answered is, "*Is my teaching strategy/technique/tool most effective in catering to different learner styles in my students or is there a better way?*" An interactive, multimedia application such as on a CD-ROM or on the internet represents a very powerful medium for delivery of information. Content can be communicated as a variety of sensory stimuli, including images, sounds, video clips, animations and interactive feedback. Advances in processor speeds and storage capacities of digital media including CD-ROMs have enabled teachers to store and access information of different types such as graphics, sounds, and text, from a single platform such as the internet, CD-ROMs, or DVD-ROMs. In other words, once a teacher has digitized and stored any combination of images, audio files, video clips and animation files on a web site, CD-ROM, or a DVD-ROM, he/she no longer has to worry about having access to outdated audio-visual devices such as slide projectors, laser-disc players, tape players, and/or video cassette players. A single CD-ROM, for instance, can be accessed in real-time, for sharing information in a truly multimedia and a seamless, interactive format thereby engaging most, if not all students in a learning environment.

Ongoing results of our assessment concerning the effectiveness of such media-intensive, interactive teaching/learning CD-ROMs show that on average, students respond better to use of such delivery methods. It is likely, therefore, that increasing numbers of educators will adopt and adapt such multimedia tools for communication of content both in and out of classrooms in the near future and in a variety of disciplines.

The other significant issue centers on the need for all multimedia authors to clarify the exact manner in which a particular multimedia application will be used be it in a classroom setting or on an individual, self-study basis. In this paper we discuss a variety of pedagogical features that have been built into the design and functionality of the two CD-ROMs for teaching and learning physical geology and environmental geology. It is hoped that sharing of the design strategies and of examples of types of use will provide a model for other teachers seeking to find examples for adaptation for creation of multimedia applications for teaching their own specific disciplines.

The Earth-Show CD-ROM

The EarthShow CD-ROM was designed for use as a presentation manager for introductory-level courses in physical geology and earth science. This CD-ROM was designed via story-boards at the Department of Geology at Radford University. Creation, testing and publishing were done by a reputed publishing company (Prentice Hall) in 2000. This CD-ROM was developed to accompany a specific physical geology text (*Foundations of Earth Science* by Lutgens and Tarbuck, 2000). Illustrations and images contained in the textbook and the CD-ROM were closely tied together. The CD-ROM chapters followed the same sequence of information as was presented in the textbook. Such a relationship was deemed critical in helping students feel that the CD-ROM was a natural extension or a supplement of their specific textbook.

In terms of use, the EarthShow CD-ROM is designed for a lucid, seamless, fast access and presentation of a variety of media for teaching and learning physical geology. In addition to quick and non-internet dependent access to images, videos, sounds and text, a number of pedagogical strategies were utilized in the CD-ROM. The following section explains some of the key design features of this CD-ROM.

The *Main Screen* consists of a total of seventeen hyper-linked buttons in addition to buttons for actions/events such as Quit, Help, Sound level, Back by One Screen, and Forward by One Screen. A user can choose and explore any of the seventeen chapters by simply clicking on the appropriate button. Each chapter's opener screen consists of a variety of multimedia features that are kept consistent in all chapters. For example, The *Slide Show* feature appears on the opening screen of each of the seventeen chapters. A user can click on the slide show icon to view the slide show. A slide show consists of a series of aesthetic and content-oriented images that are set to a contemporary, unobtrusive sound track. The user can set the volume of sound via an easily accessible icon on each screen. Images in a slide show are derived from both the accompanying text and other sources so that students have the choice of studying images that are from outside the text but relevant to the text.

Each of the seventeen chapters also have an *Image Viewer* integrated into each one of them. Most text entries have small, quick-loading thumbnail images that can be accessed easily for reinforcement of content. Some text entries have several images linked to them, and users have the option of viewing some or all of the images at their own pace via buttons on the screen. Each image is accompanied by a detailed caption that ties the visual content with textual content of the chapter. A key assessment feature of this CD-ROM is the *Self-Quiz* that accompanies each chapter. A user can study an image, diagram, or any type of an illustration and try to identify labels or other text-based information that are shown as blank spaces (as exemplified in Figure 1).

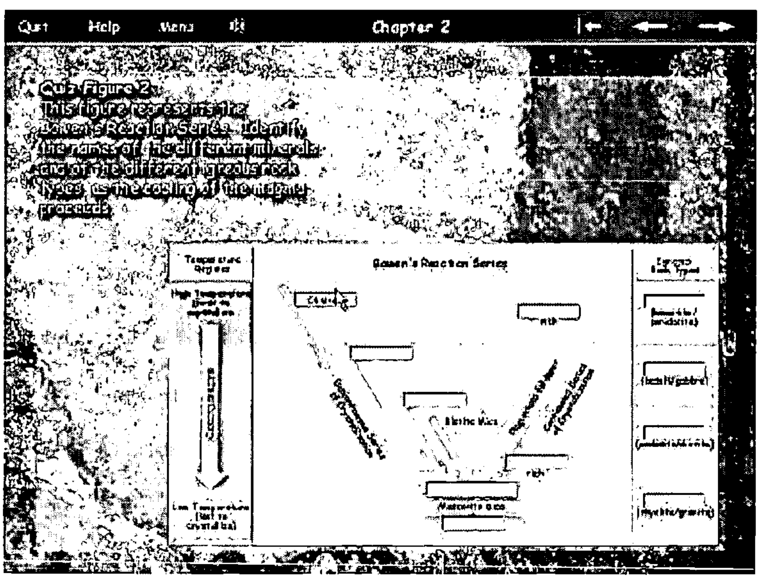

Figure 1: Illustration of a self-quiz screen from the chapter on rocks. A user has to think about the terms contained in the blank rectangular fields. The user can find out the correct answer by simply moving the cursor over a blank label as shown for the first blank field towards the middle of this screen (Olivine being the correct answer for that field).

To find the correct answer, a user simply moves the mouse over a blank field and the answer pops up in the field. The programmed answer disappears as soon as the mouse is moved away from the label. Figure 1 shows an example of such a Self-Quiz feature. From an authoring/programming perspective, such a blanks-based quiz can be constructed to cover almost any kind of subject matter. For example, applications of such self-assessment can easily be imagined for disciplines as diverse as architecture, biology, anatomy, chemistry and geography among others. In addition, such assessment techniques can lend themselves elegantly to a variety of situation-based learning and training settings, ranging from a primer on identifying parts of an aircraft's cockpit to the components of a PCB (printed circuit board) in a computer manufacturing plant and so on.

The Groundwater Pollution CD-ROM

The groundwater pollution CD-ROM, *Groundwater Quality Issues for the Future Decision-Maker*, is intended for individual use by college freshmen enrolled in environmental geology or environmental science classes. Although a number of educators have integrated aspects of pollution in the introductory-level geology courses for non-science majors, there are distinct voids that need filling. For example, there is a clear lack of educational materials for college students that specifically address groundwater pollution. The goal of this CD-ROM is to educate and help non-science majors make choices as decision-making adults that will protect groundwater. Relevance to all students is a key to this application. The work of this project is based on two respected educational theories, multiple intelligences theory (Gardner, 1983), and the ARCS theory of motivation (Keller, 1987).

The CD-ROM is a simulation of a conversation with a groundwater hydrologist who answers the student's questions about groundwater pollution issues. Students are placed in their own hypothetical futures as homeowners who use groundwater for drinking water. The information on the CD-ROM is divided into seven sections. Two introductory sections, *Groundwater Basics* and *Lab Reports*, help students understand background information for all groundwater pollution issues. Five separate issues, *Landfills*, *Septic Systems*, *Underground Storage Tanks*, *Fertilizers and Pesticides*, and *Karst Aquifers*, are covered in the CD-ROM. In each of the seven sections, students are prompted to ask specific, relevant questions about the lesson and about the subject matter. For example, the student may choose among the following questions from the landfills screen:

- What are the objectives of this section?
- What are landfills?
- What safeguards prevent groundwater pollution from landfills?
- What pollutants come from landfills and what are their health effects?
- What can I do to prevent groundwater pollution from landfills?
- What is my responsibility for groundwater pollution from landfills?

Educational theorists (Dick and Carey, 1996, for example) tell us that students need opportunities to practice new knowledge. They also tell us that students should review new skills and knowledge and transfer the knowledge to a new situation before leaving the learning experience. Therefore, students using the CD-ROM have two additional choices on each subject matter home screen:

- I want to practice.
- I want a coffee break to review and transfer.

Practice questions are clearly based on the learning objectives for the section. Multiple choice or short answer questions cover each objective. On multiple choice questions (Figure 2), students click the button beside the answer they choose. A bell or buzzer indicates whether their answer is correct. Then students can move their mouse over a button labeled "WHY" for an explanation of the correct answer. On short answer questions, students type their answers on a blank. When they have finished typing their answer, they move their mouse over a button labeled "CHECK" to compare their answer with the correct answer. Students can go through the practice as many times as they wish.

In the coffee break, students are encouraged to take a break from the CD-ROM to review their new skills and knowledge. Students are given a bulleted list of things to think about as they review. Then, students are encouraged to consider the groundwater pollution issue they just studied in a new perspective. For example, in the landfill section, students are asked to imagine that they are on the town council of a town whose landfill is filling up. "What will you have to consider about the people who drink groundwater and live near sites you propose?" the groundwater hydrologist asks. As shown in Figure 3, multimedia components are incorporated into the information presentation sections of the CD-ROM. Text, photographs, diagrams, videos, animations, and sounds are used to illustrate concepts in each section.

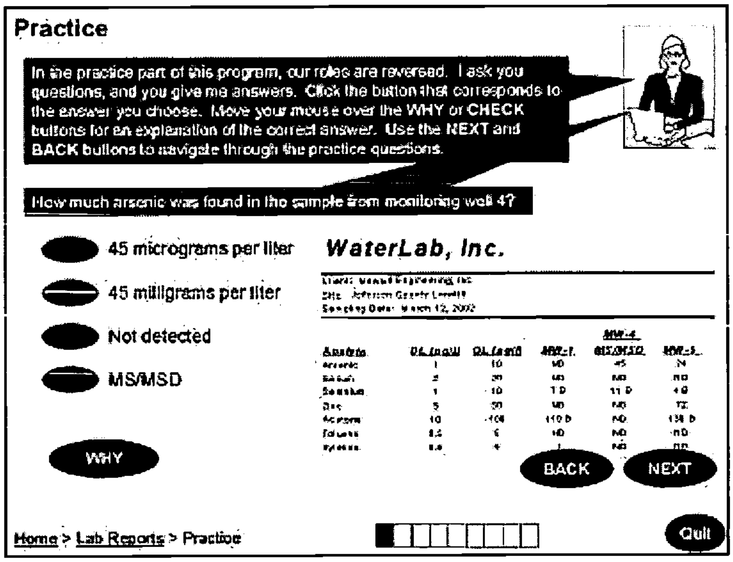

Figure 2: This screen is an example of a practice question from the Lab Reports section of the CD-ROM.

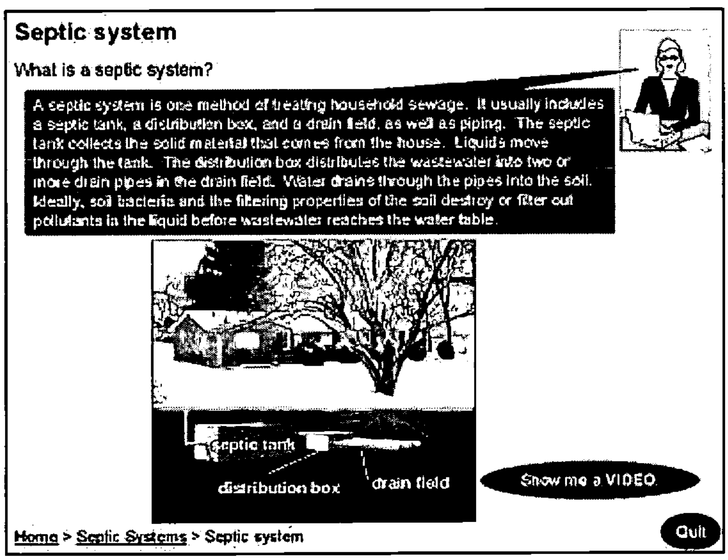

Figure 3: This screen from the septic systems section of the CD-ROM uses text, a diagram and photograph combined, and an illustration. The video button links to an animation showing how the septic system works.

Conclusion

It is our hope that sharing of such educational CD-ROM products will provide focus for other instructional technology users in their own multimedia projects. We also strongly feel the need to share work that has already been done so that the collective body of multimedia authors may continue moving forwards and charting new ground instead of expending efforts in re-inventing the wheel. Lastly we hope that insights into our multimedia design strategies and finished CD-ROMs empower other Earth Science educators in schools and colleges both within the United States and other nations to explore the feasibility of creating similar technologically advanced and pedagogically sound, customized teaching tools for use in their own classrooms.

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Creating an interactive, multimedia database for supplementing microscopic image analysis: Example of Optical Mineralogy and potential applications in other disciplines

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Abstract: This paper presents an innovative, multimedia CD-ROM recently created for supplementing microscope work associated with teaching/learning Optical Mineralogy at the college/university level. State-of-the-art multimedia authoring and curriculum design techniques were used to create a CD-ROM based on recent learning models involving multiple intelligences and learner styles. This brief paper highlights specific objectives that we wanted our CD-ROM to help accomplish. In addition, we present the key steps employed in the successful design and creation of this educational CD-ROM. It is hypothesized that use of such a CD-ROM by students in a laboratory setting will allow students to – 1) engage more closely with the subject matter due to its 'sensory-saturated', audio-visual format, 2) spend 'more time on task' outside of the classroom via use of the CD-ROM, 3) become comfortable with using such CD-ROM data bases, and 4) demonstrate enhanced understanding of the subject matter via improved scores on controlled tests.

Introduction and objectives

Optical Mineralogy involves the study of optical properties of rock-forming minerals in very thin slices that allow light to be transmitted through them. Courses pertaining to Optical Mineralogy are a key component of most undergraduate geology degree programs in the U.S. and abroad. In such courses, students routinely spend a significant amount of time learning to recognize optical properties and diagnostic features of a variety of common, rock-forming minerals with a petrologic microscope. Often students consult textbooks containing images of minerals in thin sections for reference. However, full-color textbooks containing high-resolution images of such minerals tend to be prohibitively expensive and therefore of limited use.

Modern imaging techniques and advances in multimedia authoring software, however, can provide for an easy and affordable solution to the aforementioned problem of lack of adequate and appropriate reference images for students investigating optical properties of minerals. This brief paper highlights some of the key design and user-interface features of a recently-created interactive, multimedia CD-ROM for use specifically in Optical Mineralogy laboratories across the world. The following two sections explain the specific objectives of this CD-ROM project and key steps involved in creation of this educational CD-ROM.

Specifically the CD-ROM was designed to allow college-level students in a Optical Mineralogy laboratory setting to

- Readily access mineralogical information in the form of over 300 high-resolution, microphotographs in a non-linear fashion for a total of thirty commonly-occurring minerals
- Study several different examples of specific minerals so that students can get accustomed to the 'natural variety' in which such minerals occur,
- Easily access a total of sixty digitized video-clips of rotating mineral thin sections to understand natural variation in optical properties of a crystal in different optic orientations,
- Use hyper-linked buttons to aid pronunciation of phonetically-difficult mineralogical names and terms, and
- Easily navigate to screens containing information pertaining to mineral chemistry, classification, occurrence and diagnostic optical properties.

Key steps employed for creation of the CD-ROM

In the following section we highlight the methods we used so that other workers may use such information as a model to facilitate their own projects. Briefly, the steps included -

- Selection of a total of thirty thin sections of minerals for microphotography, microvideography, digitization and editing,
- Microscope, camera, hardware and software calibrations (color, contrast, saturation and intensity of light). Microphotography, microvideography, scanning and digitization, digital editing and integration of .jpg, .avi, and .wav files into 'PowerPoint' screens,
- Design and creation of the interactive, multimedia CD-ROM user-interface including elements of - title screen, table of contents, table of technical specifications (for microphotography and microvideography), navigation buttons, screens for photographs and video clips of minerals in thin section, and interactive testing or Q&A screens,
- Microphotography minerals in thin section with a high-resolution camera attached to a petrographic microscope. Each mineral was photographed in two types of light ('plane polarized' and 'cross polarized'),
- Scanning, digitization, and digital editing of the microphotographs and integration of the image (jpeg) files thus created into PowerPoint screens,
- Paint Shop Pro – TM software was used to screen capture all of the PowerPoint screens. Captured screens were then integrated into PODIUM-TM files and hyper-linked buttons and icons were then created to infuse interactivity into the over 300 + screens,
- The completed CD-ROM was then tested and de-bugged. In addition, the finished CD-ROM was configured so that it would run smoothly on a variety of CPU speeds and with a variety of Windows-based Operating Systems.

The Relationship Between Performance in a Virtual Course and Thinking Styles, Gender, and ICT Experience

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Abstract: This study examines the relationship between students' performance in a virtual course and three factors: thinking style, gender, and prior experience in ICT. The dependent variables were: use of communication channels (e-mail, bulletin boards, forums, and surveys); scholastic performance (grades, successful Web searches, and completion of assignments), and the students' attitudes and level of satisfaction. Independent variables included six of the student's thinking styles (according to Sternberg's classification): Global, Local, External, Liberal and Conservative, gender, and prior experience in ICT. Participants were 110 eighth and ninth graders who were enrolled in a virtual course. The findings show considerable individual differences in student performance and attitude. Learners with the "liberal" thinking style clearly outperformed the other students in the course. Prior experience with ICT affected the virtual learning, while gender, did not. The results suggest that though virtual courses provide opportunities for all learners, such opportunities may be greater for some learners than for others.

Keywords: **Thinking styles, virtual course**

Introduction

The Internet's penetration of our lives and of both formal and informal education has created a need to examine the various aspects of this new way of learning and to explore how it fits in with different learners' needs. Which students can be expected to function better in this new learning environment? To what extent is this environment accessible to students with particular styles of thinking, and compatible with their needs? Can one predict success in a virtual course on the basis of students' thinking styles or other characteristics? Our study attempts to shed light on these questions, which take on even greater significance given the increasing computerization of schools throughout the world and their connection to the Internet.

In many schools, the World Wide Web serves as an instrument for teaching and learning, be it in classroom activities, research projects, or virtual courses (Mioduser & Nachmias, 2001). A virtual course is a Web-based learning environment in which communication occurs by means of computers. Such courses make use of the Web and its many resources to create a meaningful educational environment that facilitates and supports learning. Typically, a virtual course consists of on-line classes in which elements such as hypertext, graphics, audio, video, and animation are supported by a graphic interface that is easy to use and helps arouse interest. This Web-based environment offers access to a wide variety of resources, including libraries, museums, archives, and databases. In most cases, a virtual course employs two types of media: asynchronous, such as class bulletin boards, forums that promote cooperative learning, and electronic mail for correspondence among teachers, students, content experts, and fellow Internet users; and synchronous, such as text-based chat rooms and video conference calls, which enable students who are separated geographically to engage in discussions and brainstorming. The various media support active, independent learning at an individual pace, as well as cooperation among students, between the student and teacher, among teachers, and between the class and other communities (Khan, 1997 ; Saltzberg & Polison, 1996; Sherry, 2000). . Thus, models of Internet-related instruction and learning emphasize challenging activities that provide students with relevant learning experiences, promote cultural awareness, and foster information-gathering skills. Students take responsibility for the processes of learning and teaching, largely as a result of opportunities provided by computers and telecommunications. With the Internet, students have access to up-to-date information; join virtual communities; and navigate through sites as they follow links. These features offered by the Web facilitate the

acquisition of higher-level—analytical and critical—thinking skills and take the students from the curricular objectives to active learning environments (Mintz & Nachmias, 1998 ; Salant 1999).
Virtual courses have the potential to provide new solutions to the constant search for teaching tools that will address the needs of different kinds of students. These needs derive from the differences in the way people acquire knowledge, formulate ideas, feel, and behave—in other words, differences in their "style" (Gild & Garger, 1985). A "style" is a way of thinking. It is not an ability; it is the preferred way of using the abilities that one has. Thinking styles do not fall in the domain of either abilities or personality traits but, rather, in the area of interface between them (Sternberg, 1997; Riding, 1997). Each of us has not one thinking style but a profile of styles. Although we "prefer" certain styles, we are not locked into any single one, as the thinking style is likely to change according to the task and the situation. An awareness of thinking styles can help people better understand why certain activities are appropriate for them and others are not and, consequently, why one person is suited to a particular activity whereas another person is not.
Researchers have proposed a variety of theories about thinking and learning styles, all of which attempt to describe how people think and learn. In the classroom, these theories are important in terms of the teacher, the student, and the institution. Almost without exception, the way in which a person teaches tends to be most effective for students whose thinking style is similar to that person's. Moreover, teachers are more likely to value students whose learning and thinking styles resemble their own (Sternberg & Grigorenko, 1995). Maoz and Barlev (1992) observed that the use of teaching methods that were compatible with the individual learning styles of the students raised their levels of achievement and improved their self-confidence. Through various approaches to learning and thinking, educators are now actively engaged in attempting to understand and identify individual differences, and the knowledge that is accumulating will constitute a significant new tool for teachers and schools.

A virtual course is appropriate for different kinds of students because of its flexibility, its ability to handle various kinds of information, its collaborative value, and the high degree of control that it gives students over their own learning process. Quintana (1996), offers examples of features of the Internet that are suitable to different styles of learning. So, for example, images, three-dimensional models such as those created through Virtual Reality Modeling Language (VRML), are compatible with visual and spatial styles. The transmission of audio and video sequences is appropriate for students with musical and auditory styles, and use of electronic mail and forums is suitable to students with interpersonal communication style.

Various models exist for virtual courses. One example is a course in which students study completely independently, in their own free time, and all interactions with peers and the on-line instructor take place by means of telecommunications. In contrast, our study concerns a virtual course that is conducted in a classroom setting with a live teacher; in addition, students communicate with another teacher via the computer.

The goal of the study

This study seeks to determine whether a relationship might exist between students' performance in a virtual course and the students' thinking styles, gender, and prior experience with information and communications technology (ICT).

Method

This section describes the variables that were examined in the study, the subjects who participated, and the procedure that was followed.

Variables

The students' performance is represented by the dependent variables, which fall into three categories:

- Use of asynchronous communication channels—the extent to which students communicated with the on-line teacher via electronic mail and participated in bulletin boards, forums, and surveys. Each instance of such use was documented, and then all the instances were tallied.
- Scholastic performance—grades, successful Web searches, and completion of assignments as instructed. By "successful Web searches" we refer to the number of sites that a student found that satisfied the needs of the assignment.
- Attitudes and satisfaction—the students' attitudes toward studying in a virtual course and their level of satisfaction from this course. We ascertained the students' attitudes from the answers that they provided in questionnaires. The students were asked whether they prefer virtual courses or traditional instructional media; whether they would be willing to study with on on-line instructor only, in the absence of a classroom teacher; whether they felt the virtual course enabled them to study at their own pace; and whether they were satisfied with and enjoyed the course.

The independent variables consist of thinking style, gender, and prior experience with ICT.
The term *thinking style* is described by Sternberg (1997) in reference to his theory of mental self-government. The types of thinking styles that our study examines are as follows:

- **Global**: Prefers to deal with relatively large, abstract issues
- **Local**: Likes concrete problems that involve working with details
- **Internal**: Is concerned with inner worlds, is task oriented, and prefers to work alone
- **External:** Tends to be extroverted, people-oriented, and outgoing
- **Liberal**: Likes to go beyond existing rules and procedures, to maximize change, and to seek out situations that are somewhat ambiguous
- **Conservative**: Prefers to keep to existing rules and procedures, to refrain from change, and to avoid ambiguous situations where possible

Subjects and procedure

The subjects consisted of eighth- and ninth-grade students (N=110) in two Israeli schools that are part of the ORT network, a group of schools that specialize in technology and science. One school is in the Tel Aviv metropolitan area, and the other, in a city in the southern part of the country. The students took a virtual course on the retrieval and use of on-line information, a course given by Aviv, a virtual school based in Israel (see Aviv's Web site, in Hebrew, at http://aviv.org.il/info/home.htm). Conducted in the students' own school computer laboratory, the course consisted of 12 weekly sessions of two hours each. Two teachers were involved—one in the classroom and one who communicated with the students by means of the computer. In this paper, we refer to the latter as the "virtual" teacher.
During the course, we monitored and recorded student participation in interactive, asynchronous communication (electronic mail, bulletin boards, and forums) and observed three randomly chosen class sessions. Toward the end of the course, the students filled in three questionnaires, whose objectives were, respectively, to obtain relevant personal information, to ascertain the students' thinking styles (Sternberg, 1997), and to gauge how the students performed in the course, their attitudes, and the degree of their satisfaction. In addition, we interviewed the teacher and held a discussion with the classes to find out more about the students' attitudes toward studying in a virtual course, their level of interest, and the aspects of the course that they considered positive and negative. When the students finished the course, we recorded their grades. Quantitative methods were used to analyze the data.

Results

Table 1 presents the degrees of correlation between the students' performance in the virtual course and their thinking styles, gender, and prior experience with ICT.

Category of Variable	Variable	Thinking Style[1]						Gender	ICT Experience
		Glo	Loc	Int	Ext	Lib	Con		
Use of asynchronous communication channels	Bulletin board								0.2*
	Forums					0.21*			0.32*
	E-mail messages to virtual teacher								0.21*
	Surveys		0.2*			0.25**			
Scholastic performance	Grades								0.5*
	Successful Web searches		0.25*	0.25*	0.23*	0.3*			
	Completion of assignments	0.23*		0.22*		0.23*			0.36*
Attitudes and level of satisfaction (as expressed in questionnaires)	Preference for virtual course								
	Willingness to study with virtual teacher only		0.19*	0.23*		0.29*			0.3*
	Virtual course facilitates individual pace			0.31**	0.21*	0.31**			0.23*
	Satisfaction with virtual course					0.33*			
Total number of variables	11	1	3	4	2	7	0	0	7

Table 1. Correlation between performance in a virtual course and the factors of thinking style, gender, and prior ICT experience

[1] Legend: **Glo**: Global style; **Loc**: Local style; **Int**: Internal style; **Ext**: External style; **Lib**: Liberal style; **Con**: Conservative style

* $p<0.05$
** $p<0.01$

As seen in the table, performance in the virtual course is positively correlated with a number of thinking styles, some of which show a stronger correlation than others. The liberal style is correlated with seven of the eleven variables, whereas the conservative style is correlated with none. A greater correlation with performance is demonstrated by the internal style (four variables) than the external style (two), and, similarly, the local style shows a stronger correlation with performance than the global style (three variables as opposed to one). Prior ICT experience is found to be correlated with seven of the variables. The table indicates that the *r* values of the correlations are low, and no correlation exists at all between the students' gender and any of the variables.

Discussion

Students with the liberal thinking style clearly outperformed the other students in the study. We can also see that students with the external style performed better than those with the internal style, and, similarly, students whose learning style is local functioned better in the course than those whose style is global. These results suggest that virtual education can provide opportunities for different kinds of learners, though such opportunities may be greater for some kinds of learners than for others. Students with a liberal thinking style might well become active users of asynchronous communication channels, while students whose thinking styles are global, local, internal, or external are likely to perform well in tasks related to searching for information and integrating various pieces of information in their work.

The students who completed the course most successfully (as measured by their grades) were those who had prior experience in ICT. The amount of experience is correlated with almost all the aspects of performance that the study examined. Similarly, these students were the most active users of asynchronous communication channels (bulletin boards, forums, and electronic mail), which constitute a major component of virtual courses. In general, the degree to which the subjects of the study used asynchronous communication was smaller than expected.

Gender in this study was not found to explain student performance. This finding is encouraging but is in a contradiction with other studies that find significant differences between boys and girls (Nachmias, Mioduser,. Shemla, 2001).

Conclusions and Implications

Our research suggests that virtual education can provide a learning environment that is compatible with a wide range of personalities and needs, and hence such courses would be appropriate for the general school population. By assessing students' thinking styles, educators may be able to predict which students can be expected to perform better in virtual courses. McIsaac and Gunwardena (1996), have found that some combination of thinking style, personality characteristics, and self-expectations can be predictors of success in distance education programs. Those students who are most successful in distance-learning situations tend to be independent and prefer to control their own learning situations .

Furthermore, the results of our study indicate that schools should provide training in computer literacy and computer-based communications to improve the students' chances for success in an on-line learning environment.

The planning and development of virtual courses will necessarily benefit from investigations of students' behavior, their learning patterns, and the degree to which they are suited to virtual education. Similarly, the various technological options for constructing such learning environments should be examined. Such research will enable educators to exercise an informed use of technology; to apply this knowledge to the development of tools that will enhance the teaching and learning processes; and to offer virtual courses that conform to the needs of the broadest range of students.

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Inspiration and Drawing: a Computer-based Learning Package in Drawing

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Abstract: In the manipulation of images and in the creation of art, lecturers and students in Art Schools have possibly formed the most expert group of computer users, but have made little use of computers for teaching and learning.
In art few facts need to be absorbed. What is important is creativity and the development of ideas. There are few right answers. So many artists and lecturers feel that while the computer is a great tool, it has no place in the complex interaction between tutor and student.
That's the challenge which has faced a consortium of British art schools led by the London Institute. The consortium has completed an interactive multimedia learning package on drawing. The product, on DVD, approaches drawing from many different angles covering the range from measured drawing to fine art and departs from traditional modes of navigation and the usual attributes of learning technology.

With a grant from the United Kingdom Higher Education Funding Council of $500,000 and matching funds to give a budget of around $1,200,000 a consortium of art schools and universities led by the London Institute has completed a three year project to create an interactive multimedia learning package on drawing. The package seeks to enrich the student's experience in the area of drawing and make a significant contribution to art education.

There has always been a healthy scepticism as to whether computers have anything to contribute to teaching and learning in art schools. This contrasts with the situation in other areas of HE where computer assisted learning has been seen as ideal in many courses. The computer encourages independent self-paced work and can be used to pose questions and provide often quite sophisticated feedback to the student.[1]
In art the emphasis is less on facts, the needs of the student are individual, and the assessment of the students is through a piece of work demonstrating creativity and the development of ideas.

In 1995-96 almost 5% of students in UKHE were in art and design[2]. If related subjects with a clear interest in drawing such as architecture, and engineering and technology, are included the total rose to almost 16%. The growth in HE student numbers and in the diversity of their nature has placed continuing strain on teaching resources, not least in the teaching of drawing.

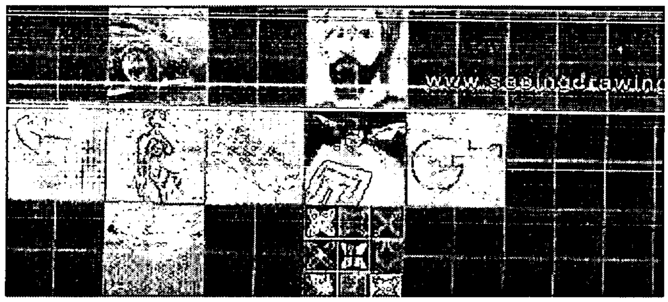
The approach adopted by the London Institute and its partners in the Falmouth College of Arts, Ravensbourne College of Design and Communication and the Universities of Ulster and Brighton has been to emphasise the richness of the subject. In the program the importance of how to see, how to interpret and how to innovate is paramount and due weight is given to the theoretical, philosophical and contextual elements. The package explores the different approaches to drawing of artists working in areas such as graphic design, fashion, product design, architecture, ceramics, advertising and fine art.

There is a considerable body of evidence that in order for learning to take place effectively on the computer, the user has to be involved in tasks where decisions have to be made[3]. The finished package is now ready for distribution on a platform-independent DVD available to UKHE at cost.

Since the project was probably the largest investment ever in learning technology in art it posed a considerable challenge. The product does not supplant the traditional relationship between staff and student but makes a

[1] Davies M., and Crowther D., (1995). *The Benefits of using multimedia in higher education: myths and realities.* Active Learning 3 (December 1995) 4-5
[2] *Students in Higher Education Institutions 1995-96* Higher Education Statistics Agency July 1997
[3] Doughty, G et al, (1995). *Using Learning Technologies: Interim Conclusions from the TILT Project.* Shaw, R. (ed), University of Glasgow, 27-33

significant contribution to the richness of the learning environment in the area of drawing. The focus remains on traditional drawing tools while promoting the new approaches to drawing possible with technology. It aims to improve the ability to utilise software applications for three-dimensional modeling and to enhance the teaching of formal drawing systems such as projection and perspective. Much of the development work in the DVD is very innovative and challenging to the user. The product moves away from traditional modes of navigation and the usual attributes of learning technology.



The proposed presentation will discuss the issues underlying the use of computers for teaching and learning in art and design and demonstrate the finished product.

Time Versus Utility: What IT Staff Say About the Educational Use of the Web

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Abstract: This paper reports on a quantitative and qualitative study that investigated the impact of the provision of Web-based teaching resources within the Faculty of Information Technology of Monash University. It presents staff perceptions of the time and effort required in development and maintenance of Web-based teaching resources and any perceived advantages. The study found that the production and maintenance of Web resources, with the necessary acquisition of the required skills, has significantly impacted on staff workloads. Many staff were spending considerable time on the development and maintenance of Web resources for their students, often providing these in addition to the traditional paper resources. Some staff were enthusiastic about the use of the Web in their teaching, however most described benefits in terms of subject management rather than from a pedagogical perspective.

Keywords

World Wide Web, teaching resources, teaching and learning environments, tertiary teaching

Introduction

In the last decade the tertiary teaching scene has changed dramatically. Economic pressures have forced universities to look beyond their traditional markets. This has led to the expansion of the universities globally and the emergence of multiple campuses, necessitating different methods of course delivery. University lecturers have had to adapt their courses to teach in a variety of modes such as distance education and video conferencing, in addition to the traditional face-to-face method. The adoption of World Wide Web (Web) technology by the tertiary institutions has facilitated many of these changes, providing effective ways for widespread delivery and access of course information (Barnard 1997; Hansen, Deshpande & Murugasen 1999; McDonald & Postle 1999).

The use of the Web in tertiary institutions has seen many advantages to students. The Web enables the development of new and exciting integrated learning environments. Subjects may now be enhanced by the addition of Web-based resources that provide support for self-managed learning, and contain interactive elements that encourage student engagement in learning (Cornell 1999, Oliver). In many subjects, students are now typically provided with Web-based resources that they have the flexibility of accessing on or off campus, and at any time (Owston 1997; Ward & Newlands 1998). These electronic resources either replace, or are in addition to, the traditional paper resources. However, the time and effort required to provide Web resources are a cost to the staff involved in subject development and management (Bruce & Desloge 1999). The Web is a new and unfamiliar teaching environment for many tertiary lecturers. Web-based teaching resources are time consuming to design and develop, often requiring ongoing maintenance. Many resources need a knowledge of programming for their construction. Staff have had to acquire new skills to produce effective teaching resources on the Web, and make appropriate use of this new technology (Alexander 1995; Hansen et al. 1999).

Therefore, a question of interest is "What are the costs and benefits of the provision of Web-based teaching resources?", and related to this, "What motivates staff to use the Web in their teaching programs?". This paper reports on a quantitative and qualitative study that investigated the use of the Web in teaching within the Faculty of Information Technology (FIT) of Monash University. It presents staff perceptions of the time and effort required in development and maintenance of Web-based teaching resources and any perceived advantages, either pedagogical or for subject management. FIT, with over 200 academic staff, is the largest faculty of its kind in Australia. We have made the assumption that an IT faculty incorporating Web technology in its course curricula would show significant use of the Web in its teaching programs. This has provided an opportunity to study issues in the development of Web-based teaching resources with a group of teaching staff who have made a commitment to the use of Web technology in their teaching.

Survey of Teaching Staff

All subject lecturers in FIT were invited to participate in a survey that aimed to establish the extent to which the Web was being used in teaching within FIT, and their perceptions of its impact. Each lecturer was asked to complete one questionnaire for each subject they had responsibility for. This contained questions to determine what resources were provided for a subject and what percentage of each resource was provided in Web-based format. The survey also contained questions to establish the time taken to develop Web resources, the average time spent each week maintaining Web resources, and who (e.g. self, subject staff, external person or group) were responsible for these tasks. Provision was made on the questionnaires for staff to provide open-ended comments.

Over 180 surveys were distributed to subject lecturers and a total of 93 completed questionnaires were returned.

A corresponding survey was given to students in selected subjects in FIT in order to gauge how they valued the Web resources provided and how important they felt they were for their learning. The results of these surveys are reported in detail elsewhere (Sheard, Postema & Markham 1999).

Provision of the Web Teaching Environment

The survey showed that teaching staff in FIT are making extensive use of the Web in their teaching programs. Of the questionnaires returned, 86% of the subjects had a dedicated Web page. This finding is supported by an audit of subject Web pages during the same semester, which located Web pages for 80% of the subjects in the Faculty. Staff of the remaining 14% of subjects in the survey, which did not provide Web resources, indicated in their responses that this was a deliberate decision. The reasons they gave were that they did not wish to make resources freely available, the students did not have ready access to the Web, or it was not worth the effort as the subject was terminating.

In forty percent of the subjects, all resources were provided in Web format and in most subjects (82.5%) at least half of the resources were provide in Web format. Many of these resources were also provided on paper. For more than one third of the subjects in the survey, all the Web resources were new. The most common resources provided on the Web were the functional resources of lecture notes, subject updates, and subject information and these resources formed the basis of most of the Web sites.

Seventy percent of the subject Web pages were designed, developed, and maintained by the subject lecturer and for a further 20%, these responsibilities were shared by a small group of subject staff. They are consequently individual, reflecting the variety of teaching styles and content of subjects in the FIT. This is in line with the Monash University Education Policy which recognises that for effective teaching and learning "it is important for universities to maintain a sense of diversity (in education) ... allowing room for individual perspectives and randa & Pinto 1996).

Seventy seven percent of the Web pages were updated at least weekly with the most common practice being to update once a week. However, in the extreme cases, one lecturer updated subject Web resources daily and eight Web sites were not updated at all during semester.

There were large variations in the times spent on developing and maintaining subject Web resources. Cornell found similar variations in his study of university teaching staff in 1998 (Cornell 1999). A couple of lecturers indicated that they spent up to 200 hours before semester on initial development and another lecturer spent an average of 28 hours per week during semester maintaining subject Web resources. These were however extraordinary cases and the average times were much lower. Over all the subjects in the survey, an average of 15 hours were spent at the beginning of semester setting up the Web page and resources. A further 2.0 hours per week were spent on maintaining existing resources or adding new resources during the semester. However for subjects which provided most resources on the Web an average of 20.6 hours were spent setting up the Web page and resources and an average of 3.7 hours per week were spent on maintenance and additions.

There are a number of factors that help explain the large variations in the initial development and ongoing maintenance times for Web resources.

- *Different management strategies for Web resources.* Some lecturers set up all or most of their Web resources before the beginning of semester, while others developed their Web sites as the semester progressed and therefore spent more time on ongoing development throughout the semester. This dynamic style of subject delivery has the advantage of flexibility and adaptability as discussed by Arnold (Arnold 1997). Ten percent of the subjects in the survey had Web pages that were never updated during the semester, but most (78.7%) were updated at least weekly.
- *The proportion of new Web resources.* The development and maintenance times increased as the proportion of new resources increased. Over 90% of the subjects in the survey had new Web resources and in 36.3% of subjects all the Web resources were new. Added to this the Web is a changing environment with new features and improvements to Web technology constantly being developed (Owston 1997).
- *The types of resources.* Web resources range from direct conversions of paper resources that take very little time to produce, to those that require many hours of work in design and development, e.g., animations. Web resources may be provided as static items that are never updated, e.g., a subject handbook, or a series of static items that are developed as the semester progresses, e.g., a set of lecture notes or tutorial exercises which are provided for classes each week. Alternately, Web resources may be dynamic items that are intended to be modified or developed over the semester e.g. subject updates. Some require regular updating such as feedback or newsgroups.

The Staff Voice

In the written responses on the open-ended section of the survey questionnaires, staff generally discussed their own use and management of the Web for their teaching. Their comments focussed on the types of Web resources they provided for their students and the time and effort that was involved, rather than presenting pedagogical perspectives of the use of the Web for their teaching. The issues involved in the technology implementation rather than the impact on students is a common theme in current literature, as noted by Windschitl (Windschitl 1998).

Many lecturers were very positive about the practical advantages of using the Web for their subjects. They saw the Web as an effective and efficient system for distributing course material and information to students.

> *"(The Web) saves an enormous amount of paper, saves time queueing at photocopying machines, improves "reach" to students, enables quick publication of "hot news" items or error corrections, stimulates email contact from students to tutors and myself..."*

By placing teaching resources on the Web, some lecturers are shifting the responsibility for obtaining these resources over to their students. This was highlighted as a saving in time because of the reduced amount of printing and photocopying needed. The amount of paper distributed to students is also reduced, although there is evidence from student surveys that resources provided electronically are often downloaded and printed by students anyway, producing no net saving in paper as found by Jones (Jones 1999).

The use of the Web as a distribution centre for course materials is not always popular with students. This agrees with the findings of an experiment by Ward & Newlands (Ward & Newlands 1998). There was evidence from the staff surveys that many lecturers, often in reaction to student requests, were providing students with paper copies of resources available on the Web.

"My lecture notes are all up on the Web I give the students paper copies as well, they demand this!"

Resources placed on the Web are instantly accessible by every student on or off campus. Many lecturers saw this as one of the main advantages of providing resources on the Web. However intellectual property protection was an issue with a couple of lecturers who expressed concern about the security of the Web, and the fact that their Web resources were freely available to students in other courses and the outside world.

"I think it is a wonderful idea to have Web-based resources available to students. But I would prefer to make the resources available only to students enrolled *in the course"*

The Web has made possible the provision of new types of learning environments for students. Some lecturers appear to be using the Web to facilitate a move towards a distance education style of teaching as discussed by Miranda (Miranda & Pinto 1996). One lecturer had actually moved all class-based tutorials for his subject into a forum on the Web.

"This semester I moved all formal tutorials onto the Web allowing occasional lecture times as needed. The response was great. Part timers and those with language problems fully participated in active debate. No more discussion-based format tutes for me!"

Other lecturers took a negative view of this style of teaching, expressing their opinions that the Web should not be used as a substitute for face-to-face teaching.

"Having one integrated teaching environment is convenient for students however there is a danger that they may become reliant on this totally for their learning, not experiencing lectures and tutorial classes, contact with other students or exploring other sources of information *such as libraries."*

The trend towards putting most subject resources on the Web was seen by some lecturers to be giving students unintended messages. A couple had experienced problems with students not attending lectures because they decided that all they needed was available to them on the Web.

"Drop in attendance at lectures since introduction of Web page...difficult to teach students who you do not see"

The Web provides facilities for instant contact and communication with students however this often results in less personal contact. Some lecturers expressed concern about the Web encouraging a remoteness from students and they were not able to easily monitor how their students were progressing through their subject. There are mechanisms to measure how often and how many accesses are made to Web pages however this does not provide the same quality of information as personal contact with students.

A typical subject Web page in this survey contained at least basic functional subject information, subject updates and lecture notes. The Web pages ranged from basic repositories of passive information, to totally integrated Web environments including interactive learning elements. Many lecturers commented about the amount of work required to produce and maintain Web resources, and especially the effort required to produce well designed and effective Web-based teaching resources, as also discussed in other studies (Gillani 1998; Ward & Newlands 1998). Typical comments were:

"Putting all the resources on the Web required a significant effort, which I think is usually underestimated..."

"They take a huge amount of time to do properly"

"No effort toward standardisation of subject Web pages is being made, 'n' subjects -> 'n' styles of Web pages"

The lack of skill in working in a Web environment and not being able to produce good quality resources was a concern to some lecturers, as also found by Ward (Ward & Newlands 1998). There were a variety of tools used to produce Web resources, ranging from writing HTML using basic text editors through to WYSIWYG editors.

"...time constraints on exploiting the potential of the Web; lack of support for more ambitious use of the Web"

"Difficult getting some resources into computer format..."

One lecturer expressed disappointment about the variation in standard of subject Web resources in FIT:

> *"There is a very wide range of quality in respect of subject resources. Some of the Faculty's are innovative which reflects in a high standard of teaching materials being delivered over the Web. In other cases it is almost embarrassing to think that it appears under the Monash logo"*

The surveys revealed that some lecturers were providing Web resources for reasons other than subject management or pedagogical considerations. Some lecturers indicated that they felt obliged to provide resources on the Web because of pressure from students or other colleagues. With 86% of the subjects in FIT providing a Web page, there are indications that students now have an expectation that Web resources will be provided for them in each subject they study.

> *"Students are expecting to find information in all of the following ways with a high expectation of instant satisfaction of need, with constant pressure to provided up-to-date resources at all times for immediate student gratification; lectures, printed lecture notes, tutorial, printed tutorial notes, Web page, anonymous discussion, email, help desk. Time spent by staff on subject is extensive."*

There were few comments from lecturers about the benefits to students of providing Web resources, and these were expressed only in terms of convenience, availability, and accessibility of resources.

> *"From the informal feedback from students, it appears that students find it very useful to have a specific Web page for each subject which stores all relevant information and resources"*

> *"... very convenient for those students who do not come to the lectures, for announcements outside the lecture hours, and for correcting mistakes found in the course material and providing solutions to homework"*

> *"Extensive use made (by students) of on-line materials at numerous sites"*

The lecturers' responses to the open ended section of the survey showed their perspectives of the costs and benefits of the use of the Web in teaching. These comments focussed around issues of developing and managing the teaching environment. None of the lecturers who responded to the surveys mentioned the value of the Web for student learning. They remarked on the students' demand for Web resources and how much they were using them, but none indicated the possibility that this enthusiasm may then translate into a greater engagement in their learning.

Conclusion

The Web has transformed the tertiary teaching environment. This study of the use of the Web by lecturers within the Faculty of Information Technology indicated that there is a trend for most lecturers in the Faculty to provide a dedicated subject Web page for their students. The Web pages range from static pages with basic functional resources to totally integrated interactive learning environments. The production and maintenance of Web resources, with the necessary acquisition of the required skills, has significantly impacted on staff workloads. The survey revealed that many lecturers are spending considerable time each semester on the development and maintenance of Web resources for their students, often providing these resources in addition to the traditional paper resources. However, the survey also showed that most of the time was spent on the initial development of resources, and the ongoing maintenance times were considerably lower. It was a considerable saving in time to reuse Web resources.

The responses from the questionnaires indicated that many staff were enthusiastic about the advantages of using the Web in teaching. However most viewed the Web as an efficient and effective means of distributing resources to students rather than providing pedagogical benefits. A number of lecturers had developed or were in the process of developing engaging integrated Web-based teaching environments that were valued by their students, but to many others the Web was seen as a convenient facility to provide students with instant and ready access to subject information. Some lecturers indicated that they were producing Web resources because of students' expectations rather than any perceived teaching or learning benefits.

Several lecturers expressed concerns about observed changes in student learning behaviour since the introduction of Web-based teaching resources in their subjects. An impressionistic view is that the provision of resources on the Web has encouraged students to disengage from face-to-face learning in subjects that were not designed or intended to be taught in that way.

The Web has changed the practices of tertiary educators. The Web enables the provision of new learning environments with a greater variety of teaching resources. The development and management of these resources is an added cost to the staff in time, effort, and acquisition of the variety of new skills necessary. With the widespread use of the Web in tertiary education, students now have an expectation that Web resources will be provided for them in every subject. This raises the issue of what the learning outcomes of the provision of these resources are. The question of the benefit for students considering the extra cost for staff remains unanswered. This is a critical issue for educators involved in the long-term design and management of Web based learning environments.

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Issues in the Management of Information Technology in Changing Educational Organizations

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The development of Internet-based technologies and the choice these provide of synchronous and asynchronous teaching and learning is changing educational organizations.

The first part of the presentation considers issues in the management of information and communication technologies for teaching and learning in the context of a shift from distance education to telelearning. A significant feature of this change in the management of Canadian education is the emergence of new teaching and learning structures - digital intranets, and, within these, virtual classes.

The presentation will explore issues in the management of effective teaching and learning in these new educational environments. Successful integration of information and communication technologies for tele-teaching students is in part dependent on the transition from closed to open teaching and learning environments.

The challenge of Internet-based teaching and learning environments for schools includes a need for collaborative professional development and new approaches to the nature and location of leadership.

EVA: Collaborative Distributed Learning Environment Based in Agents

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Abstract: In this paper, a Web-based learning environment developed within the project called Virtual Learning Spaces (EVA, in Spanish) is presented. The environment is composed of knowledge, collaboration, consulting, experimentation and personal spaces as a collection of agents and conventional software components working over the knowledge domains. All user interfaces are Web pages, generated dynamically by servlets and agents. Each EVA host has an agent associated with it, which can establish links with the other EVA hosts forming shared knowledge and collaboration space of a distributed EVA learning environment. The article focuses on the description of the system architecture, implementation of software modules, and the application results.

Introduction

The technological innovations on the one hand, and the growing popularity and availability of Internet on the other, are the main reasons of development in the last years of numerous applications and investigation projects in the field of technology-mediated education (Youngblut, 1994; O'Malley, 1995; Hamouda & Tan, 2000). The virtual teaching, integrating computer and communication technologies in different educational scenarios, is advocated as a solution to the problem of exponential growth of knowledge in the contemporary society (Collis, 1999). As a matter of fact, information technologies offer exciting opportunities to thoroughly redesign the education process and to achieve, among others, the following benefits: integration of means (text, audio, animation and videotape), interactivity, access to big quantities of information, plans and individualized work rhythms and immediate answer to the apprentice's progress.

However, the introduction of the technologies in the real education environment is a difficult problem. Therefore, the intense search of new pedagogic solutions and teaching/learning technologies is a time challenge, where the advanced information technologies play the main role. The EVA *(Espacios Virtuales de Aprendizaje in Spanish - Virtual Learning Spaces)* project is dedicated to the development and implementation of a Distributed Learning Environment (DLE), personalized and collaborative, by means of which different academic and administrative activities can be offered in a distance manner to the students of different institutions and public and private companies (Nuñez et al., 1998; EVA, 2000).

EVA is a learning paradigm that considers different forms of acquiring, transmitting and exchanging knowledge among people and work groups that don't usually have physical access to the conventional sources of knowledge: books, magazines, schools, universities, laboratories, libraries, good professors, etc. EVA constitutes a conception of the education that uses advanced information technologies like, for instance: JAVA servlets and applets, Multiagent Systems (MAS), Groupware, Multimedia and Virtual Reality (VR). The EVA system is also composed of a number of authoring tools for virtual teaching and learning according to the EVA methodology. The main two authoring systems are: visual environment for the development of Multibooks, *ELVA* - an auxiliary tool facilitating the development of learning materials; and a CASE tool for the development of VR worlds with complex behaviour of their components: EASYVRML facilitating the development of virtual laboratories and simulations in VR. (Quintero, Armenta, Balladares & Nuñez, 1998).

The EVA philosophy is congruent with the existing classroom practice: mainly aims at learning goals and outcomes that are already embedded in traditional curricula, do not neglect the use of conventional learning materials, and can usually be plugged into existing curricula with minimal change to course plans. It benefits from explicit representation of the topics that students investigate, but it doesn't need to be omniscient. Further, since EVA does not attempt to tutor, it is free of obligations to model students' cognition and to make complex pedagogical decisions. In the rest of the article, the architecture of EVA environment, implementation of software using Java servlets and agents, and the application results are considered.

EVA architecture

The conceptual architecture of EVA is structured into the four essential learning elements, called Virtual Learning Spaces. These spaces are: *knowledge* - all the necessary information to learn, *collaboration* - real and virtual companions that get together to learn, *consulting* - the teachers or tutors (also real and virtual), who give the right direction for learning and consult doubts, and *experimentation* - the practical work of the students in virtual environment to obtain practical knowledge and abilities. These four spaces are complemented with the *personal space* where user-related information is accumulated. These spaces are supported by a number of tools developed using different information technologies (fig. 1).

The knowledge space is composed of a set of "*Multi-books*" (or *POLIlibro*, in Spanish), personalized electronic books, generated by concatenating selected Units of Learning Material (ULM) along the learning trajectory for each knowledge domain. Planning of learning trajectory for students who navigate in EVA (they are called EVAnauts) in discretized knowledge space allows a student to establish her own route and learning rhythm, according to her scientific and professional interests, to the time and resources at her disposal, making possible to combine her more immediate requirements with the long term objectives.

The systems of virtual education traditionally use the client-server architecture since it is the basic principle of operation of the Web: a user (client) by means of a browser requests a service (pages HTML, etc.) from a computer that serves as a server. Usually, in the DLE each user has a personal account at the corresponding DLE server, which makes it impossible to share similar learning activities with students and tutors subscribed to another DLE servers, even in the case they use the same environment. EVA, also using the client/server architecture, tries to solve this problem making use of agent technology (see the next section for details).

The EVA environment is installed on the servers which we call EVA nodes. It is formed by the HTML pages, Java programs (Applets and Servlets), a number of MAS and a database (Sheremetov & Núñez, 1999a; Peredo, Armenta & Sheremetov, 1999). To customize the learning spaces for each user, we have adopted the technology of dynamic page and link generation and interactive pages using *servlets, applets and agents* (fig. 2). For the client's request, a servlet communicates with the database by means of the SQL (Structured Query Language) and generates the answer as an HTML page in the client's navigator. The servlets, being programmed in Java operate with controller JDBC (Java Dates Base Connectivity) to access databases. Since the controller ODBC (Open Dates Base Connectivity) is used by Windows, a controller bridge between Java and OBDC is required, that allows the servlets to operate with the database. Java Web Server (JWS) or Apache Web Server are used to mount servlets, which so far constitute the concept of virtual classroom and virtual laboratory providing flexible mechanism to communicate with the database manager that manipulates the entire page related information. EVA user interface generated by EVA servlets is shown in fig. 3.

At the current stage of our experiments, the EVA environment as it is configured in the CIC-IPN, makes use of a number of servers each playing different functional role. *Server EVA* uses Apache Web Server, installed in a ULTRA SUN 10 work station to host the static information of the system related with the educational material included in the Multibooks, the personal Web accounts of the professors and students and the security system. It serves as a gateway to the rest of the system. *Server HERA* is the main server of the EVA environment. It also makes use of Apache Web server and is dedicated to the generation of dynamic pages and transmitting them via *http* to the client machine. The server is a PC computer with microprocessor Pentium III Dual at 500 MHz. The database for the operation of the system is installed in this server. Finally, *server AGENTES* uses a JWS server installed in a PC computer with microprocessor Pentium III Dual at 500 MHz. It serves to store the information related with the videoconferences and video-on-demand, as well as to host platforms for the MAS of different purposes.

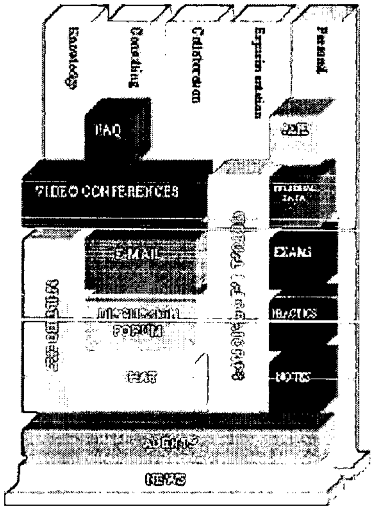

Fig. 1. Learning spaces and tools distribution

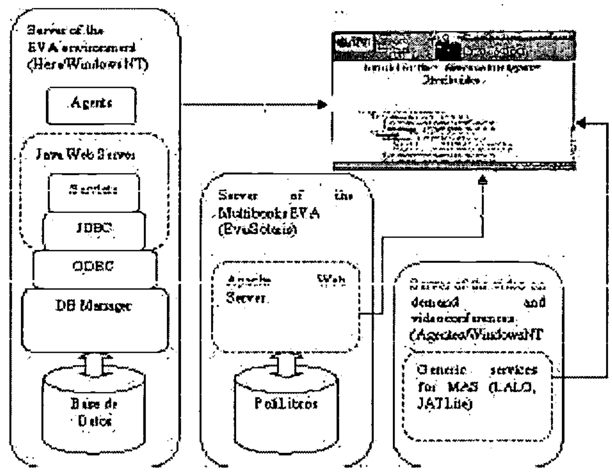

Fig. 2. Software architecture of the EVA environment

Actually, the architecture described above is not that fixed. Each node of EVA controls the corresponding knowledge domain. It means that all the information about the ULMs pertaining to it is stored in the database. So each ULM, which forms the content of Multi-books may have its own location specified by the URL in the database, and there is no need to have all the materials on the main server (*EVA*, for example). Sure, knowledge domains are interrelated between then, so usually to study in EVA means to study Multibooks pertaining to different domains. In other words, the distributed model of the knowledge space is needed, which integrates these parts into the common knowledge space. It is done by means of the use of domain agents carrying out trajectory planning functions. In the same way, the MAS of the personal assistance permits to generate groups of students with common interests physically connected to different EVA nodes.

At the current stage of our experiments, the architecture illustrated in fig. 4 is used. This figure shows an excerpt from the model actually implemented in the IPN creating groups of users from different colleges having similar study plans. Each client uses a Web navigator to communicate with his EVA server (where he is registered). However, his personal assistant agent establish communication with the personal assistants of his working group (possibly registered to other servers) and, if needed, with the domain planning agents to create virtual distributed learning space for each particular user. The next section explains it in more details.

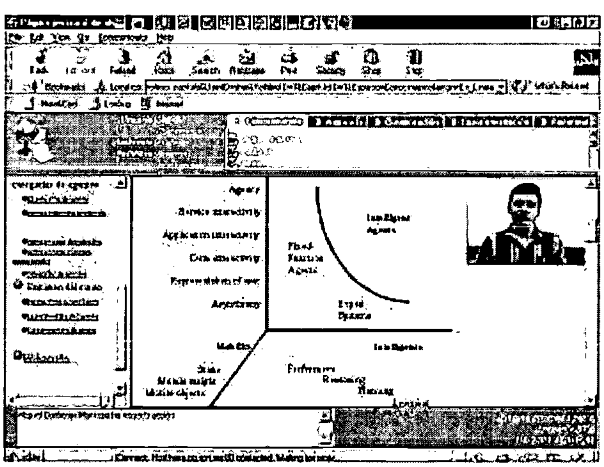

Fig. 3. EVA user interface: Multibook "Intelligent Distributed Systems"

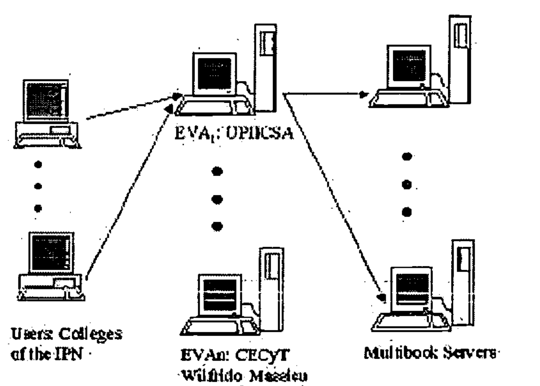

Fig. 4. Software architecture of the distributed EVA environment

Multi-agent Systems in EVA

As it was already mentioned, while implementing EVA, we have detected several problems of the traditional client-server architecture that impel the search of new solutions in the organization of environments of distributed software and the software for the Internet. One of these technologies of recent creation is the technology of agents, which seems to be a promising way to approach the problem of DLE development. The notion of agents is the central part of contemporary learning environments, where they act as virtual tutors, virtual students or learning companions, virtual personal assistants that help students to learn, mine information, manage and schedule their learning activities (Müller, Wooldridge & Jennings, 1997; Chan, 1996; Gordon, & Hall, 1998). One of the main purposes of our project is to develop models, architectures and multi-agent environment for collaborative learning and experimentation.

The core of the EVA environment consists of a number of components, composed of a set of deliberative and auxiliary agents, forming three multiagent systems: a virtual learning community, a multiagent planning system and a multiagent virtual space of cooperative experimentation. For details of these MAS implementation see (Sheremetov & Núñez, 1999a, Sheremetov & Núñez, 1999b). In the learning spaces, students and tutors receive help from their *Personal Assistants*. Personal assistants (PA) is a class of intelligent agents that act semi-autonomously on behalf of a user, modeling his interests and providing services to the user or other PA's that require it. PA has the following functions, implemented as plug-ins of the PA's kernel (fig. 5):

- Implements environment for collaborative problem solving. Helps tutors, coordinating collaborative activities. It can give privileges in the acceptance of the contributions, define the problem to discuss, among others. Helps students, regulating their participation in the discussion, showing coordination messages, etc.
- Implements a News system for the communication between students and professors.
- Implements a system of Electronic Agenda where all the information on the student's activities is stored.
- Implements the structured Chat tool with the possibility of the users' connection registered in different EVA environments.

In the Collaboration Space, our prototype of learning community incorporates also a *Group Monitor agent*. Agents have mental states represented in terms of beliefs, knowledge, commitments, with their behaviour specified by rules. A *Group Monitor Agent* maintains the shared knowledge model of a group and compares it with a group problem model from the knowledge base that contains the objectives, concepts, activities, etc. that characterize a group. His behavior is guided by a set of domain independent conversation rules, which refers to the interactions between the group members. During the group session, the monitor agent maintains the current problem state (shared group knowledge space) and the history record of all contributions for each participant. The problem state in terms of shared beliefs and knowledge is used to change the interaction mode, choosing one of monitoring techniques from his rule base. This result in changing behavior of learning companion from group leader (strong companion) through a week companion to a passive observer. User interface of this collaborative environment is shown in Fig. 6.

Personal assistant is implemented as Java Application and can be loaded in any computer with Java support and Internet connection. With this, we can say that each user will have a PA agent according to the social role that plays in the cooperative environment, as a tutor or a student. The personal data for each user are stored in EVA's database, so, when being invoked, his PA will already have a previous knowledge about the person to whom it assists and of the social role that he plays in the environment. Two types of utility Agents are also used in this MAS, a *Broker Agent* (or Directory Facilitator) and a *Wrapper Agent*. The first of them is considered a service facilitator, since for any Assistant (Professor or Student) it will look for the services provided by other agents and other assistants. Wrapper Agent can be defined as DB service provider, because it administers the EVA database with the purpose of consulting and it's modification in an explicit way (fig. 5). All the agents use Knowledge Query and Manipulation Language (KQML) for communication.

Prototypes of agents have been developed using Microsoft VC++, LALO, JAVA, and JATLite with rule-based inference capabilities, programmed in Jess (Friedman-Hill, 1998; JATLite, 1998). *Personal Assistant and Planning* agents are Java applications implemented with Swing package of the JDK 1.2 development environment and with the integration of a Java component for the creation of JATLiteBean agents.

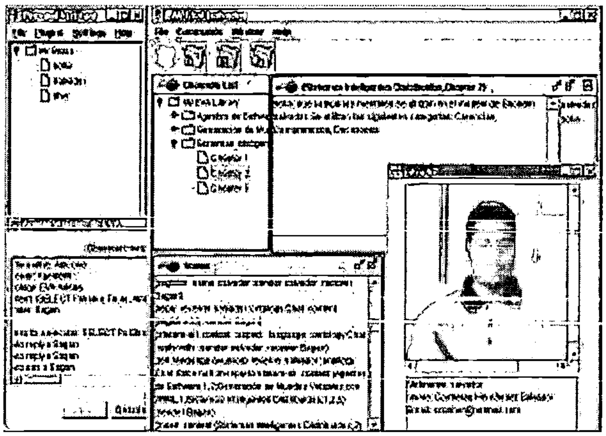

Fig. 5. Interface of the PA environment

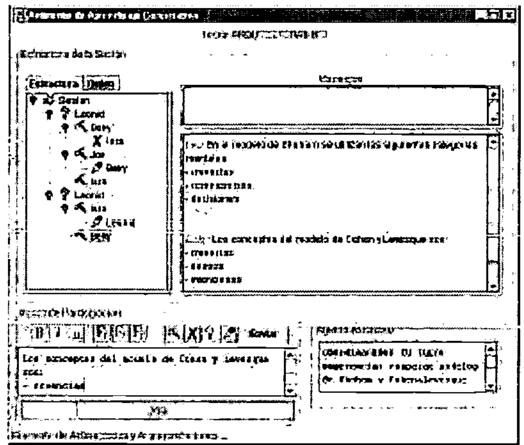

Fig. 6. User interface of the collaborative environment maintained by the PA Agent

Current experiments and conclusions

At the moment of writing, the first version of EVA is in the implementation and testing phase. The following results have been obtained since it was launched:

1. In the fall semester of 1998, the EVA environment was first used to impart the seminar of Software Agents in the CIC. The server was accessed by near 20 students from the PC's of the LAN of the CIC and from remote computers from the periphery of Mexico City, from an approximate distance of 50 miles. Since then, the EVA environment and the Multibooks have been used by the professors of the CIC as an additional didactic support in the Postgraduate courses in Computer Sciences.
2. Started in October, 1999, the first international course in EVA called "The digital documentation in means of social communication" was imparted twice, jointly by the Center of Training of Educational Television (CETE) of the General Direction of Educational Television of Mexico and the Complutense University of Madrid, with the participation of students from Mexico, Colombia, Argentina and the Dominican Republic.
3. Also in October, 1999, under the supervision of the Coordination of Academic Computation of the IPN, the development of the institutional project "Installation of the model and system EVA (virtual spaces of learning) in the IPN" has begun. This project has as objective to support the educational modernization of the IPN, taking advantage of the methodology and the EVA software environment, within the framework of the Program on Educational Technology for Academic Innovation. The EVA environment is installed at the servers of diverse schools and colleges of the IPN, as, for example, UPIICSA, CECyT Wilfrido Massieu, CECyT 6, which serve as nodes in the training network and in developing of the corresponding Multibooks.
4. Starting in October 2000, the Virtual Master's Degree Program in Computer Science using EVA as a platform of distance education for the students from the system that integrates about one hundred of Technological Institutes in Mexico has also begun. Only 50 students have been admitted for the first stage of this experiment after presenting their admittance exams in EVA. Four Technology Institutes were selected through Mexico as regional sites, where EVA nodes have been installed enabling 4-nodes distributed Virtual Postgraduate Department.

We have also begun to work on the digital library of the CIC and the National Library of Science and Technology (BNCT) of the IPN that will allow to have an interactive portal of the BCNT that takes advantage of all the benefits of the ATM network using an EVA-like middleware written in Java. The digital library will de integrated into the current version of EVA environment which is under development to enable the creation of a virtual campus EVA-IPN.

Our experiments to-date have demonstrated the high flexibility for the EVA MAS system as well as the interoperability with non-agent software modules. We have also detected some difficulties while working with the proposed architecture. For example, all the agents and protocols must exist (be active or able to be initialized automatically) for a service to be provided. Also, working with different databases, we have detected some problems when accessing them with JDBC drivers on WindowsNT platform. Nevertheless, our expectation is that as the set of agents grows, the development will be easier.

The work on virtual learning community, composed of learning companions and personal learning assistants is in process. We have developed a number of prototypes but a lot of work is still to be done to convert them into a real DLE.

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Distance-Collaborative Design: An Approach to the Design of Children's Electronic Textbooks

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This paper describes a design approach, called Distance-Collaborative Design (DCD) which is used in the process of designing Malaysian children's electronic textbook (e-book) interface. Distance users are employed as design partners in order to elicit user requirements with users who live far apart from where the e-book is being developed. DCD has three major phases: initiation, construction and implementation. Initiation involves seven steps: identifying existing problems with teaching-learning materials, develop ideas to solve the problems, report on the rationale of choosing the idea, identify possible solutions, plan new system, develop conceptual model of new system and plan general requirements of the new system. Construction is iterative and consists of at least three mini-projects. Each iteration contains all the usual system development life cycle of analysis, design, development and evaluation and it tackles a small objective beginning with first objective to assess users' perceived usefulness of system concept. Firstly, however, this paper explains the concept of the e-book, whose design is based on a model which allows content to be presented by mixing graphic page mode, talking page mode, hypermedia page mode and web page mode. Each mode includes various activities which support and nurture as many children's intelligences and learning styles as possible.

Designing Children's Electronic Textbooks With Distance Partners

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Abstract : This paper describes a design approach, called Distance-Collaborative Design (DCD) which is used in the process of designing Malaysian children's electronic textbook (e-book) interface. Distance users are employed as design partners in order to elicit user requirements with users who live far apart from where the e-book is being developed. DCD has three major phases: initiation, construction and implementation. Initiation involves seven steps: identifying existing problems with teaching-learning materials, develop ideas to solve the problems, report on the rationale of choosing the idea, identify possible solutions, plan new system, develop conceptual model of new system and plan general requirements of the new system. Construction is iterative and consists of at least three mini-projects. Each iteration contains all the usual system development life cycle of analysis, design, development and evaluation and it tackles a small objective beginning with first objective to assess users' perceived usefulness of system concept. Firstly, however, this paper explains the concept of the e-book, whose design is based on a model which allows content to be presented by mixing graphic page mode, talking page mode, hypermedia page mode and web page mode. Each mode includes various activities which support and nurture as many children's intelligences and learning styles as possible.

Distance-Collaborative Design Approach

A prototype of a children's electronic book (e-book) is under development. This e-book is designed based on Howard Gardner's Multiple Intelligence theory. According to him, children learn in at least seven different ways: verbal/linguistic, logical-mathematical, visual/spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal. Each child could learn in any one of these ways or through a combination of several ways. Taking this into account, our e-book is defined in terms of *structure* and *content* presentation. The e-book *structure* is made up of at least three main sections: front section, main section, and back section. Main section can have as many chapters as required and in each chapter there are no limit to the number of required pages. However, in each page, the number of paragraphs for children textbooks is frequently less than five, with an average of three. Children textbooks also normally do not have foreword, preface, acknowledgement, dedication, list of tables, list of figures, footnote, reference, index, glossary or appendix. The *content* presentation components should be carefully designed. The types of activity in which the users will be involved play significant roles in the success of pedagogic design (Barker and Manji, 1991). With regard to this, the seemly activities, which should be included in the design of children e-book contents so as to meet the seven intelligences, include writing essays, play with word processors, reading, drawing and painting programs, sing along programs, listening to rhythms, puzzles, using email and chatting programs, creating notes on daily activities/on-line diary and etc. (for a more detail description on many other activities and their suitability for the seven intelligences refer to Norshuhada and Landoni, 2000). We group the above activities into four modes: *graphic page, talking page, hypermedia page* and *web page*. Each mode will have activities that support at least one learning style.

In the process of designing the above-described e-book, few design approaches were considered: traditional system development, user-centered design and participatory design (PD). PD or collaborative design is popularized for such reason that it involves users in all the design phases as testers, informants and design partners (Druin et al., 1999; Scaife and Rogers, 1999). In this project, we recognize the importance of involving users in the design phases, however since the prototype is developed for Malaysian schools (which is located far from Scotland where the project is run), where medium of instruction is Malay and whose culture is different from the western countries, we introduce an approach called Distance-Collaborative Design (DCD) whereby distance users are involved in the design process. In this approach, users (1 head teacher, 1 teacher, 2 children and 2 parents) who live in Malaysia are selected, as in any participatory design activity; major stakeholders should be represented. Communication is performed through the use of email, Internet (web site, chatting program) and telephone instead of face to face meetings. The head teacher and teacher are employed as informants and design partners to provide the content and verify the teaching strategies, as well as give feedback on interface design issues. Since the children in this project are young (aged 7-9) and we are aware of the extent they can be involved due to limitations on their knowledge and experience, we employed them as testers and informants rather than design partners. Their parents help them in the communication processes. The parents of the selected children are knowledgeable in computer system design as they themselves are working in system development environment. Thus they represent not only parents but also design experts and become informants and design partners. DCD has three major phases as shown in Figure 1.

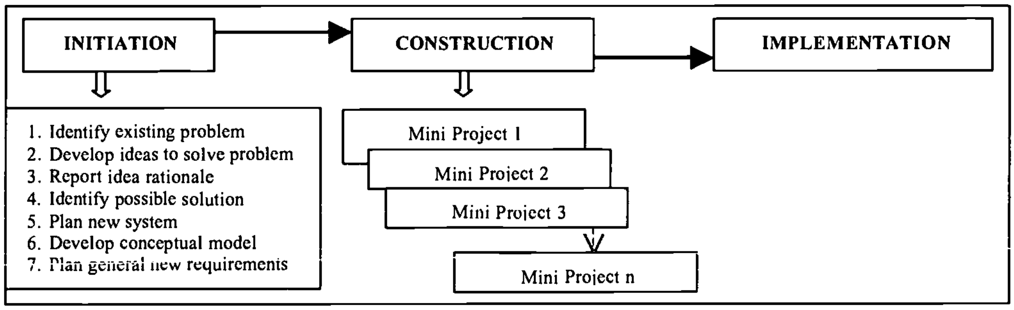

Figure 1: Phases in DCD

The *first phase* (Initiation) involves seven steps in which the head teacher is involved in the first two. The seven steps are: identifying existing problems with teaching-learning materials, develop ideas to solve the problems, report on the rationale of choosing the idea, identify possible solutions, plan new system, develop conceptual model of new system and plan general requirements of the new system. The *second phase* (Construction) is iterative and consists of at least three mini-projects. We adopt this method from Uden and Dix (1999) and make modifications to fit our purposes. Each iteration contains all the usual system development life cycle of analysis, design, development and evaluation. Each iteration tackles a small objective beginning with first objective to assess users' perceived usefulness of system concept. Then if the perceived usefulness of the system is reported to be high, construction process move to second level of mini project with the objective of refining the first mini project and testing other usability aspect of the system. Each iteration is completed with an evaluation to confirm that each mini project has met its objective. The iteration continues until the usability is reported to be high and system is ready to be implemented.

Since we are using Gardner's theory as a guide to the development of our proposed children's e-book, we first need to have evidence that our design idea is indeed useful in catering and nurturing children's learning styles and well accepted by potential users (there is no point of proceeding to the next mini project construction if design idea is poorly accepted by users). It is widely suggested that as the functions and interface features of a new system are made, it is an ideal time to measure user assessments of a proposed system in order to get an early reading on its acceptability (Davis, 1989). Hence for this reason, our project concerns only with the first construction iteration (i.e. mini project 1). The construction phase of mini project 1 consists of six stages: create storyboard, design navigation structure, design system interface, develop content, produce media element (graphic, audio, animation and etc.), and evaluate users' perceived usefulness of the e-book system. All these stages involve users in various ways. To start with, three interface design ideas are electronically posted to all partners and they are asked to make comments on the lay out of the e-book, placement of icons, choice of icon designs, metaphors used to described icons and size of icons. Second stage involves asking them to produce their own design ideas and each design is then posted to all partners to be commented. Finally, they are asked to choose, in their opinion, the best design. Most voted design is then selected as the system design. While children are involved as informants and testers mainly about icon metaphors and design, the head teacher and teacher propose content and instructional strategies.

Conclusion

Our investigation started from the observation that flexible electronic textbooks could play a crucial role in education. In particular they could allow to nurture and stimulate multiple intelligences in children. We have since then developed a Distance-Collaborative Design approach to allow us to produce prototypes suitable for our user needs.

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Multimedia Guide to Fractal Geometry in Progress

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Fractal geometry has changed our vicw of natural processes and geometric forms. The Guide is a software kit supporting a university course on this science. It contains an introductory electronic textbook, annotated list of publications, favorite Internet links and provides facilities to run programs. One program visualizes the mechanism of birth of classical and IFS fractals. A student can grow fractals by himself and explore their features by trying different generators and mappings. Another program demonstrates connection between the Mandelbrot and Julia sets. It has certain advantages over analogous programs and throws a bridge to nonlinear dynamics and chaos theory by showing different variants of behaviour inherent in underlying quadratic process. Particular attention has been given to the programmes that model natural processes and structures: aggregation, percolation, plants, landscapes, etc. To create the most complete educational software we would be pleased to collaborate with other specialists and enthusiasts.

Using Concept Mapping as an Interactive Learning Tool in Web-based Distance Education

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Abstract: Issues and trends discussed in literature across a number of disciplines including distance education, instructional design science, sociology, human factors engineering, visual communications, and computer and information science indicate that there is a critical need for web-based courseware to be theoretically grounded and interactive. A thorough search for web-friendly, interactive, instructional techniques highlighted concept mapping as a possible solution. Therefore, the purpose of this study, was to explore the integration of concept mapping into web-based distance education courseware as a tool to increase interactivity and learning outcomes.

Introduction

The goal of this paper is to provide a possible model for achieving effective web-based instruction using concept mapping as an interactive learning tool. The model is the result of the author's work on a grant at The University of Arkansas, Fayetteville (UAF), that included the design, development and evaluation of two undergraduate web-based distance education courses. The model outlines a possible definition for interactivity called *adequate dialogue* and a description of how concept mapping successfully increased interactivity and learning outcomes based upon this definition. Course authors may decide to adopt the model as it is presented or choose other components that meet the criteria of adequate dialogue in order to achieve interactivity in their own web-based courses.

Defining Interactivity: A Synthesis of Perspectives

Since the design and development of technology-based learning environments is cross-disciplinary many different definitions exist for the term interactive. Therefore to begin this project, it was necessary to establish a possible definition for interactivity. Within this study, the definition of interactivity is taken from two sources: Moore's (1990, 1996) theory of *transactional distance* and Laurillard's (1993) discursive, adaptive, interactive and reflective *conversational framework*. Moore's concept of transactional distance describes the nature of distance in all educational settings. Laurillard's conversational framework elaborates on the character and complexity of academic learning, the roles of students and teachers in the learning process, and the strengths and weaknesses of various technological mediums as support mechanisms for those roles.

Briefly, Moore (1990, 1996) detailed three different types of interactions which he argued are essential to distance education: learner-instructor interactions, learner-content interactions, and learner-learner interactions. McIssac and Gunawardena (1996), who discussed Moore's theory at length, said that highly structured course content decreases the dialogue between students and instructors, whereas less structured course content increases that dialogue. Laurillard (1993) added depth to Moore's theory by stating that all teachers must recognize the special character of academic knowledge while encouraging dialogue between the teacher and student that is discursive, adaptive, interactive and reflective. In addition to her conversational framework, Laurillard (1993) also provided a media comparison that detailed the strengths and weaknesses of various types of media as support mechanisms for the twelve steps of discourse responsibility she described.

Combined, Moore's theory of transactional distance and Laurillard's analysis of technological mediums provide a working framework for the concept of interactivity for this project and study which may be described as *adequate dialogue*. Adequate dialogue may be established by using instructional techniques or technologies that enhance the exchange of ideas/knowledge between instructors, students and media while fitting within Moore's theory of transactional distance, and fulfilling at least 8 of Laurillard's 12 conversational framework guidelines.

Concept Mapping: Increasing Interactivity & Learning Outcomes

A review of the WWW for available web-based distance education courses reveals that many of the university level courses currently offered on-line are limited because they are designed to mimic a traditional textbook and contain only one element of interactivity in the form of, a listserv, a thread discussion group, or email. Such courseware can provide only weak instruction and is best used to support the traditional classroom, as opposed to providing good distance education. The integration of concept mapping exercises into a web based learning environment (made up of the components listed above) can dramatically re-create that environment by providing an mechanism within the course interface which extends and supports *adequate dialogue*.

Concept maps graphically illustrate relationships between ideas and greatly aid students in the process of restructuring their own knowledge and/or expanding their own conceptual understanding. Within a concept map, two or more concepts are linked by words that describe their relationship. A concept is "a perceived regularity in events or objects or records, designated by a label" (Novak & Wandersee, 1990, p. 29). For example, "free fall is due to gravity" could be described with a concept map containing two ideas, free fall and gravity (which both appear in symbols), and three linking words, "is due to".

The Results of the Research Stage UAF Study

The results of the research stage of the UAF grant project revealed that the integration of concept mapping into web-based distance education provided effective web-based instruction. Twenty-one students volunteered to contribute to the UAF study by completing pre- and post-content knowledge concept mapping exercises; 6 students were chosen to participate in the nominal group interview process based upon their pre-content knowledge concept mapping exercise performance. Triangulation of all of the data gathered indicated that the integration of concept mapping into web-based distance education courseware created more opportunities for students to learn by establishing *adequate dialogue*. The pre- and post-content concept mapping score data revealed that participating student knowledge of poultry physiology increased during interaction with the physiology test module. The nominal group interview data clarified how concept mapping impacted interactivity and the learning process.

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Mentoring at a Distance: Helping Adult Learners Succeed in an Online Learning Environment

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Abstract: This paper presents a discussion on mentoring strategies in an online learning environment. Material has been culled from numerous research studies in distance learning and practical experience mentoring over 150 graduate students in a learning and technology program. Topics include what mentors should know about adult online learners, beginning with the end in mind, developing goals, frequent communication of expected goals and outcomes, fostering relationships of trust, and providing adequate follow-up and support.

Introduction

The purest form of distance education occurs independent of time and place (Simonson et al., 2000). In other words, learners, not institutions, choose when and where to learn. This is also called asynchronous distance learning, and the Internet has made this a reality to the world. One of the greatest challenges in distance learning is fostering continuous progress and achievement since attrition rates in distance education programs are usually much higher than in traditional programs, in some cases as high as 50 percent (Picciano, 2001). Western Governors University (WGU) is an online, competency-based university which provides every student with a mentor to help foster this environment for successful learning. The role of the WGU mentor encompasses the roles of advisor and instructor at traditional institutions. Mentors at WGU have educational backgrounds in the disciplines in which they mentor and advise students. In addition, they work closely with their students across several domains of knowledge from matriculation to graduation.

What Mentors Should Know About Adult Online Learners

As student-centered learning continues to take hold in education, the role of the teacher is shifting in both traditional and distance education from the "sage on the stage" to that of facilitator and mentor (McVay, 2000). This is especially true in an online environment where the adult learner is expected to learn by integrating life experiences with new information to construct meaning. This transition includes a movement from (a) lecturing to coaching, (b) taking attendance to logging on, (c) credit hours to performance standards, (d) competing to collaborating, (e) passive learning to active learning, and (f) textbooks to customized materials (Oblinger, 1994).

Part of being a successful online mentor involves improving the mentoring relationship by helping to make these transitions and identifying the characteristics of successful online students. Research studies have provided a number of characteristics of those most likely to complete distance learning coursework and programs. Completers are more likely to (a) have an internal locus of control, (b) possess advanced degrees and higher grade point averages, (c) study at least 10 hours per week, and (d) have already successfully completed a distance learning course (Bernt & Bugbee, 1993; Dille & Mezak, 1991; Laube, 1992). Research has also confirmed that completers possess more positive attitudes about their tutors than those who drop out early (Laube, 1992). At-risk students, or those that have the greatest potential to be non-completers, are students who (a) have not completed college and are therefore more likely to lack the metacognitive skills for approaching coursework and assessments and (b) have an external locus of control and do not take responsibility in managing the learning process (Dille & Mezak, 1991). At risk students are particularly benefited by having mentors to share and discuss issues and concerns related to their academic performance (Picciano, 2001).

Strategies for Success

We have developed four basic strategies from our own mentoring experience that have proven to be effective in producing successful online learners. These strategies are important in any learning environment but are particularly meaningful for online student learning. First, students in most online programs begin their studies with only a vague understanding of the various projects and activities required to complete their degree. Most do not appreciate how the individual program components are related to each other. This understanding often comes only at the end of the program when students have completed several classes and projects. The online mentor should help students begin with the end in mind by describing how each project is related and how projects should be aligned to culminate into a final project if required. This not only saves students a great deal of time and resources but also builds a more cohesive understanding of how the program works and what students need to know to successfully complete the program.

Second, for any mentoring relationship to work, goals need to be well defined. Smith (1995) provides five criteria for creating "SMART" goals. Goals must be specific (S), measurable (M), action-oriented (A), realistic (R), and timely (T). Since goal setting is an evolutionary process, the mentor and mentee "revisit their learning goals throughout the mentoring relationship" (Zachary, 2000, p.94). A key to online mentoring at WGU is working individually with each student to develop an academic action plan which serves as a road map for the student's academic journey through the program. The academic action plan articulates specific components of the learning agreement, outlines learning opportunities such as coursework, independent learning resources, textbooks, and Internet resources. It also helps define both short term and long range goals and tracks student progress.

Third, frequent communication of expected goals and outcomes is essential to the mentoring relationship. Zachary (2000) calls this process "accountability." A simple, "How is it going?" is a good strategy to ask frequently instead of only when things go wrong. This is most often conducted through email and phone conversations but is done more formally by holding regularly scheduled interview sessions with the student wherein the academic action plan is reviewed, expectations are defined and redefined, goals are set, adjustments are made, and the mentoring relationship is strengthened. A helpful strategy is to have the mentee summarize the session and send it to the mentor in an email to support accountability and ensure understanding of what was discussed.

Finally, an essential component to online mentoring is providing adequate follow-up and support. Students should know that the mentor is aware of their individual needs, abilities, and learning styles. Email and telephone requests should be responded to promptly, within the day if possible, and no longer than 48 hours. It is important to remember that the mentor should facilitate the learning process, not provide all the answers. Students will inherently make mistakes but mistakes are an opportunity for learning. This comports to the analysis of a mentor by Cross who relates the pursuit of a degree to a journey that is full of unexpected outcomes in which the mentor is "not so much interested in fixing the road as in helping the [mentee] to become a competent traveler" (Cross, 1987, p. ix). As students gain skills and explore new concepts and theories, they discover both learning goals and obstacles previously not considered. By applying their newly found knowledge and skills, students realize fulfillment in opportunities previously unknown.

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COMPUTER NETWORK BASED LEARNING IN PROJECT GROUP ENVIRONMENT

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Abstract: This paper springs mostly from experience gathered in relation with conducting a Socrates funded ODL project: named 'Computer Network Based Learning in Project Group Environment'. The project objective was set to test working methods in practice and evaluate how academic institutions can gain from using computer networks in learning processes and everyday communications. The project started in Autumn 1998 with a one-week seminar. The beneficiary of the project is EVTEK Mercuria Business School, Finland. Partner institutes are from the United Kingdom, Ireland, the Netherlands, Germany, Italy and Spain. Presently the project is in the stage of evaluation and dissemination of its various activities. The project will end in August 2001. This paper is focusing on reporting on our experiences and our presentation will be focusing on the learning points based on these experiences.Updated information on the project can be found at http://virtual.mbs.fi/virtual

Project Activities

After having learned technicalities on how to prepare network based learning material we focused on understanding network learning pedagogy, including

- different aspects of ODL and the attitude to ODL in different cultures
- the evaluation of the effectiveness of web-based learning in the educational environment, i.e. how effective web based learning is for the individual student, teacher and institute
- what organisational requirements should be met to promote ODL
- evaluation of the techniques of ODL as tools for academics
- the role of effective communication and how that can be achieved using net-based learning
- dissemination of learning experiences and outcomes

During the second year of the project we have been able to focus on the above-mentioned factors as well as network pedagogy. Transnational project groups defined their project work plans in a seminar held in October 1999 in Holland.

Subproject 1: Handbook on how to combine IT with traditional working methods

This handbook, "Tips for Online Learning", is intended to form a pool of lecturers' and students' experiences with online learning. We take special interest in how the technology is supporting learning.
Each section takes the form of a series of "tipsheets", a list of observations or ideas, distilled from implementing online courses. We are more interested in how the technology has been used to support teaching, rather than the specifics of how to use certain learning environments.

The working draft of the handbook is at the website http://virtual.mbs.fi/virtual/oltips indicating what sort of content we are interested in. The integration of this material into a pilot of the handbook is presently in construction and will be ready by end of May.

Subproject 2: Web based study modules combining IT with traditional learning

Project partners have started pilot web courses in order to develop, share and further evaluate the web-based learning environment. We provide practical information on development of online courses, including experiences and evaluation of both lecturers and students.

During the first project year investments/choice of platforms took place and training was mainly provided to achieve technical skills and positive attitude for staff. The objective for the second year was to have all partner institutes involved in starting pilot courses, with different objectives to be developed and evaluated. Out of seven partners, only one has not achieved this result.

Other objectives have been to offer a base for quantitative analysis. The project members created a feedback form.

At Mercuria Business School some 6-7 different courses were started during the spring season 1999 on the purchased server. In July 1999 the courseware tools were purchased and by the end of August there were already some courses working with the new environment. At this stage there are some 50 courses up and running on the server. Assessment software has been installed and will be used with courses in the near future. A pedagogical course on NBL has been attended by 33 of our teaching staff from November 1999 until April 2000. Joint courses have been conducted with Glasgow Caledonian University and Sheffield-Hallam University. Here are some examples of online courses (http://student:visitor@webct.mbs.fi/webct/homearea/homearea) at Mercuria Business School: Online Courses in Open University, Polytechnic and International Co-operation. Supportive Intranet platforms have been constructed for both staff (MBS info) and students (Opiskelijainfo and Studentinfo) in autumn 1999. External web site information has been improved; the layout leaves a lot to be desired, and has not been worked on due to strategic organisational changes at the institute. Having now experienced visible results, the organisation is very devoted to invest in NBL and its supportive web based activities. Several teachers of online courses are working on pilot courses in order to evaluate and disseminate the experiences of them.

At Wolverhampton University the Online courses have first been provided for postgraduates, (http://www.wlv.ac.uk/wbs/olbaba) arranged by a specific department supporting this activity. The project was promoted through distribution of a CD-ROM presenting the advantages of online learning. In addition there is a huge development programme going on (http://wolf-nt.wlv.ac.uk) The Wolverhampton Online Learning Framework (WOLF) is a purpose built computer based learning environment developed by the University of Wolverhampton. In this respect Wolverhampton goes its own way but in the long run it will have a lot to disseminate on the topic.

Starting July 1999 Hogeschool Holland,/Hogeschool International Business School, invested in a learning platform and courseware tools, testing them during the autumn semester. Due to different solutions in allocation of time and resources the organisation was not able to support fast development of working out new online courses.

Starting spring 1999 Hochschule Anhalt purchased the needed equipment and know-how of their own. First they worked out tutorial activities for student teams. The training started in the autumn semester 1999 with a workshop for tutors (6) on FP Express and html-language. During the winter they trained 25 of their teachers on the same subjects. Several web-based courses have been started.

The Institute of Technology, Tralee has been using the courseware tool TOP Class for some courses in the Department of computer science and IT. As part of a major move to an integrated MIS at institute level, WebCT is the new platform..

Univerisity of Alicante has been developing its own courseware tool, VirtualCampus for course communication for two years. Further development has been done with MicroCampus web course toolware for online courses, which has been designed by the Multimedia Lab of the University.

Subproject 3: Web based support for transnational studies

The IOI (International Office Information) stemmed from a need to make better use of new and innovative Internet based technology to manage the growing numbers of international partners, student and staff mobility flows and project participation. The set goals were the effective dissemination of information, increasing student and staff mobility and paralleling and replacing existing paper based systems. The process was designed to maximise throughput, effectively use the resources and technology becoming available, simplify student access and increase individual autonomy.

Web sites (Internet and Intranet) with provision of information were produced. The development work was produced separately in each institute, co-operation on methods of analyses are presently worked on.

The aim of this project was to use web based technology to facilitate mobility and non-mobility international activities. The IOI project was co-ordinated by MBS International and the partners were Universita' di Genova, Italy and the Institute of Technology, Tralee, Ireland. Although partners for mainly logistic and practical reasons did much of the work independently, the initial input and sharing of ideas at workshops and seminars was essential. Partners were able to view each others progress through the Internet and also via both informal contacts and regular reporting to the subproject manager.

Subproject 4: Work placement & Supervised Work Experience

We are working on setting up an international and **multilanguage recruitment support system** before the end of the July as a 'beta' version between some of the partners. Based on experiences it may be elaborated to work globally, focusing on providing opportunities for recruitment of graduates from abroad.-

NettiRekry is an asp-based software program, which is running on Microsoft NT-server with IIS4. This new version of NettiRekry is the second model in our NR-family. The pilot version Nettirekry was used by for Mercuria Business School to serve at national level: connecting companies looking for employees and students who are looking for work opportunities. Already this version was a success story. It has been running over a year now and has more than 1300 users.

We are also working on a **'Supervised Work Experience Module'**. With SWE-module students and companies can easily access the school's SWE database and look for material updates and leave reports etc. Supervised Work Experience-sites are dealing with supervision of the work training of students in connection with EBA studies; a double-degree programme that is taking place at Hogeschool Holland, Wolverhampton and Mercuria Business School. This operates in situations when students are performing their work-training phase of their studies. In order to make the training function in accordance with the objectives of the working practice period it requires constant interaction between the student, the supervisor of the working experience from the institute and the student himself

Workplan plan for 3rd project year (September 2000-August 2001)

Subproject 1: Further evaluation of transnational projects

The outcomes of this subproject are related to what can be disseminated and contributed to the handbook. Therefore, this subproject should be active as soon as possible. All partners should contribute to the extent that they help in collecting information. Analysis will all be done at MBS.

The major assessment work should focus on the effectiveness of network methodologies used to improve network-based learning.

By the end of the 2nd year, some evaluation efforts were made, basically to the extent of testing the methodology of assessment. Both internal and external assessment including the users and providers of the NBL will be executed.

The results will be implemented in the Handbook on Network based learning and its help desk in order to be disseminated to a wider public. This will lead to a broader understanding of the specific features, benefits, challenges as well as resources needed with the NBL.

Presently (April 2001) the evaluation work has been gathered and the conclusions of evaluation will soon be published to evaluate the utilisation of network facilities in implementation of courses, both from the perspective of the teacher and the students. Also evaluation of activities within Web-based support of transnational studies can be further evaluated as well as the activities of work placement and supervised work experience.

Subproject 2: Dissemination of the project outcome

All partners are expected to contribute to making dissemination work during the springtime (especially February - May) of year 2001.

Target Group	Message	Activities	Responsible person(s)
• Project partners • Lecturers , staff • Students	• Experiences with online courses in group environment • Handbook on how to create NBL-material	• Further evaluation of the running study and service modules • Internal education and training activities • Help desk service (see definition below)	Lecturers, local co-ordinators, project manager, students, external assessors and consultants
• Other educatio nal institutio	• Experiences with online courses in group environment • Handbook on how to	• Dissemination in seminars and events, 5 per project country, total 35 (see list below) • Promotion for the Handbook (see	• Project manager and local co-ordinators in different countries

ns in the EU	create NBL-material	up-to-date situation below)	
• Other interest groups, i.e. compani es, national agencies, associati ons	• Dissemination on the new web-based working methods in education and potential possibilities for pedagogical further development and closer co-operation between educational institutions and companies	• Active personal contacts • Dissemination seminars and events • Web-based recruitment for supervised work experience students (Activities implemented 3.a.) • Student projects for companies, agencies and associations utilising the NBL • Company representatives as external assessors in the development of the concept of NBL	• Lecturers, project manager, local co-ordinators, students

Table 1: Dissemination of the project outcome

Subproject 3: Handbook
The handbook aims to be differentiated from other options from at least two perspectives: 1. It will be very practice oriented and 2. It will be supported by audiovisual material

Aims of the Handbook	What will the handbook look like?	Resources required	Time scale for the further development activities
• To help the facilitators of network-based learning • To gather together the separate evaluations of the sub-projects • To produce a final summary document to represent the overall project	• It will be web-based (although a printed copy may be produced) • It will be fully indexed and searchable • One master copy will be produced which can then be customised and translated by individual institutions	• Technical resources programming for index and search engine • Editorial resources • Accumulating and editing material • Proof reading	• Review and comment on the existing handbook - • Suggest additional information to handbook • Gather evaluations from other sub-groups - continuous • Incorporate further evaluations into handbook

Table 2: Aims of the Handbook

Learning points and conclusions
The experiences and recommendations based on them will be summarized ins the handbook; Tips for Online Learning. Also, that is what our presentation at EDEN conference in Stockholm will focus on.

References
Socrates ODL project website 'Network Based Learning in Group Environment' http;//virtual.mbs.fi/virtual

Communication in the Virtual Teaching and Learning Space

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Abstract
This research project addresses broadly the issue of whether the new media, being potentially interactive (and thus bridging teachers, students and other educational agents) may open new ways of teaching and learning, which are more adequate to contemporary life and the global society.

"Technology is the campfire around which nowadays we tell our stories."

Laurie Anderson, American artist and multimedia pioneer, chose the image of the campfire to drive our attention to the central role of technology in our society, shaping out collective views of the world and mediating human relations.

The university, as a social and cultural institution, could not be untouched by this phenomenon. In fact, there are many similarities between the mass media and the traditional teaching model. Both are marked by the separation between the main agents (producers/audience, teacher/student) of the communicative process.

New media, being potentially interactive, may help educators in their efforts to close the gap related above, creating new learning environments which are more "in sync" with post-modern society and culture.

More directly, it aims at identifying the degrees of teacher awareness and understanding of the communicative changes brought by the new interactive media such as the internet and its impact on the learning process as it happens at the Pontificia Universidade Catolica do Parana.

This project is part of the research being carried on by the research group Virtual Leaning Communities, itself part of the broader Theory and Practice of Higher Education project, linked to the Masters and Doctoral programmes at our institution.

Our university began to implement last year a new educational model, for all its 51 undergraduate majors, based upon "learning programs" developed jointly by teachers and students. This model leans heavily on problem-solving, investigative skills as well as on collaboration and tutoring.

Eureka is a collaborative learning environment, developed at our university, in cooperation with Siemens Corporation. As many other such environments, Eureka offers discussion forums, e-mail, chat room, scheduling, message board, repository, and other online and offline resources aimed at facilitating collaboration and learning. At the end of academic year 2000, there were more than 10.000 Eureka registered users, of a 23.000 (staff and students) academic population.

Eureka`s 350 virtual rooms will be our research universe. They are the environment in which the central issue of the use of new technologies as support for educational changes can be addressed. We will follow the tutors from the moment they open their virtual rooms until the end of the academic year, looking into the ways they communicate with their students in this environment, the tools they use and how they use them, the ways the students react to stimuli and how they start and keep their own forms of collaboration and communicative exchange.

So far we have been able to identify a close resemblance between the way mass media mediates communication and the way traditional teaching happens.

We want now to find out whether new media can be associated with a new learning paradigm: a student-centered, problem-based, research-oriented, knowledge-building model, where collaboration and interaction are essential.

Mass-Media and Traditional Teaching Common Characteristics.

Centralized control: messages (content and form) are constructed by the few who control the medium

One-way communication: messages travel in one direction only, from those who control the medium to those who receive them

Prevalence of "cold" media prevail: as defined by MacLuhan, the more finished the message is, the less space the medium leaves to the spectator, the colder the medium

The spectator: from the Latin *expectare* (to be there, just watching); spectators/students are expected to sit quite and listen/watch, without interfering with the production of messages.

Linearity: messages built along a pre-defined, pre-built sequence, in a linear flow with its own temporality, independent from the spectator, who cannot alter this direction or speed, nor choose alternative ways.

New interactive media characteristics

Decentralization: one the main characteristics of the internet, the first big media without owners and central controllers, opened to all

Two-way communication: information flows in multiple directions, allowing new communicative exchanges

Interactivity: hot media prevails (if we take the potential for interaction in its fullest sense).

The "users": so new that there isn't a good word for it, these new spectators refuse to "just watch"; they want to participate, to interact, to wet their hands in the ocean of information, to manipulate messages and create new meanings

Multimedia: more than just a new audiovisual medium, multimedia is opening a universe of multiple stimuli

Non-linearity: the wide use of "water metaphors" (to navigate, to surf, to dive...) to describe user movements in the information "ocean" reveal the non-linear structure of the new media; one can move in the surface, or dive into depths never made possible by linear media

New media and contemporary education

As we develop and spread new tools around campus, new forms of communication between teachers and students can take place. New tools, however, are not enough to make a difference. It is the attitude of the learning agents that counts more.

If we want to depart from traditional, informative teaching, and move towards new directions for learning, we must try to establish new communication spaces and to develop new communication skills, alongside with the ones we are familiar with (at least as consumers of media products).

That is the challenge for nowadays educators. New forms of teaching and learning surely will employ new technologies and resources, more interactive and flexible. On the other hand, educators must change their views and attitudes accordingly. It is imperative that we find a common ground upon which true, rich communication exchanges with our students can occur.

Learning can and must be a joyful, stimulating activity.

The university (and the school as well), as a communicative space, must go beyond the model based on the mass media, reaching for the new digital, interactive media - if education is to keep on being significative and important to students and to society.

Insuring Quality for Online Instructors:
The Walden Certified Online Instructor (COI) Program:

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Abstract: Since the summer of 1999, Walden Institute (the parent organization of Walden University) has been offering a 3-month certified online instructor (C0I) program providing educators, managers, and other professionals, with the basic skills and knowledge necessary to be an effective online facilitator. This presentation will explore the rationale of the COI and its effectiveness in training online instructors.

Rationale for the COI

Online courses have become a major component of almost every major post-secondary institution, and corporate training department. Teachers and trainers are expected not only to facilitate these courses, bur very often to create them as well, despite the reality that they may have little or no actual experience with online learning/teaching. Teaching online requires new skills and knowledge beyond those of traditional classroom instruction. However, there has been relatively little public or scholarly discussion about what these requirements are and how best to meet them. This session will provide an opportunity for such a discussion, using the Walden Institute COI course (www.waldeninstitute.com) as a case study and basis for the discussion.

Questions/Issues addressed in the formation of Walden's COI

- What are the skills/knowledge needed to effectively teach online?
- What is the best format for online instructor training?
- How long should an instructor-training course be?
- How much web/internet/computer background does an instructor need to teach online?
- What are the typical problems that online teachers encounter?
- Are all teachers/trainers capable of being online instructors?

Development of the COI

Most tertiary school systems have offered some degree of in-service training to their faculty, usually in the form of short workshops/seminars that provide introductions to online teaching. In addition, many schools of education now have one or two courses about online education as part of their teacher-training curriculum. But these efforts tend to be too brief and limited to provide the extensive, hands-on experience needed. What is needed is instructional approaches aimed at developing understanding, supporting peer interaction, and facilitating learners participation and use of technology by taking theory to practice.

In 1999, Walden Institute began to offer a Certified Online Instructor (COI) course (see http://www.waldeninstitute.com/coi_ov.htm) intended to provide the kind of training needed by teachers and trainers. The COI is a 12-week, instructor-facilitated course offered entirely online. Separate course sections are offered for academic and business training participants with slightly different course materials. To complete the COI and earn certification, participants must demonstrate their mastery of the following major competencies:

1. Basic elements of on-line courses: email, threaded discussions, real-time conferencing
2. Characteristics of distant, diverse, and adult learners
3. Qualities of effective on-line educators
4. Instructional and interface design considerations for on-line education
5. Different tools available for creating and managing on-line education
6. Strategies for integrating on-line and classroom instruction
7. Techniques for evaluating the quality of on-line learning courses and programs
8. Critical aspects of implementing a successful on-line course or program
9. Ethical and legal issues associated with on-line education
10. Emerging developments that will affect on-line learning

Requirements to obtain a Certificate

Participants must complete a course design project that spans the topic areas in the syllabus, which results in a working lesson prototype. Some of the successful projects from the COI include: An online course in Stress management; ESL instruction; a course on the basics of Yoga; a workshop on Creative and Critical thinking; and a course for undergraduate Interns to link the knowledge obtained on the job to theoretical principles learned in the classroom.

During the course, participants are also given opportunities to serve as the facilitator of discussion forums and web conferences. Since the course was first offered in 1999, more than 500 teachers and trainers from institutions and organizations across the U.S. have completed the COI and received certification.

The COI provides a community of learning for teachers and trainers where they can share and acquire ideas from each other – making it possible to cultivate diverse perspectives. The theoretical framework for developing the COI coincides with Fleischauer's (2000) report from the National Education Associations summit on quality online instruction. The COI offers a solid foundation to proceed with the development and management of on-line education. In particular, the project the participant completes provides a specific plan that can be (and often is) implemented. However, there are many additional factors, specific to your institution/organization, computer systems used, and the participant's position/role, that will determine what additional knowledge is needed to pursue on-line teaching or mentoring activities. Upon the successful completion of the COI the participants is aware of what is needed to further their work as an online instructor

Usability and Learning in OnLine Environments: A Case of Interactive Encounters

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Abstract: This paper proposes a set of strategies to maximise learner-content and learner-learner interactions in on-line learning environments. Extrapolating the outcomes of a research study that investigated the ways in which users responded to the interactive constructs embedded within interactive multimedia applications, the concept of encounter theory is introduced. Using observation and interview techniques, participants in the study identified a range of options by which learner-computer interactions might be enhanced. The implications of these findings for on-line and desktop environments are considered, specifically in terms of the independent learner's encounter with content material and other learners. Developing a comprehensive understanding of the interactive phenomenon will not only lead to more effective useability and learning in on-line environments, but also to their working better for the learner.

Introduction

With the current demand for on-line content and communications, people are making extensive use of the internet for both human-human communication and information retrieval, and within this context there is a substantial and sustained demand for learners to have rapid access to and quick but meaningful responses from content material. The momentum towards on-line learning as a *de facto* educational delivery system is also emphasising the value of communication and interaction between learners, teachers and content.

This paper derives the concept of encounter theory, which predicts that conceptualising the on-line learning experience as a series of encounters will enhance the overall learning experience, based on the outcomes of a research study that examined the interactive constructs within a series of CD-ROM applications. Given the research data generated, it was evident that people work with the same interactive products in quite different ways, having different expectations, deriving various meanings and achieving various levels of engagement and communication. Consequently, the ways in which producers of on-line applications perceive the learner as undergoing a series of encounters between a fellow learner, a teacher or some digitally presented content will be crucial to learning outcomes being achieved. Conceptualising the on-line learning experience through encounters will potentially make on-line content more intuitive, and therefore more accessible and interactive to the learner.

The following discussion briefly reviews the way in which interactivity in computer-based environments is currently understood and describes the methodology and results obtained from the research study. The implications from the study for on-line learning environments are then addressed in terms of the potential encounters between learner and content or learner and learner, and the how the production team has the responsibility for creating the environments in which these encounters will operate effectively.

What is Interactivity?

Interactivity, in the context of computer-enhanced learning (CEL), can range from simple navigation through web pages to human-human collaborative experiences to immersion in interactive virtual worlds. While the many dimensions of interactivity are well documented (Sims, 1999), considerable uncertainty remains about how best to design and implement interactions to achieve the desired learning goals. In the field of educational technology there has been a distinct shift from interactivity as overt physical reactions to those involving internal cognitive processing. From a broader perspective, Laurel (1991) and Shedroff (1994) have emphasised the potential of theatre, specifically in relation to the way interactive multimedia technology has been implemented within the commercial sector. The use of concepts such as narrative, play and performance were considered a potential source for addressing the complex nature of interactivity, and from the design perspective would involve rethinking the way the learner's position within the learning environment is presented.

To address the ways that people work with interactivity, specifically in relation to learner-content interactions and their effects on useability and learning, a research study was designed to observe people working with the interactions provided in contemporary computer-based multimedia applications. The importance of this research lies not only in developing a better understanding the learner-content relationship in human-computer interactions, but also identifying the means for achieving maximum teaching and learning advantage from the rapid growth of on-line content and communications.

In examining these interactions, it became apparent that the success of learner-content interaction is not so much dependent on the learner's ability to use the technology, but on the strategies implemented by the production team in maximising the communication potential of content, whether it be through a web-site, discussion group or desktop application. Better understanding the ways in which learners interpret the content is the key to the on-going success of computer-based learning environments, especially when that interpretation is expressed as a series of encounters between learner, content and the underpinning design.

Methodology

To examine the phenomenon of interactivity and provide a baseline for its understanding, seven different CD-ROM titles were selected based on their range of design, interface and interactive elements. Forty-six participants from an undergraduate multimedia program volunteered to contribute to the study and were randomly allocated to one of the titles. Each participant was requested to work through the content for a period of approximately 30 minutes, speaking out loud their interpretations of, and responses to, the interactivity being presented. All participants were videotaped and each video sequence was analysed to generate data identifying the major sections and/or content areas accessed, the duration of that access and the types of interaction undertaken by the participant during that access. The data relating to content and interaction types were processed using a custom-built software application that not only generated graphical and numerical information for reporting purposes, but also enabled a dynamic view of the participants' interactive experienced working with that title. For each participant, an audit trail (Misanchuk & Schwier, 1992; Fritze & McNaught, 1996) of the major content areas visited and a profile of their interactivity was generated by this application. To record the diversity of interactions undertaken by participants, seven different forms of interactivity were derived from the taxonomies of interactivity (Schwier & Misanchuk, 1993; Aldrich, et al, 1998) as illustrated in Table 1.

Interactivity	Description	Code
Exploratory	Where the participant is exploring the "information details of application structure and operation.	1
Navigational	Where the participant chooses to move from one location to another or selects a menu option	2
Presentational	Where the participant is watching the dynamic presentation of material	3
Involved	Where the participant is purposefully involved in following a set of actions to achieve a goal or assessing the static content being displayed	4
Manipulative	Where the participant is actively manipulating content objects to achieve a goal	5
Reflective	Where the participant is discussing aspects of their overall experience with the observer	6
Accidental	Where the participant initiates an interaction for which there is no program response	7

Table 1: Interaction Types

Results

The audit trail depicted in Figure 1 shows an example of one participant in terms of both the content accessed and types of interaction being undertaken while working with one of the titles. This audit trail highlights that while participants worked through a range of the content available, the form of interactivity varied over the contact time. A second means to represent this data was through a profile of the interactivity, expressed as a percentage of the total session time, as illustrated in Figure 2.

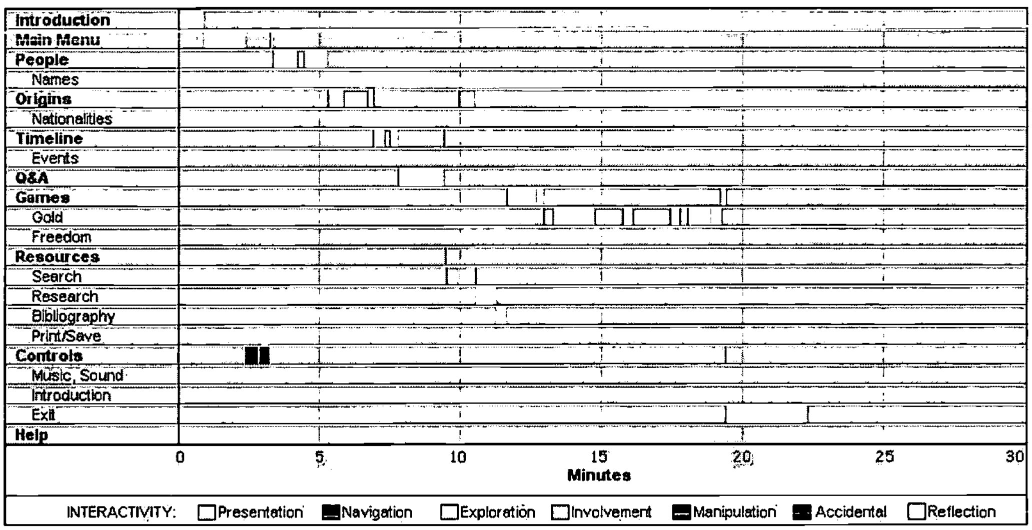

Figure 1: Content/Interactivity Audit Trail

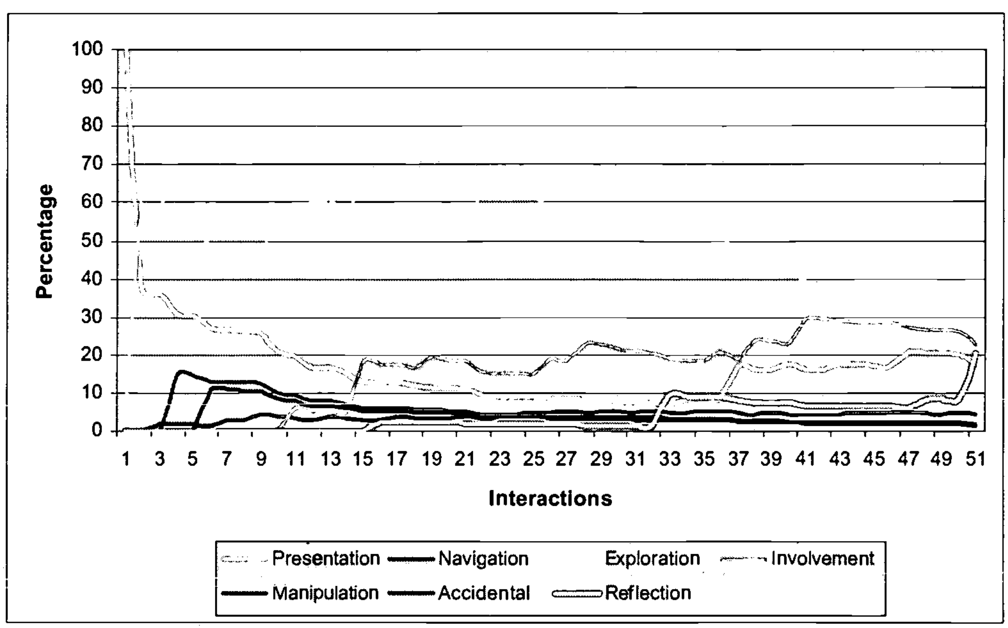

Figure 2: Interactivity Profile -Percentage Over Time

In this example, after the initial presentation, the participant began to explore the various options presented within the application, becoming involved with some of the material at approximately the 10th interaction. This data can be compared with the Content Audit Trail (Figure 1), where the first interaction associated with the user being involved with the content occurs at approximately the 4th minute of the overall encounter. The profile depicted through plotting the percentage of interaction type over time provides a visual representation of an individual's path through an application.

Discussion

Working with Interactivity

The process of collecting and analysing the data provided the opportunity to reflect on the relationship between the design of a title (in terms of interface and interaction) and the ways in which users gained benefit from their encounters with the embedded content. What became evident, and is supported by the data recorded, was an apparent discrepancy between the time a user might work with a product and the time it would take to gain benefit from that product. For example, participants often indicated they had not determined the purpose of the application and I believe this was because it would have taken an extensive amount of time to develop a satisfactory understanding of the application's underlying structure.

The significant outcome from the audit trails generated from the research data is that they both confirm and contradict the theoretical positions of learning and interactivity. In terms of confirmation, the variation in audit trails (see Figure 1) substantiates the claim that computer-based learning products provide for individualised experiences, as participants chose a variety of routes by which to explore and engage with the content. However, when considered in terms of the interactive profile (see Figure 2), this individualisation did not appear to convert into meaning, thereby contradicting the assertion that such individual experiences will also enable engagement and meaning.

Consequently, if a product underwent useability testing such that an interactive profile was generated, the trends presented by that profile would reflect the extent to which those interactions were **balanced**. From this analysis, achieving a convergence and resultant balance of interactivity, over the shortest period of time and after the fewest number of interactions, would be desirable, and indicative of the user working effectively with the product. Applications that did not achieve a balance, consistent with Norman's (1986) gulfs of execution and evaluation, would need to undergo some form of interactive adjustment.

Interactive Encounters

The word encounter is defined as "a meeting with a person or thing, especially casually or unexpectedly" (Macquarie Dictionary, 1998:365). This seems most applicable to what happens when users first activate a CEL application, where they may be familiar with the content and aims of the overriding curriculum, but their first encounter with the computer options will potentially be confronting. As the research participants worked through the titles it became apparent from their interactions and spoken comments that the *casual* and *unexpected* aspects attributed to encounters were equally applicable to the interactive experience. This complex integration of audit trail and profile demonstrates that it is not adequate to simply build interactions and trust in the user to interpret and benefit from them. There is also a responsibility for the application (whether web-site, discussion group or CD-ROM) to be created in such a way that it too has a responsibility for maintaining communication with the user – thereby supporting the creation of truly interactive environments. In this context, the relationship between human and computer might better be envisaged as a series of **encounters**, with both parties responsible for playing the appropriate role within those encounters. Ultimately, this is the challenge for the producers and designers of computer-based learning environments.

Introductory Encounters

When a learner first commences working within an on-line application (whether a web-site, discussion group or management system), an attempt to make introductions between the major players is recommended. Depending on the structure of the application, this may involve actual members of the development team presenting the background to the design and its intended operation. Alternatively, the use of characters within a microworld and the roles they are to play in the subsequent presentations can be introduced. Learners also have the responsibility to introduce themselves and to inform the designer of their experience and expectations, as suggested in the context of negotiation. In this way the application can use the information to configure the way in which it will be presented and the means by which the learner can progress through the associated interactions. The notion of an introductory encounter can also be applied to that of the parting encounter, where the learner is recognised for the role they played and information exchanged. It is a relatively simple technique to record user responses and integrate them into future presentations – placing value on the individual learner is a means to enhance the purposeful nature of the application.

Controlling Encounters

In human-human encounters, the participants may operate equitably or one may dominate the process, and in the case of interactive applications, the research participants demonstrated that the two-way exchange of information is essential. However, based on their observations, there was little opportunity to control the content other than the selection of high-level menu items, the navigation between locations, choosing to activate clickable objects or scrolling through large amounts of textual information. While participants were quite able to operate the various controlling items, the responses made by the application were often unpredictable as well as unvarying. There may be a relatively simple means to address this observation. If interactions were structured so that the user could control or act as a spectator then it becomes more their choice as to how the presentation is revealed. By generalising this to a wide range of content domains and metaphors, independent of the technological environment, there will be a likelihood of achieving even more effective learning outcomes.

Strategic Encounters

It is also important that the encounters between learner and designer be strategically positioned throughout the application in such a way that they can be initiated by either of the two parties. The activation of these encounters will be dependent on the extent to which the user has achieved interactive balance and control over the application. While the use of agents has been applied to personalise the environment and provide contextual advice, the responses provided by those agents are typically defined by the program to operate under prescribed conditions, rather than those conditions being negotiated by the user and designer. Of importance is the extent to which the user has the illusion that they are being communicated with on an individual and personal level. Thus a teacher working with a discussion group has the responsibility to keep learners informed of the strategy in play at any one time.

Empathetic Encounters

Finally, the encounters between learner and designer need to manifest a level of empathy and tolerance. There is no reason why an application cannot indicate an inability to undertake a task, or to be apologetic for being limited in its range of responses. The underlying arguments for negotiations and encounters is one of personalising the application, of integrating the designer into the process, and continually ensuring that the learner is comfortable with their progress. A typical response to this form of encounter was when one participant attempted to locate information within a database. Although the search was successful from a technical perspective, the information returned could not be interpreted because he had difficulty linking his request with the material returned. Had the application (as a manifestation of the designer) informed the user of the way in which the search would be performed, the range of data being searched and the potential retrievals, either the search request would have been terminated or the information returned interpreted more easily.

Encounter Theory

In the same way that Kearsely & Shniederman (1998) proposed that an engagement theory provide a set of prescriptions for successful computer-mediated communication, the encounters presented in this analysis provide a framework for what I have termed encounter theory. If the development of on-line learning applications is considered as a sequence of inter-related encounters, then the interactions provided to the user will be of consequence, as they will have been presented in a conversational framework as integral to the operation of the application. In addition, navigation through the application will be more directed and destinations reached predicted by the user rather than unexpected, and the content subsequently presented generating more value for the learner. Reeves (1999) declared that we know how to build these applications, we just need to do it better. Envisaging applications as a series of encounters, rather than a means to structure content, is one way this might be achieved.

Conclusion

In recent years, the word interactivity has tended to be applied more frequently to the facilities afforded through computer-mediated communication and the increased promotion of on-line learning and web-based training. Regardless of the computer-based medium, effective interaction between learner-learner or learner-content cannot be assumed to be an implicit facility of computer-based environments. Rather, considerable design effort must continue to be placed on the ways in which learners will both adopt and adapt to the exchange of ideas and engagement with content through computer-mediated resources. Moving to an on-line environment, with the perceived benefits of synchronous and asynchronous human-human communications, can mask the importance of human-computer interactions. However, I maintain that interactivity can enhance engagement and learning, which is the critical component of any computer-facilitated learning artefact and that this interactivity needs constant maintenance regardless of the medium of delivery. Using the concept of encounters is one means to generate this enhancement and facilitate its maintenance.

Developing a comprehensive understanding of the interactive phenomenon will not only lead to more effective useability and learning in on-line environments, but also to those applications working better for the learner.

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AIOLOS: A TUTORING SYSTEM FOR WASTE MANAGEMENT

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AIOLOS is a multimedia based training system on the subject of hazardous industrial solid wastes, using the recent advances in the field of IT. The learning process is based on autonomous, self-paced principles and a variety of on-line sources available via a CD-ROM. It aims to inform and sensitise the high level personnel in industries that have to manage hazardous solid industrial wastes, so that emissions into air, water or soil will be reduced. In short, the user engaged in a training session can -at any given time- navigate to one of the available thematic subjects, use the custom controls (previous, next, up, main), view any scheme/diagram/animation enlarged, view the definition of unknown terms, print selected sections of the current educational unit, take notes, activate/deactivate the sound, view the EC waste-related Legislation, learn from the Theory-in-Action scenarios, use an English translator and evaluate the progress made using the self-evaluation exercises.

Developing a Model for Technology Based Learning: A Practitioner Response to a Constructivist Learning Model.

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Abstract
This paper outlines a proposed model for technology based learning. The learning processes identified within the model are considered in the context of recent research and feedback from practitioners working with adult learners. This is followed by an attempt to identify the characteristics of each process and analyse these in the context of programme delivery.

1. Introduction

The aim of this paper is to present an exploration of a model of Information and Communication Technology (ICT) based learning and suggest how the model may be adapted for use as a tool to support the development of shared understanding for practitioners working with adult learners in technology based learning projects.

2. Background to the Employment and ICT Learning Project

The work on learning models was commissioned as part of the Employment and ICT Learning Project. The Project was co-ordinated by the City's Economic Development and was conceived as practitioner-led and complementary to broader policies and planning within the Department. The Department funds Projects which deliver employment and training skills to local adult learners. The Project brief was to disseminate information and develop tools to support the sharing of knowledge and understanding around the use of ICT in training and education programmes for disadvantaged adult groups. The Project had a core team and a steering group and met with a wider group of practitioners on a number of occasions throughout the life of the Project.

Previous research indicated that within the EDD funded ICT Learning and Employment Projects there were many examples of process focussed, constructivist online learning models. There was also a willingness to share and collaborate on developing best practice methodologies. It was felt that constructivist approaches should be made explicit and explored in the context of a model which could promote shared understanding of how learning is supported through the use of ICT.

Another factor in the focus for the research and development was the complementary nature of this approach in relation to the Government sponsored national initiative, Learn Direct, which has taken an instructional approach to the delivery of online learning. There are currently moves to incorporate additional communication functionality in the Learn Direct environment to provide a less rigid instructional model. These developments have emerged through what Learn Direct call ' good practice models' including various funded sources. As locally based projects within the EDD funded programme have developed their methodologies for clients with a constructivist rather than an instructional focus, it was considered that exploration of a model offering a constructivist approach could promote discussion with Learn Direct colleagues.

3. The learning model

It was agreed in initial discussions that proposed learning models promoted within the project should try to meet the following criteria:

- a focus on the processes of learning
- reflect the particular way of working that was emerging across Projects, that is, constructivism,
- indicate the significance of what learners bring with them into the learning process
- include a variety of methodologies, for example, mixed delivery, that is face to face and on-line delivery.

It was then agreed within the learning models planning group that Reeves' model for effective dimensions for learning on the web could support the Project brief. In presenting this model Reeves is careful to qualify the scope of the model " people value even simple models because these models guide thinking about extremely complex phenomena such as learning" (Reeves, 1998).

Within Reeves' model the identified processes can be viewed as generic processes which can also be applied in an ICT context. In this way, the model offers the potential flexibility to develop face to face and mixed methodologies. It was also felt that, while Reeves focuses on the use of the world wide web, it would be more helpful for the Project to reference ICT in general whilst acknowledging the particular strengths of the web in the context of Reeves' findings.
However, Reeves' model was also seen to present some rigidity in its style which could inhibit flexibility. It was felt that a looser model structure may facilitate practitioners' access to the model. In this way, Reeves' processes have been become the main focus for the Project model and these have been represented as a system metaphor which shows the interactions and boundaries of the model. In separating out the range of processes it has been possible to integrate concepts from other models which enhance Reeves' model.

Figure 1. Processes facilitated by use of ICT

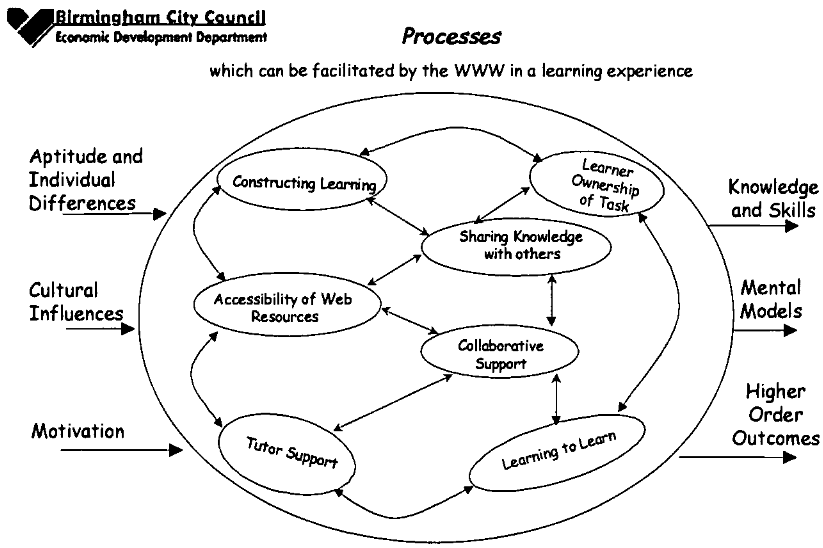

Figure 2: A model of WWW - based learning environment factors - (Based upon Reeves:1999)

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Note: the arrows of the inner system donate the TOTAL interaction of all the components.

The general principles of constructivist approaches to teaching and learning have been variously described. These principles are summarised in the points below where constructivist learning:

- takes place in the real world
- involves social negotiation and mediation
- content and skills should be relevant to the learner
- student's prior knowledge and skills are acknowledged
- assessment is formative
- students encouraged to be self mediated and self aware
- teachers are facilitators and should encourage multiple perspectives

The processes of Reeves' model have been researched for the Project model and are described below within the context of constructivist approaches to the use of ICT in teaching and learning.

3.1 Opportunities to construct learning

The process of opportunities to construct learning is key to the constructivist approach. The approach which stresses the importance of the active involvement of the learner where the learner has the opportunity to engage in activities which facilitate the active restructuring of existing knowledge and skills. As Reeves writes:

" ..because the constructivists emphasise the primacy of the learner's intentions, experience and cognitive strategies , the web may prove to be an even more powerful tool for constructivist pedagogy"
(Reeves 1998)

Recent research has led to the development of further theoretical models of learning with ICT where active involvement in the learning process is a key characteristic. Papert (1989) and others have highlighted the action based element of constructivism, as Papert describes "people don't get ideas, they make them", and have extended the concept to include the construction of personally meaningful products/artefacts, that is, constructionism; a combination of constructivism and the teaching strategy of construction.

' This vision puts construction (not information) at the center of the analysis. It views computer networks not as channel for information distribution, but primarily as a new medium for construction....within a community'
Resnick p.2

The extended activity of learners working collaboratively across networks has been described by Papert et al as 'distributed constructionism'.

3.2 Learner ownership of tasks

One of the key elements of effective learning has been identified as the importance of authentic context for student activity. This is referred to in a wide range of learning models including Reeves(1998), Resnick (1997) and Schneiderman(1997) who see ownership of learning as a key process to be facilitated in technology based learning
.

Kearsley & Shneiderman (1998) have recently published a number of papers on engagement theory; a proposed approach to technology based learning which has commonalties with Reeves model and stresses an approach to technology based teaching and learning which is constructivist, collaborative and experiential. They describe a methodology which

' Promotes human interaction in the context of group activities, not individual interaction with an instructional programme. '
Kearsley and Schneidnerman (1997)

The key activities in the engagement framework comprise relate, create and donate activities in learning with technology, that is, collaboration, construction and authentic tasks in a genuine setting. The donation cycle of the theory relates to completing tasks that have an authentic task for an authentic audience.
Team working is also a key feature of constructivist learning which relates back to theories of social interaction

3.3 Sharing knowledge

Practitioners working with learners linked to EDD projects reported that learning with technology provides opportunities for learners to engage in sharing and representing knowledge for a wider audience. This sense of audience has had a positive impact on learners through providing opportunities for learners to present their work to varied audiences through websites and CD Roms, for example.
Findings on projects where learners used the web to publicise their work show that
"..students demonstrated great concern for accuracy in their displays,
.students quickly assumed the major responsibility for content and editing decisions despite the fact that the original task of designing the displays had been structured for them by the teacher,
students accessed wide ranges of science materials to find the content they desired, and
their commitment to and enthusiasm for the project remained very high."
(Reeves 1999)
This indicates that the web has a role in facilitating the development of metacognitive skills.

3.4 Access

Accessibility of resources is widely seen as one of the major benefits of the new technologies. The web has been harnessed for use in learning in many ways, for example, through the development of web quests (Dodge, 1998) where students are provided with scenarios and guided to resources.
There is considerable discussion around the use of the Web as resource in learning where the balance of the power of the web to customise resources to learner's needs is checked by the requirements of cultures which demand the authentication of information available.
Issues of authenticity of information are compounded by other access issues which may mitigate the access to learning with technology including cost, connectivity and usability issues. The issues of usability of technology for learners was very important for the Project practitioners' and these concerns are well described by Resnick, Rusk and Cooke (1999) in the context of the Computer Clubhouse .
The model of distributed constructionism described earlier has been successfully applied to community based capacity building projects in the US. Projects, for example, the computer Clubhouse, have targeted disadvantaged and excluded communities and provide access to technology and, critically, access to support to enable participants to develop the ' technological fluency' required to maximise technology opportunities. The Computer Clubhouse reports that access is not enough and strategies to support technological fluency in order to engage meaningfully with technology is essential. Strategies include use of local volunteers as mentors and authentic project work.
This aspect of fluency is significant within EDD Projects as many organisations worked with disadvantaged communities and have recognised the need to balance access with an underpinning principles which promote the development of learners' technological fluency.

3.5 Tutor support

The model suggests the development of facilitative tutors in the learning process where the tutor takes on the roles of coach, collaborator and mentor . This style of tutor support suggests a shift in control and an increasingly active role for other 'stakeholders' in the learning process, for example, through the use of other learners as mentors and through peer working.
In terms of working with learners through technology there are implications for tutor skills which are widely documented and were of concern to the Project group. Berge (1996) has proposed a range of skills that the on line tutor needs which relate to strategies to support effective communication and facilitate interactivity, strategies to co-ordinate learning and strategies to maximise use of the medium.
For the Project group issues regarding on-line and off-line models of support and the support structures required to facilitate tutors working in this way.

3.6 Collaborative support

Collaborative activity reflects the more open aspect of the web and other technologies which provide a framework and control mechanism for opportunities for many to be involved in the sharing and construction of knowledge. Collaboration may enhance learning by bringing together a wealth of information and experience for the sharing and restructuring of knowledge through interaction as described by Vygotsky and others. Collaborative activities have been a key characteristic of most Project delivery where practitioners appreciated the flexibility to provide learning opportunities to work collaboratively with otherwise isolated learners. The ability to archive discussions was seen as a great advantage for the learner group in terms of providing opportunities for reflection and learning from others. It was also recognised that the process of working collaboratively may present a steep learning curve for some learners who require support to work effectively in this way.
Kearsley and Shneiderman identify the development of communication, planning , management and social skills as the potential learning in collaboration in electronic environments.

3.7 Learning to Learn

Learning to learn, or metacognitive skills, are described by Flavell as:

> "…. learner's awareness of objectives, ability to plan and evaluate learning strategies, .. capacity to monitor progress and adjust learning behaviours to accommodate needs"

(Flavell, 1979).

The development of these skills may be facilitated by a number of other processes within the model, for example, through collaboration and may, as Reeves suggests, be facilitated through technology itself through intelligent agents and by storing feedback to other learners.
Practitioners felt that It is also important to acknowledge that the scope of learning skills required in the future because the changing nature of these impacts greatly on learners perceptions and behaviour. These skills have been

described by Reeves and comprise a range of technological skills including the sending and retrieving of digital information.

The changing nature of learning and working skills is also noted by Resnick

"A technologically fluent person should be able to go ' from the germ of an intuitive idea to the implementation of a technological project. Increasingly, technological fluency is becoming a prerequisite for getting jobs and participating in society." (Resnick 1998)

4. Extending the model

Another example of work around constructivist approaches to use of ICT includes Ewing's work where researchers have identified the characteristics of constructivism in relation to ICT. (Ewing, Coutts and Rusk 1999). This model has been used to identify the elements of constructivist use of ICT within the primary curriculum.

The framework of this model, where characteristics of the constructivist approach are compared with observed teaching practice, provides an opportunity to extend the model above (see fig.1) to make more explicit the characteristics of the model which may then be used in the as a tool for the planning and development of programmes.

4.1 Characteristics of technology based learning processes

As a means of creating a checklist for practitioners to use in planning, delivering or evaluating technology based programmes, the processes of the model are listed below with appropriate characteristics underneath.

Opportunities to construct learning

Students are actively involved in their learning through structuring and restructuring existing knowledge

Activities require interaction and reflection

Learner ownership

Learners take responsibility for their learning through planning

Learning is related to learners' everyday experiences

Learning relates previous knowledge and skills

Sharing knowledge

Learners use technology to represent ideas, demonstrate skills

These representations are available to a wider audience

There are opportunities for learners to engage with this wider audience

Learners may operate in a number of roles within the learning process; author, editor etc.

Accessing resources

Learners have access tot he appropriate software hardware and resources

Guidance on accessing resources through technology is available

Opportunities to personalise and tailor resources are available

Learner opportunities to access resources are not restricted

Tutor support

Tutors have appropriate skills in terms of key characteristics of tutor skills described

Tutor support is available within technology based programmes

Tutor roles are characterised by facilitation, mediation and negotiation

Collaborative support

There are planned opportunities to work with other learners

Collaborative support may involve peers, experts, etc.

Individual and group knowledge constructions are available to others

Learning to learn

Resources to support the development of metacogniitive skills is available

Guidance on working on line is available

Reflection on learning available

Learning development opportunities are available

Experience and learning from previous learners is available

5. Application of model

The characteristics of the model can applied to a programme to indicate the extent to which the programmes are operating within the constructivist paradigm. In this case the process characteristics are set against an online learning programme, Learning in Electronic Environments, which aims to develop tutors' skills in on line delivery.

The comparisons are made against evidence from programme evaluation.

Characteristics of processes that can be facilitated by technology based learning	The Learning in Electronic Environments Programme
Opportunities to construct learning Students are actively involved in their learning through structuring and restructuring existing knowledge Activitics require interaction and reflection	Students are encouraged to reflect on their own experiences Activities promote construction of learning
Learner ownership Learners take responsibility for their learning through planning Learning is related to learners' everyday experiences Learning relates previous knowledge and skills	Learning activities are related to professional experience Learners asked to summarise for group
Sharing knowledge Learners use technology to represent ideas, demonstrate skills These representations are available to a wider audience There are opportunities for learners to engage with this wider audience Learners may operate in a number of roles within the learning process; author, editor etc.	Use of programme virtual classroom Areas available to others Opportunities to summarise group constructions available
Accessing resources Learners have access to the appropriate software hardware and resources Guidance on accessing resources through technology is available Opportunities to personalise and tailor resources are available Learner opportunities to access resources are not restricted	A range of access routes are available Telephone and F2F support with virtual interface Selection of resources is made available to learners Induction into environment available
Tutor support Tutors have appropriate skills in terms of key characteristics of tutor skills described Tutor support is available within technology based programmes Tutor roles are characterised by facilitation, mediation and negotiation	Tutors experienced on-line tutors Range of communication options available; one to one, one to many and many to many Facilitative strategies encouraged through questioning, direction to resources
Collaborative support There are planned opportunities to work with other learners Collaborative support may involve peers, experts, etc. Individual and group knowledge constructions are available to others	Most activities require collaborative working Opportunities are available to work in a whole group or small groups Discussions are archived and public
Learning to learn Resources to support the development of metacogniitive skills is available Guidance on working on line is available Reflection on learning available Learning development opportunities are available Experience and learning from previous learners is available	Opportunities for reflection are available through guided activity Activities around identifying learning styles are undertaken There are opportunities for learners to work in ways that reflect personal preferences Samples of previous work available

6. Conclusion

The development of the learning model has been seen as a positive outcome for the Project. The application of a tool based on the model has shown that it has uses in supporting programme evaluation and development. In working on an additional tool to support shared understanding between practitioners it is hoped that opportunities will be available to further test the effectiveness of the model and tools.

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The Unwired Classroom – Innovative Technologies in Computing Education

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Abstract: Access to technology, where you want and when you want. This is the promise of Wireless Mobile Technology, combining the management and control of a computer lab, the freedom of portable computers, and the power of the Internet into a single solution. So just how practical is this technology and where is it being implemented? This paper reports preliminary results from research conducted within business and education facilities in New Zealand into new and innovative technologies such as wireless laptops in schools. In particular, the use of wireless laptops and LAN networks in St Kentigern's College in Auckland, New Zealand, as implemented by Walker Wireless Ltd of Auckland, is the focus of this paper.

The Unwired Classroom

The purpose of this paper is to assist educators in becoming aware of the increasing role that technology plays in the classroom. Facilitating classroom activity without wires and cables brings a whole new flexibility to the classroom itself and where the class is conducted. The following paradigms were evident in the use of this new technology:

- Ease of movement
- Personalization
- Flexibility
- Convenience and time saving
- Cost effectiveness

The Technology

Computers bring many challenges with them in terms of attachments, cords and other peripheral devices. Add networks to that and we have cable and wiring all over our office or classroom which takes up a lot of space. Every time we want to move our position in the office or go to another class we have to log in again and use a computer set up differently to the one we are used to. With the arrival of high performance wireless laptops such as the Toshiba laptop with built in wireless LAN, we have the possibility of a different learning dynamic, one which involves a great deal of personalization and flexibility.

Walker Wireless is a relatively new company, 1 year old with around 20 technicians on board. Alan Leigh, the Marketing Manager, provided the information and support for this study. Walker Wireless operates off a spectrum of 5.7 to 5.8 and has purchased licensed spectrum in the 1098 spectrum, opening up different customers and ways to transmit. Wireless has significant advantages over PDSN, which involves laying cable or fibre with only 15% of its costs proportioned towards establishing the network.

St Kentigern's College is a well-established secondary school in Auckland with a commitment to the knowledge and technology economy. Walter Chieng provided the information and support for this study. The whole campus is wireless LAN. When a student starts at the school part of their package is to purchase a laptop. They are then able to access services around the whole school. Currently just under 1000 of the 1100 students have laptops.

The Market and Case Study – Walker Wireless and St. Kentigern's College, Auckland, New Zealand

The market in New Zealand for wireless is new, focused on the business sector with an educational component. Virtual private networks with multi-sites and IP connections are the main market as there is a big demand for Internet connectivity with lower cost solutions. Customer dissatisfaction with current systems, such as slow modem speeds is also a good reason for a move into wireless as even ADSL has a raft of disclaimers, ranging from your distance from the central server point, to electromagnetic exchange and even PC performance. Wireless is clean and crisp, with in excess of 11MB in terms of delivery and a potential offering of up to 26MB.

Walker Wireless has just recently installed Wireless LAN at St Kentigern's as part of the school's ongoing commitment to a mobile knowledge and technology educational base. With the whole campus being wireless LAN and the students having laptops, access to services is easy, convenient, very personal and extremely cost effective. The school is aware of the following paradigms:

- Ease of movement and effective space dynamics – Rather than cluttering their classrooms with computers, St Kentigern's are encouraging students' freedom of movement with laptops. Wireless laptops are quite small so can be used in places without any special need for tables or desktops. This same concept is encouraged in small offices with teledesking.
- Personalization – As I am sure we all find, there is nothing more annoying than logging on to a computer that doesn't have the software or utilities we require for our task. The students can personalize their laptops with all they need for their daily study. The school provides the major software suite that the students use for their curriculum.
- Flexibility – Laptops are used in many different ways, from access to services on the campus, to classroom activities, to simple communication with teachers or other students via email concerning the day's classes. Going from class to class, a student still has access to all the syllabus right there on their laptop. Their primary use is for syllabus work from the teachers and for collaborative activities with other students. In the future the network will be used for online testing and for the parents to connect to. It is driven by the curriculum and used in a way that enhances delivery.
- Convenience and time saving – The laptop is configured by the school and the student so it is easy to use, and the teacher can concentrate on teaching. A lot of time wasting is saved and trouble-shooting avoided. Having a laptop available all the time means the student becomes very familiar with its operations. The need to set up is minimized and there is a greater focus on learning. Like the telephone, wireless laptops and portable devices will soon be second nature.
- Cost effectiveness – The school is unable to achieve their objectives economically with desktops. They, like many schools, wish to have computers available across all curriculums and can't afford to have desktops. With laptops, which are subsidized through the Toshiba SNAP programme, the laptops are provided at very reasonable rates along with the software, making the purchase accessible for all parents and an investment for the student. The laptops are available at any time and students learn to use it when they need it. It is a partnership between the school and the parents. This makes it a true Win/Win for all concerned, community, school, parents, teachers and students in terms of a commitment to our growing relationship with technology.

Conclusion

The Wireless LAN network developed for laptops by Walker Wireless and St Kentigern's College in Auckland is an example of pioneering mobile technology "where you want it, when you want it". It facilitates classroom activity without wires and promotes education that is truly a partnership between parents, teachers and students. With its cost effective strategies and ease of use, flexibility and convenience, Wireless laptops in education represent cutting edge technology and state of the art collaboration on a very inspirational level. The author would like to thank both Walker Wireless and St Kentigern's for providing the knowledge and information for this paper.

Resources

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Supporting Social Interactions in Distance Education with a 3D Virtual Learning Space

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Abstract: The paper introduces main ideas underlying an ongoing project directed at supporting social interactions in distance education with 3D virtual learning spaces. It is assumed that Active Worlds can constitute environments, which will make it possible to capitalize on tacit aspects of social context, critical for effective learning. In addition, challenges for the technical and educational design of such environments are discussed.

Introduction

Learning environments for traditional education have a long history. Their features have developed to fit the practice of teaching and learning in its entirety, that is, to support both formal and informal, explicit and implicit processes. Any attempt to translate educational practices to a new type of environment is associated with a danger of overlooking "invisible" phenomena, which are nevertheless critical for effective learning. The area of distance education based on new information and communication technologies (ICT) seems to justify these concerns. Even though much research has been done in this area, it is evident that we do not yet have a clear picture of how students' learning in distance education should be supported (IHEP, 1999).

One of the most obvious problems with distance education is the lack of everyday social support for students taking distance courses. Considering learning as not only a cognitive process but also as a social practice (Lave & Wenger, 1991; Vygotsky, 1978), there are reasons to believe that the lack of social support may have negative consequences for knowledge and skill acquisition, social competence, self-confidence, and motivation. In our view, the potential of modern ICT makes it possible to revisit this problem and suggest new solutions that can be implemented in practice. An especially promising opportunity appears to be providing students and teachers with a virtual environment that can be used for social interactions by people who are physically located in different places.

The aim of this paper is to present an outline of future work focusing on the use of a 3D virtual learning space to support social interaction in distance education. The learning space is being implemented in the Active Worlds (AW) (www.activeworlds.com) system, which consists of multi-user 3D virtual worlds that can be accessed online. The learning environment created in AW will be analyzed and evaluated with attention to existing and emerging types of social interactions while being used at distance courses given in Northern Sweden. The design of the 3D space emphasis on earlier work on multi-user 3D environments performed within the Department of Informatics, Umeå University (Croon Fors & Jakobsson, 2000; Holmström & Jakobsson, 2001).

Why Active Worlds?

AW is one of the most sophisticated and popular 3D virtual worlds available online today. The AW system consists of more than seven hundred worlds in the main universe and more than a hundred in a separate universe dedicated to educational use. A user can enter a world within the universe and navigate through a 3D environment viewed from a first-person perspective. In that environment one can meet other people and interact with them, build one's own home and explore the surroundings. Besides real-time chat capabilities, it is also possible to communicate with other users by sending them messages through contact lists and by using one's avatar (which is the graphical representation of the user within the 3D environment) to make gestures and to position oneself in the environment.

When trying to establish a social context in distance education, we find many potential benefits connected to using an interactive 3D virtual world. In addition to giving students online access to course materials that can be distributed and announced in the world, this environment also constitutes a place for interaction between students. Spontaneous or arranged meetings with fellow students give opportunities for sharing problems or findings with each other. Furthermore, it helps maintaining informal social bonds between students, which is crucial when trying to create a rich and supportive social context. Perhaps, this is a way to prevent feelings of loneliness and alienation that are not uncommon in distance education and often hinder students from active participation in a distance learning setting. In the long run this could lower the dropout rate that is one of the problems connected to distance education.

Challenges for the Technical and the Educational Design

The challenges associated with creating a 3D virtual learning environment relate to both technical and educational issues. At the technical level the main challenge is to find a design strategy that will generate a 3D environment with the desired functionality. Some of the key features of being in virtual worlds seem to be interaction, movement, and construction (Heim, 1998). When using virtual worlds in educational activities it is crucial to make use of these characteristics. Otherwise the participants will lose their feeling of being there (notion of presence), and they will probably not be motivated to spend time there (Holmström & Jakobsson, 2001). This means that the design of virtual worlds should capitalize upon these key features so that the virtual world becomes a tool to create a sustainable social context for learning activities.

The main educational design challenge is to accomplish a tight coupling between the course content and the educational strategy employed by the teacher, on the one hand, and the structure of the 3D virtual "social space", on the other hand. Besides, it is important to make the virtual space attractive and easy to use. Teachers will most likely not engage in these kind of learning settings if it means a lot of extra work or if the setting is hard to manage, and hence the design must be made so that overhead is minimized. Furthermore, the virtual environment must be designed so that the students are allowed to express themselves and have fun. It should be a place that facilitates interaction and invites the students to construct their personal space within the learning environment (Dickey, 2000).

Currently the work in progress reported in this paper mostly focuses on the above challenges. Hopefully, the end result will be a virtual learning space facilitating formal and informal social interactions and thus effectively supporting the social context within a distance education setting.

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Movie-based Media in Teaching Business English

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Abstract

The presentation is supposed to demonstrate the first outcome of the project entitled *Learning Business in Hollywood.* It includes the multimedia language-learning module based on seven episodes from the 1987 20th Century Fox movie, *The Working Girl*, and developed with the Wiser Educator™ multimedia authoring system. The project aims in developing the whole series of Business English learning modules based on movie episodes that present professionally oriented communication in business settings.

Introduction

The steady growth of the international business and the globalization of economy in the age of information determine the increasing value of English as a *lingua franca* used in the professional settings all over the world. As a vehicular language of the global business community, English, in the format of English for Specific Purposes (ESP), has been taught on the university level outside the English-speaking world. Quality ESP courses need quality teaching and learning materials and efficient technologies to help optimize the language-learning process.

Technologies in ESP

Traditionally involved with technologies for language teaching, ESP practitioners have been widely using such routine aids as audio and video, however, tend to employ little of multimedia - partly because of *technofear* (Delcloque 1997), which has been typical for the Humanities faculty, and partly because of the lack of professionally oriented, technology-enhanced, linguistically valid, and culturally authentic learning materials to be integrated into the ESP curricula. Most of these have been developed in the format of video courses and as such suffer the typical drawback of any language-learning video, the weakened feedback that can hardly be compensated by the workbook, with its limited interactivity.

Movie-based Multimedia Modules in ESP Courses

The combination of the video presentation efficiency and the computer interactive capacity has been known as multimedia capable of developing desired skills in students. But even those few available multimedia language can be just partly used only on the beginning level because they are not as specific about professional issues as should be. Besides, ideally, they should be as close to the particular ESP course as possible.

Multimedia Authoring for ESP Faculty

The issues of insufficiency, fragmentality, and obscurity can, and should be, addressed by individual ESP practitioners; today, due to the development of multimedia authoring systems, it is slowly but steadily becoming the routine part of language teaching.

While elaborating the criteria of the choice, an ESP practitioner should consider his/her personal characteristics as well as the needs of his/her course. General characteristics of an average ESP practitioner include the comparatively low level of technology proficiency, even *technophobia* (Glendinning 1997) which means that one of the choice criteria should be the maximum author-friendliness of the software.

Another criterion comes directly from the peculiarities of ESP as a subject: an ESP course aims in developing communication skills based on a certain language material to be practised. This means that the authoring software should include the language-exercise template.

Finally, the software should also be user-friendly, which means that students should have no problems using the outcoming learning modules.

These considerations determined the final choice of *The Wiser Educator™* as the environment for producing the series of Business English learning modules based on movie fragments, *Learning Business in Hollywood.*

Movies as Language-learning Materials

The idea of using the movie fragments as the learning material is based on several considerations. First, situations and language in the movies are truly authentic and, as such, present the real-life communication,. Second, videos also display the communication background, which increases their impact on the student. Third, their soundtracks, to some extent polluted with genuine background noises, are those of the real life. Finally, the plot of the movie is much more attractive than that of the language course, which adds up to students' motivation in their work with the movie-based multimedia.

Movie-based Multimedia Module Production

The work on a single learning module comprises the following stages: selecting the movies and its episodes to be used, copying the episodes on the computer hard disc (e.g. using the *Avid Cinema™* software), editing the episode (total length not to exceed one minute, according to the US copyright laws), inserting the episode, in the format of *.mov file, in *The Wiser Educator™* , submitting and smartlinking the text of the episode with the video, developing tasks (matching, gap filling, sequencing, true/false, and multiple choice formats), and posting the module on the Web, if necessary or desirable.

Conclusion

The outcome of this work is the original multimedia language-learning material that can be used in Business English courses as an absolutely authentic source. The format of multimedia facilitates not only multiple revisions of the discourse patterns presented but also provides feedback enforced by formal tasks that guarantee the internalization of the language material. In the future, the author plans on developing more modules presenting various situations and problems in business practice.

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Interaction Evokes Reflection: Learning Efficiency in Spatial Visualization

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Abstract: Different levels of interaction in a computer game-like situation were compared as means of learning efficiency on an internet-based spatial visualization task, involving polyomino puzzles. 109 undergraduates were divided among three treatment groups: *pilots*, who interactively attempted to solve the puzzles; *consultants*, who watched and talked with pilots without interacting; and *co-pilots*, who alternated between pilot and consultant roles every 40 seconds, and collaborated. Participants were pre-tested before and post-tested after engaging in the experiment. Repeated measures analyses showed pilots and copilots learned more than consultants. Differences were significant at 0.05. Copilots learned most. These results suggest that alternating between interaction and observation is the best way to learn spatial visualization.

Introduction

With the proliferation of interactive computer environments, such as simulations, tutorials and "edutainment", in a variety of highly spatial content areas such as math (especially geometry), chemistry, and physics, it is important to investigate the relationship between hands-on interaction with computer programs and the acquisition of spatial visualization skills. Typically educational situations involve both hands-on and observational activities. For example in a math class, students might first watch the teacher solve problems on the board, then attempt to solve problems themselves. Similarly in a class on Excel, students might first watch the teacher create spreadsheets and then create spreadsheets themselves. Cooperative learning groups in school computer labs often place one student at the mouse and keyboard with one or more other students watching and advising; an alternate model of cooperative learning in computer labs has students taking turns at the controls. The comparative effectiveness of different variations of hands-on interactivity (hands-on, observation, taking turns, etc.) for learning spatial visualization is an important issue for the pedagogy of computer-based learning.

Although measurable by a number of standardized tests and accepted as a valid psychological construct, because of its non-verbal nature, spatial visualization remains elusive to unambiguous definition. I offer the following eclectic definition: Spatial visualization is the ability to solve multi-step problems involving configurations of shapes, primarily using mental imagery or other mental representations and transformations of same which explicitly preserve the topological and geometric relations of the problem, while optionally involving additional logical, verbal and symbolic reasoning.

Spatial visualization is an important factor in student success in a variety of spatial domains such as geometry (Battista, 1990), other higher forms of mathematics (Battista, 1990; Smith, 1964), chemistry (Pribyl & Bodner, 1987) and physics (Pallrand & Seeber, 1984).

Interestingly there is a relationship between time and spatial visualization. Without time pressure, people often resort to entirely non-spatial strategies for solving spatial problems (Smith, 1964). Moreover the measurement of elapsed time as well as success of solving the task provides a more accurate measure of spatial skill. If someone takes an exceeding long time to solve a spatial problem, their success may be more indicative of patience or persistence than spatial visualization skill. For the purposes of measurement, it is more productive to record elapsed time, as well as success rate and determine spatial visualization *efficiency* as the success rate divided by elapsed time.

Additionally there is a relationship, long posited by scientists, between acquisition of spatial visualization skill and hands-on interaction. Piaget & Inhelder (1948) suggested that a combination of hands-on touching and integration of different viewpoints, is instrumental in children's development of spatial ability and mental models of spatial objects. There are similar connections between spatial visualization and interaction with virtual shapes in computer programs. Interactive computer graphics can facilitate improvements in adolescents and adults' spatial visualization (Okagaki and Frensch, 1994; Gagnon, 1985).

The principle of *spatial weaning* (Smith, 1998) suggests that hands-on, interactive situations may initially be more beneficial to novices to a spatial domain who may not be familiar enough with the geometry of that new spatial domain to construct mental imagery necessary for visualizing solutions. Once students become more familiar with the geometry of the new domain, they may benefit more from less interactive situations. They are now familiar enough with the geometry of that domain that they can construct mental imagery necessary to visualize hypothetical solutions without the scaffolding of hands-on stimuli.

However, the very opposite of hands-on interaction, i.e., relatively more passive observation, sometimes has the advantages in educational settings (Sweller, 1994). Hands-on manipulation may divert short term memory resources needed for students to comprehend a new schema requiring the simultaneous mental manipulation of a larger number of elements. When algebra or geometry students are learning specific principles or techniques, it is often more beneficial for them to observe the teacher working a problem than to immediately try to solve it themselves. Immediately solving problems applying principles only recently introduced imposes an extraneous "cognitive load" on the students short term memory (Sweller, 1994). As students mentally manipulate the elements of the problem, they must also hold in mind the new principle that the problem illustrates, straining the capacity of their short term memory.

Considering that there are theoretical advantages for both interaction and observation, an important question is 'How do interaction versus observation compare as learning situations?' Smith (1998) provided some evidence that fifth-grade students, less skilled in spatial visualization, benefit more from computer interaction, while fifth-graders already skilled in spatial visualization benefit more from observation. However, it is unclear how these results extend to other age groups and other learning situations. Moreover, it is unclear how alternating between interaction and observation, another possible variation of spatial weaning, might effect acquisition of spatial visualization skills. These questions have important implications for the pedagogy of interactive computer programs in a variety of subjects involving spatial visualization skills, such as geometry, chemistry, physics, etc..

The current study seeks to statistically test the principle of *spatial weaning* discovered with think-aloud methods on fifth graders (Smith, 1998) and extend it to another age group, i.e., college undergraduates. *Spatial weaning* predicts that students unfamiliar with a spatial domain will benefit most from either high interaction, while benefiting least from observation alone.

Furthermore, we are interested in looking at these concepts from the point of efficiency in spatial visualization. Timed spatial tests emphasize mental imagery and provide a more accurate measure of spatial visualization skill than tests with no time limits. Therefore we are interested in efficiency in spatial visualization, i.e., how many problems can be solved divided by average time to solve them.

Our main research question is: How do a) hands-on interaction and b) observation compare as collaborative computer-based situations for learning efficiency in spatial visualization?

Since the pedagogy of computer interaction and spatial visualization is relatively new, a broader search of learning conditions is warranted. Perhaps some variation of hands-on interaction might be most beneficial. Thus we examined another variation on spatial weaning, i.e., alternating between interaction and observation/consulting. A secondary research question focuses on variations in hands-on interaction with a computer: How do a) exclusively hands-on interaction compare, b) intermittent hands-on interaction (alternating between hands-on and observation) and c) observation compare as learning situations for efficiency in spatial visualization?

The Study

The study used polyomino puzzles because they require a variety of spatial visualization skills, such as mental rotation, that are often used in solving geometry problems. 109 college undergraduates (48 male, 61 female, mean age 18.3 years) solved two types of computer-based polyomino puzzles: 'I-puzzles': Interactive puzzles, where participants drag and rotate pieces via mouse to assemble them into a target shape (see figure 1), and 'M-puzzles': multiple choice static 'visualization puzzles' where pieces cannot be moved, but participants must use spatial visualization to determine which of four static puzzles could be hypothetically solved (see figure 2). Validity of the M-puzzles as a measure of spatial visualization was previously obtained through correlation (.518) with a standardized test of spatial visualization, the Differential Aptitude Test, Space Relations Subset (DAT, authored by Bennett, Seashore, & Wesman, 1947).

In both types of puzzles, mirroring (or reflection) was not an allowed transformation. This created situations where the students had to accurately mentally rotate shapes to determine if a shape and a space it might hypothetically be placed in were congruent. If a hypothetical solution required a reflection, obviously it was not valid.

The M-puzzles and I-puzzles are complementary, using the same types of shapes. The M-puzzles are designed as a test of spatial visualization. The I-puzzles are intended as an interactive activity to exercise and improve spatial visualization and thus performance on the M-puzzles.

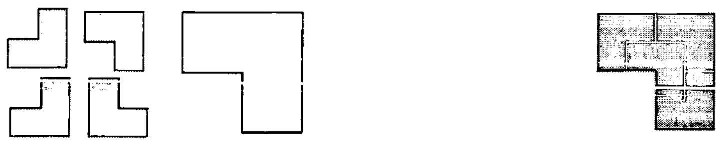

Figure 1: Beginning position of an I-puzzle: the shapes on the left can be dragged and rotated by mouse to assemble the shapes into the shape on the right. Ending position of an I-puzzle: the smaller shapes have been assembled onto the larger shape. classified as a solved I-puzzle.

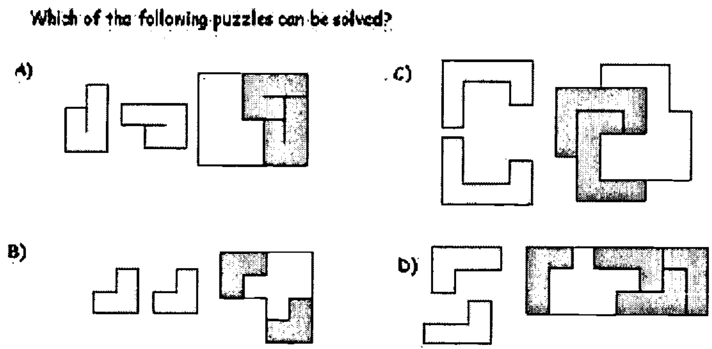

Figure 2: An M-puzzle: the participant must pick which puzzle could be solved without removing the shapes already on the larger target shape.

The experiment employed a pre-test, treatment, post-test design. Both pre-test and post-test each consisted of 9 randomly ordered M-puzzles presented to the participants by a web-browser over the internet via a Java-script program, with the results being written back to the server machine. Elapsed times were recorded locally on the computers used. Only when a participant finished the entire set of puzzles, was the data sent over the internet. Thus there was no issue of inaccuracies as a result of internet lag.

The pre-test and the post-test are approximately equal in difficulty, the M-puzzles having been calibrated at an earlier period. The M-puzzles were partitioned into two groups (pretest and post test) of approximately equal difficulty.

Participants were specifically instructed, in writing and orally, that time was a factor and they should solve the pretest and post test m-puzzles as quickly but as accurately as possible.

On the M-puzzles, used in the pre-test and post-test, participants received feedback, after each puzzle, as to whether they answered it correctly. After the full set of puzzles were completed, they were told how many total they answered correctly and were given a whimsical ranking, such as "Space Cadet", "Sargent" or "Master-at-Arms" based on the number correct. Thus participants were able to monitor their progress from pre-test to post-test. The pretest and posttest were completely individual activities. Participants were not allowed to talk or otherwise collaborate with each other in any way during pretest and posttest. Because the M-puzzles were presented in a different random order to each participant, opportunities for copying from each other were minimal.

In order to isolate and analyze the effects of high and low active control during the treatment, two thirds of the participants were "yoked" together in "pilot-consultant" pairs. The pilot interactively solved as many, progressively harder, I-puzzles as possible within a 40 minute period. The consultant sat next to the pilot, in front of the same computer and watched the pilot solve the I-puzzles, but was unable to interact in a hands-on manner (via mouse or any other input device) with the computer display. However the consultant was instructed to pay close attention to the pilot's progress on the I-puzzles. The pilot and consultants were instructed to talk with each other as a collaborative team working towards the common goal of solving as many puzzles as possible within the 40 minute period. The pilot and consultant scenario just described represented two of the three treatment conditions.

For the third treatment condition, referred to as the co-pilot condition, pairs of participants alternated every 40 seconds between being pilot and consultant. In the co-pilot pairs, two people, via two mice, were connected to one computer. A switching device, known as the Siamese Twin Computer Mouse (patent pending) allowed only one of the mice at a time to be active and automatically switched which mouse was active every 40 seconds. See figure 3.

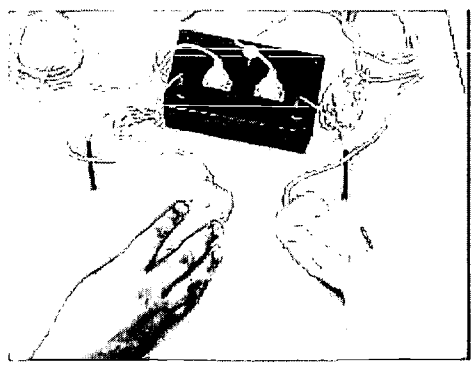

Figure 3: Siamese twin Computer Mouse

Thus for 40 seconds, one participant had interactive control over the I-puzzles, while another participant paired with him/her watched the same visual display without being able to interact with the mouse. The next 40 seconds, the roles were reversed so that the participant last observing now had interactive control, and vice-versa. LED's positioned on top of the monitors alerted participants of their current role. A lit LED indicated interactive control, an unlit LED indicated observation. Co-pilot pairs were instructed to talk with each other and work towards the common goal of solving as many of the progressively harder I-puzzles as possible during the 40 minute period.

All participants, pilots, consultants and the co-pilots, were explicitly instructed to talk, collaboratively, with their partner during the treatment and to learn as much as possible from the treatment as this knowledge would be useful for the post-test. The pretest and posttest data from the three groups, pilots (39), copilots (36), and consultants (34), provided data focusing on the secondary research question: " How do a) exclusively hands-on interaction compare, b) intermittent hands-on interaction (alternating between hands-on and observation) and c) observation compare as learning situations for efficiency in spatial visualization? "

With the experimental design used, approximately two thirds (or 75) of the participants (pilots and co-pilots) were "hands-on", experiencing a significant amount of interaction with the computer during the treatment. Approximately one third (or 34) of the participants were "consultants", experiencing no direct interaction with the computer. The pretest and posttest data, grouped by hands-on versus consultants, provided data for answering the main research question, "How do a) hands-on interaction and b) observation compare as collaborative computer-based situations for learning efficiency in spatial visualization?"

Findings

As a baseline to determine if learning took place on average for all the participants, pretest to posttest progress in efficiency was analyzed with an F-Test of Multiple μ's. The test was significant at alpha = 0.05, F-Ratio = 4.68, with an obtained significance level of 0.032. Mean of pretest efficiency was 0.0798, while for posttest the mean was 0.0972. Standard deviations for pretest and posttest were 0.0556 and 0.0628 respectively.

To investigate the main research question, how hands-on versus observation compare for learning of efficiency of spatial visualization, repeated measures analyses were used. One analysis of variance, with repeated measures of efficiency on pretest and posttest as the dependent variable, and with independent grouping variable hands-on versus consultant, and gender as covariant, was significant at the 0.05 level (F =

3.98, obtained significance level was .049). Table 1 shows the means for the efficiency for the two groups (hands-on versus consultants) in pretest and posttest.

	Hands-on	Consulting
Pretest	0.0807	0.0779
Posttest	0.104	0.0817

Table 1: Means of efficiency by group, hands-on and consulting.

Table 2 shows the means of efficiencies on the pretest and posttest for the three groups, pilot, copilot and consultant.

	Pilots	Copilots	Consultants
Pretest	0.0811	0.0802	0.0779
Posttest	0.102	0.107	0.0817

Table 2: Means of efficiency by group, pilots, co-pilots and consultants.

Note that the copilot group had the highest posttest mean efficiency, as well as the most improvement in efficiency from pretest to posttest, while the consultant group had the lowest in both. The results for the pilots group were similar to that of the copilots. A second repeated measures, focusing on copilots and consultants only, with efficiency as the dependent variable, and role as the independent variable, was also significant at the 0.05 level (F=5.861, level of significance obtained was 0.018. A third repeated measures analysis of pretest and posttest efficiency, looking at the pilots and the consultants only, and also with gender as a covariate, was not significant at the 0.05 level (F=1.886, obtained significance was 0.174).

To investigate the secondary research question, how exclusively hands-on (pilots) versus intermittent hands-on (copilots) compare for learning efficiency in spatial visualization, we compared how the two interactive groups (pilots and copilots) progressed, pretest and posttest, in terms of efficiency. Selecting only the groups, pilots and copilots, a repeated measure of pretest and posttest efficiency, with grouping variable role during the treatment (pilot versus copilot) and gender as covariant, was not significant at the 0.05 level. F was .357.

Conclusions

Since across all the participants, the posttest mean of efficiency was significantly greater than the pretest, learning of spatial visualization apparently occurred. The experiment provided an appropriate scenario for comparing different situations for learning spatial visualization.

We can also conclude that some amount of interaction with the computer is superior to no interaction, since the repeated measures analysis, comparing hands-on (pilots and copilots) versus consultants, indicated a significant difference in improvement on efficiency in spatial visualization. Similarly intermittent interaction with a computer is clearly preferable to consulting/observing, since the repeated measure analysis comparing the copilot and consultant groups indicated a significant difference. On the other hand, there was no significant difference in learning between exclusive interaction with a computer and intermittent interaction.

The first theoretical constructs motivating this study was *spatial weaning*, the idea that hands-on/interactive situations may be initially more beneficial to novices to a *spatial domain* (system of shapes) than hands-off/reflective situations. The additional sense information, the integrated visual, tactile, proprioceptive and motor processes associated with the hand-eye coordination of interactively solving spatial problems provide a scaffolding for learning mental image-based transformations, such as mental rotation, particular to that *spatial domain* (system of shapes). The results indicate that the principle of spatial weaning, discovered in the context of young children, apply as well to adults. That the copilot/alternating group performed best indicates that length of time period needed for spatial weaning is relatively short for college students. Hands-on/interactive situations provide additional advantages such as involvement, greater attention and motivation.

The second theoretical construct motivating this study was cognitive load, or the idea that hands-on interaction may impose an extraneous cognitive load that interferes with learning of the new skills. Cognitive load theory predicts that the consultant group should outperform the two hands-on groups, definitely not the case in this experiment. This is especially surprising considering that the consultant treatment condition was much more similar to the posttest than was either of the hands-on conditions. Since both the consultant and posttest activities were hands-off and reflective, one might have expected optimal transfer. However, since the copilot (or alternating) group learned most, perhaps periodic role-switching promotes meta-cognition, or productive reflection on the problem-solving process, i.e., interaction evokes reflection. Hands-on and consulting are complementary. Both spatial weaning and cognitive load theory are supported by the results.

The recommendation for teachers is to have their students alternate interactive activities with more reflective activities. In terms of classroom logistics, when pairing-up students on computers, intermittent interaction via the Siamese Twin mouse, provides twice as many students with hands-on interactive experience, than is possible with an exclusive hands-on situation.

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Teaching Over the WEB versus Face to Face

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Abstract: This qualitative study investigated differences, from the point of view of instructors, between teaching college courses over the WEB vs. in more traditional face-to-face formats. We interviewed 21 college instructors who had taught in both formats. Four of the interviews were by telephone and 17 by email. Interview fragments were categorized and counted for frequency to highlight emerging trends. Results indicate that web-based classes have profoundly different communication style than face-to-face classes. This has far-reaching consequences for online classes, in terms of greater equality between students and instructors, greater explicitness of written instructions required, greater workloads for instructors, deeper thinking manifested in discussions, initial feelings of anonymity giving way later to emerging online identities. Authors propose a model with two competing systems, isolation effects and community effects.

Introduction

Experiencing a huge demand for college courses taught over the WEB and not wanting to be swept aside by competitors from the commercial sector, universities are often pressuring faculty to teach courses online. Many such faculty have never taught online, and therefore wonder what they are getting into. What are the differences between teaching online versus face to face? What can faculty expect from the experience of teaching college courses over the WEB? Other faculty have some experience teaching online, but haven't shared their experiences, nor read the literature on distance education. Their knowledge remains fragmentary. Are faculty experiences with teaching online specific to the their content area or representative of the larger experience of teaching over the WEB? The current study seeks to integrate the experiences of professors currently teaching online into a qualitative description.

Before embarking on the research, we were aware of a number of research-based notions of distance education. Firstly that it requires a considerable amount of time to design and develop an online class (Williams & Peters, 1997). The instructor must shift from the role of content provider to content facilitator, gain comfort and proficiency in using the web as the primary teacher-student link, learn to teach effectively without the visual control provided by direct eye contact (Williams & Peters, 1997). Moore 1993) suggested that there are three types of interaction necessary for successful distance education: 1) learner-content interaction, 2) learner-instructor interaction and 3) learner-learner interaction. Distance learning courses need to ensure that all three forms of interaction are maximized. Peters (1993) criticizes distance education saying that it reduces education to a kind of industrial production process, lacking the human dimension of group interaction, and even alienating learners from teachers. He compares distance education to a mass-production assembly line process where a division of labor (educators and communications specialists) replaces the more craft oriented approach of traditional face-to-face education. However Peter's (1993) pre-dates the current web-based boom in distance education. His notions, like the computer themes in Stanley Kubrick's 2001: a Space Odyssey, sound slightly like industrial age paranoia towards computers. The personal computer and the internet have probably been a greater force towards individualization than mass production. An updated overall qualitative description of the current instructor experience of college web-based teaching is needed. What are the differences between teaching web-based distance education courses versus teaching face-to-face? The current investigates the online experiences of a number of college instructors.

The Study

We interviewed 21 instructors who had taught both in the distance and the face to face format. The instructors ranged from assistant professors to adjunct professors. 15 of the 21 instructors taught in the context of the SUNY Learning Network, a non-profit grant funded organization that provides the 15 State Universities of New York (SUNY) with an infrastructure, software, web space, templates for instructors to create their online course, workshops on developing and teaching online courses, a help desk and other technical support for web-based distance education. The remaining 6 informants taught web-based distance education courses in similarly supported situations at state universities in California and Indiana. Four of the interviews were conducted over the telephone and 18 via email. The four telephone interviews occurred first and were used to develop a set of open ended questions for email interviews. Since email interviewing did not require the laborious process of transcription, the email interview process allowed the gathering of data from a much larger number of participants than possible with telephone or face to face interviews alone. By reading over the transcriptions of the telephone interviews, the investigators found emerging themes that were converted into 27 open-ended essay questions comprising the "email interview". The email interview, as it is used in this study, is differentiated from a questionnaire on several counts. It uses open-ended essay-style questions, as opposed to Likert style, fill in the blanks or multiple choice items common to questionnaires. The initial questions included some "chit-chat" and informal questions designed to put the interviewee at their ease. It also involved some degree of interaction between the interviewer and the interviewee. The interviewers sometimes emailed participants follow-up questions to particularly interesting responses. The informants averaged approximately 45 minutes to complete the email interview. The investigators read over all the interviews at least two times, looking for trends and consistencies and generating 39 categories of responses and mnemonic codes to symbolize these categories. Some typical coding categories include **">WK"** meaning that the online classes require more work and **"N FUNNY"** meaning that humor was problematic in the online environment. Three investigators coded the interviews and then counted up the frequencies of the categories of responses, as the number of times a particular response occurred (not the number of informants who said or wrote a particular response). So if one informant wrote at three different times in the interview that online classes required more work, that interview contributed three occurrences of the >WK category, not one occurrence. The coding system was done, not to be objective, but rather to uncover trends in the data. This type of qualitative research is by its nature non-objective. Never-the-less, to get some estimate of the level of consistency between the three investigators who coded, six of the email interviews were coded by all three coders and a comparison made between their codings. We calculated the correlation matrix a between the three coders, with the correlations being 0.681 between coders 1 and 2, 0.685 between 1 and 3, and 0.744 between 2 and 3. The determinate of the correlation matrix, which would be zero if the coders agreed 100 percent and 1 if they were totally independent, is 0.208, certainly much closer to agreement.

Frequency	Symbol	Category Description
29	<CHN	<channels Less bandwidth for communication online, for example no visual gestures, etc.
24	X	. Greater explicitness of procedures/lectures online, etc.
19	>WK	> work Instructor spends more work time online than f2f
18	ALL	Everyone has to participate in online ... discussions
16	WR>>	Written communication results in deeper thinking
16	1st	Up-front organization/work online... time has to be put in before class starts
16	()	Online students are more self-reliant/Online students need to be more self-reliant/.Student commitment required online
15	>INFO.	A lot of information resources on the net
13	N ID	Anonymity, lack of bias, identity disembodied, personality disembodied, no appearance, no ethnicity
13	UR	Personalities emerge online through styles of written communication, consistency of written communication creates a student id
10	-><-	Rel build :Establishing relationships with students online.
10	EMAIL	lots of email contact with students
9	=	Instructor on a more equal footing with students online than in f2f, students more aggressive towards instructor online
8	<P	Lack of participation/attendance online
8	WW	written record of all dialog
8	:D	Freedom of speaking because of anonymity online
7	> 1-1	ind rel :Greater individual relationship/communication online
6	>TM	more time management for students online .
4	!ASYN	asyn pro Asynchronous advantages: do it when you feel inspired, not during F2F class time
4	!? INS	instructor have problems with the online environment or dealing with same or having someone deal with them
4	N FUNNY	Humor difficult online

Table 1: Most common types of responses in the interviews.

Findings

Table 1 shows the twenty-one most common types of responses, including in the columns from left to right, the frequency of the response, the mnemonic name of the category and a short description.

Some of the most important, most emphasized and most frequent responses made points we had not directly asked about. A lot these issues related to bandwidth limitations and the dominance of text in the WEB-based classes. Some instructors feel like a life time of teaching skills go by the wayside. They can not use their presence and their classroom skills to get their point across. Nor can they use their oral skills to improvise on the spot to deal with behavior problems or educational opportunities. Because of the reliance on text-based communication and a lack of visual cues, every aspect of the course has to be laid out explicitly, in meticulous detail to avoid misunderstandings. Every lecture must be converted to a typed up document. Directions for every assignment must be spelled out in a logical, self-contained way. Therefore web-based distance classes require considerably more work, often including hundreds of hours of up-front work to set up the course.

On the other hand, the development of an online class, especially if it is the conversion of a face-to-face to the online environment, makes the instructor confront and analyze the material in new and different ways.

"The web course was interesting to develop because it required that I break down pieces of information into small parts and sequence each part in such a way as to make sense to someone who is reading the information on line. Wrestling with how and what to link to what presented many challenges that were good for me. I really had to think about the course and the nature of how it was presented to students.."

Once the course begins, the long hours continue. Online instructors must log on to the course web site at least three or four times a week for a number of hours each session. They respond to threaded discussion questions, evaluate assignments, and above all answer questions clearing up ambiguities, often spending an inordinate time communicating by email. The many instructor hours spent online create an "*online presence*", a psychological perception for students that the instructor is out there and responding to them, without which, students quickly become insecure and tend to drop the class.

This great amount of work sounds intimidating, however, most online instructors looked forward to their time spent online as time away from their hectic face-to-face job, a time spent in an alternate abstracted more intellectual world: *"This is why I like the online environment It's kind of a purified atmosphere. I only know the students to the extent of their work. Obviously their work is revealing about them."*

The web environment presents a number of educational opportunities and advantages over traditional classes, such as many informational resources that can be seamlessly integrated into the class. Instructors can assign web pages as required reading, have students do research projects online using online databases. However it is important that the instructor encourage the students to learn the skills to differentiate valid and useful information from the dregs, as the internet is largely unregulated.

Some instructors also had online guests in their classes, authors of articles, experts in their field, residing at a distance, yet participating in online threaded discussions with the students in the class. All these things could theoretically be accomplished in a tradition class by adding an online component, however because online classes are already on the web, these opportunities are integrated far more naturally.

Other advantages of online classes result from psychological aspects of the medium itself. The emphasis on the written word, resulting from bandwidth limitations, encourages a manifest deeper level of thinking in online classes. A common feature in online classes is the threaded discussion. The fact that students must write their thoughts down and the realization that those thoughts will be exposed semi-permanently to others in the class seem to result in a deeper level of discourse.

" The learning appears more profound as: the discussions seemed both broader and deeper, the students are more willing to engage both their peers and the professor more actively, each student is more completely "exposed", and can not simply sit quietly throughout the semester: the non-participating students are equally as noticeable by their absence from the course as the verbal are noticeable by their presence. the quality of students' contributions can be more refined as they have time to mull concepts around in their thinking as they write, prior to posting."

The asynchronicity of the environment means that the student (or professor) can read a posting and consider their response for a day before posting theirs.

Every student can and, for the most part, does participate in the threaded discussions. In online classes, the instructor usually makes class participation a higher percentage of the class grade, since such participation can be more objectively graded (by both quantity and quality) through instructor access to the permanent archive of threaded discussions, unlike in face-to-face classes, where, because of time constraints, a relatively small percentage of the students can participate in the discussions during one class session. Because of the absence of physical presence and absence of many of the usual in-person cues to personality, there is an initial feeling of anonymity, which allows students who are usually shy in the face to face classroom, to participate in the online classroom. Therefore it is possible and quite typical for all the students to participate in the threaded discussions common to web-based classes.

"... I enjoy these courses and the 'forced' voicing of all the students. One cannot simply sit there and not participate!"

This same feeling of anonymity creates, some political differences, such as more equality between the students and professor in an online class. The lack of a face-to-face persona seems divests the professor of some authority. Students feel free to debate intellectual ideas and even challenge the instructor.

"In a face-to-face class the instructor initiates the action; meeting the class, handing out the syllabus, etc. In online instruction the student initiates the action by going to the web site, posting a message, or doing something. Also I think that students and instructors communicate on a more equal footing where all of the power dynamics of the traditional face-to-face classroom are absent."

"On line you establish yourself again and again with each response."

Students are sometimes aggressive and questioning of authority in ways not seen face-to-face. With the apparent anonymity of the internet, students feel much freer to talk.

"Students tended to get strident with me on line when they felt frustrated, something that never happened in f2f classes because I could work with them, empathize and problem solve before they reached that level of frustration."

In the opening weeks of distance courses there is an anonymity and lack of identity which comes with the loss of various channels of communication. Ironically, as the class progresses, a different type of identity emerges. Consistencies in written communication, ideas and attitudes create a personality that the instructor feels they know.

"Interesting story: recently I had printed out a number of student papers to grade on a plane. And (damn them!) most forgot to type their names into their electronically submitted papers. I went ahead and graded and then guessed who wrote each one. When I was later able to match the papers with the names, I was right each time. Why? Because I knew their writing styles and interests. When all of your communication is written, you figure out these things quickly. I would know if someone else wrote a paper."

This emergence of online identity may make the whole worry of online cheating a moot point. Often stronger one-to-one relationships (instructor-student and student-student) are formed than in face to face classes.

Conclusions

The authors' interpretation of the data is that the different factors discussed above in the results section interrelate with each other in ways that seem complicated at first but turn out to be quite simple if looked at diagrammatically with vectors of causation. We therefore propose a theoretical model. The most common response from online instructors was <CHN, meaning fewer channels of communication online. Fewer channels of communication, <CHN, is the major factor driving two competing systems of causation, 1) ***isolation effects*** and 2) ***community effects***, which together form an ***online paradox***.

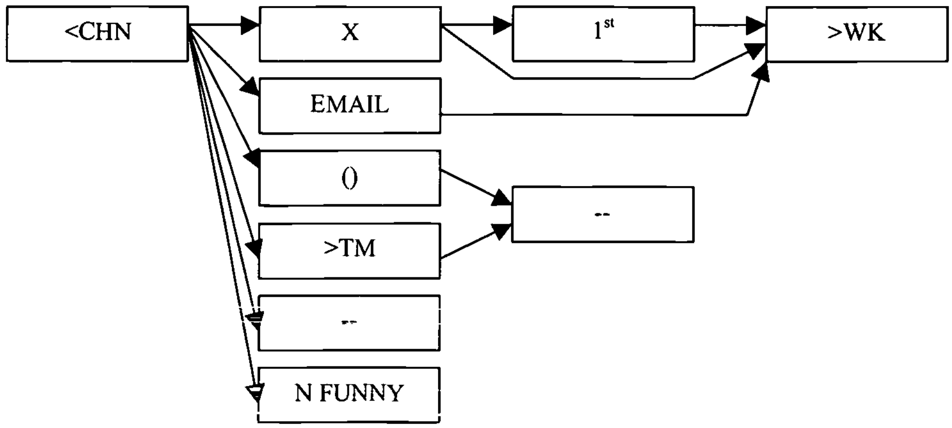

Figure 1: Isolation effects.

Figure 1 shows the isolation effects. Fewer channels of communication (<CHN) results in a need for more explicit communication (X). The need for explicit communication causes the instructor to spend more time developing the material before the course begins, in turn creating more work for the instructor (>WK). The need for explicit communication continues as the course progresses, resulting in still more work for the instructor (>WK). All this online work may minimize time for face-to-face relationships further isolating the instructor. Fewer channels of communication (<CHN) has a number of other isolation effects. <CHN creates ambiguity and student insecurity sometimes forcing the instructor to communicate excessively by email, with a number of negative effects. Since other students can not see the email, the instructor often has to answer the same questions more than once, resulting in more work, >WK, for the instructor. If questions are asked in a public forum, such as threaded discussion, other students can also answer questions, helping to build an online community. On the other hand, email can build individual relationships between the instructor and student. Thus email between instructor and students encourages the instructor-learner interaction and lessens the transactional distance talked about by Moore, but instructor-learner email also lessens learner-learner interaction. If questions are posted in a public place, then often students will help each other, promoting community. The authors advocate minimizing email and suggest that it should be used only for questions requiring confidentiality, such as discussion of grades. <CHN also forces students to be more self-reliant (()) and to exercise greater time-management skills (>TM). These are valuable skills, however some students may need more personal or community support to develop these skills. Thus undergraduate courses may be less appropriate for teaching in online, asynchronous, text dominated environments. Because of <CHN, and the resulting requirement for greater self-reliance and time-management skills, there is a greater attrition rate in online courses (category --). Distribution of grades in online classes often has a "U"-shaped curve, instead of the bell-shape normal distribution. Finally, <CHN creates ambiguity making humor risky in the online environment (N FUNNY). Since humor is a tension releaser, and often a norm binding groups together, N FUNNY is an isolation effect.

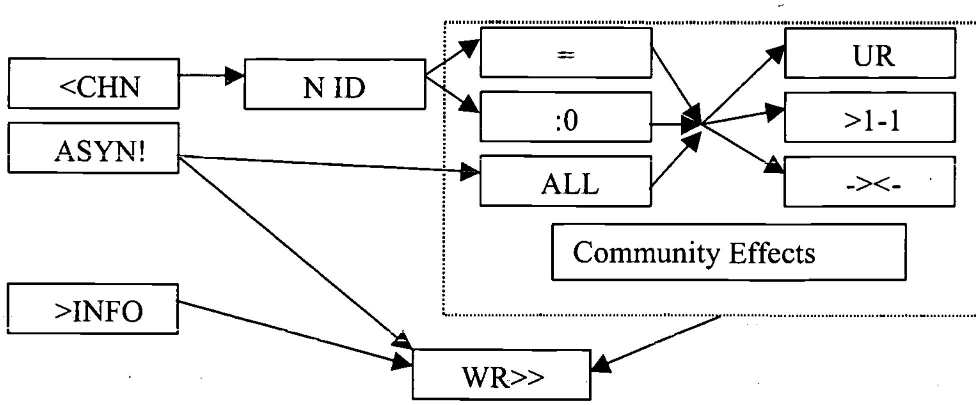

Figure 2. Community Effects

<CHN is the major factor and the advantages of asynchronous environment (ASYN!) the minor factor in creating an array of community effects (See figure 2). <CHN results in an initial loss of identity online (N ID). N ID promotes more equality between instructor and students (=) and greater student freedom of speech online because of the anonymity (:0). The minor factor, advantages of asynchronous environment (ASYN!), allows all of the students to participate in class discussions (ALL). Equality, freedom of speech and all students participating (=, :0 and ALL), result in three other effects, emergence of identity based on consistencies (style) of written communication and ideas (UR), greater individual relationships (>1-1) and building of relationships between instructor and students (-><-). The six effects, greater equality between instructor/students, freedom of speech, all students participating, emergence of online identity, greater individual relationships and building of relationship between instructor/students, are the ***community effects*** of online, web-based, asynchronous distance education. The six community effects, in combination with the advantages of asynchronous environment, the availability of greater information resources over the net (>INFO) and the effects of the written medium itself; result in a deeper level of thinking in this text-based environment (WR>>).

The ***paradox of online education*** is that less channels of communication result in a tension between ***isolation effects*** and ***community effects***. When isolation effects predominate, students drop out, when community effects predominate students succeeding the course; creating a "U"-shaped grade distribution. For those students who do stay with the course, there the potentiality for community is at least as great as for face-to-face classes.

Current web-based online college courses are not an alienating, mass-produced product. They are a labor-intensive, highly text-based, intellectually challenging forum which elicits deeper thinking on the part of the students, and which presents, for better or worse, more equality between instructor and student. Initial feelings of anonymity, not withstanding, over the course of the semester, one-to-one relationships may be emphasized more in online classes than in more traditional face-to-face settings. With the proliferation of online college classes, it is important for professor to understand the flavor of online education, to be re-assured as to its intellectual and academic integrity of this teaching environment.

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Campus Neo - a Bothnian Virtual Campus

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The Campus Neo project will develop an integrated environment for distance education and life-long learning. This environment enables Nordic universities and other organizations to establish a new virtual campus, the interregional university Campus Neo, which focuses on the advanced use of networking for research and educational purposes. The main objective with the Campus Neo project is to integrate existing interactive services, collaborative learning environments and communication methods in a way that should enhance tele-presence among students and university professionals. Combining asynchronous learning services with synchronous communication tools fulfils the need of a complete environment. The project seeks synergy benefits and forms user friendly, functioning and permanent possibilities for collaboration on the basis of already existing solutions for on-line education. This is achieved through three dimensions: the innovative utilisation of infrastructure and networking, the use of technological applications and tools, and the implementation of appropriate pedagogy and learning mechanisms.

Technology Opportunity Centers: Closing Digital Divide

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Abstract. In 1996, the West Virginia High Technology Consortium (WVHTC) Foundation, with 20 partners, received a U.S. Department of Education Challenge Grant titled "Your Future in West Virginia . . . Growing Together." Beginning from an "idea" in 1996, WVHTC Foundation's Education Division has forged dynamic partnerships with the WV State Department of Education, the WV Board of Education, County Boards of Education, and other education advocates. They have equipped and managed the Technology Opportunity Centers, trained teachers in computer-technology skills statewide, and have been instrumental in other education initiatives and accomplishments throughout West Virginia. In the variety of training courses offered by the WVHTC Foundation, at no cost to the participants, thousands of teachers and community members have gained practical experience in use of various computer applications. The present brief paper examines the input, process, and outcomes of the Technology Opportunity Centers (TOCs) in the state of West Virginia.

TOC Background

The Technology Opportunity Centers (TOCs) operate in a state that has earned top ratings on its climate for education in the past few years. West Virginia ranks near the bottom of the 50 states on health status of its citizens and its economic picture. In contrast, West Virginia is a rising star on the education horizon.

In 1996, the West Virginia High Technology Consortium (WVHTC) Foundation, with 20 partners, received a U.S. Department of Education Challenge Grant titled "Your Future in West Virginia . . . Growing Together." The partners included Barbour County, Harrison County, Marion County, Monongalia County, Preston County, Taylor County, Clay County, Mingo County, and Nicholas County. The initial grant was for $4.1 million over a five-year period. The competitive grant was one of 24 funded from 538 applicants.

Goals of the challenge grant were:

To expand and enhance the capacity of teachers to teach, using technology.

To expand and improve curriculum and technology applications in schools.

To plan and implement education and training programs in the area of career information and decision-making for students and community members.

To enhance the marketability of displaced workers in the community.

Thus, the grant-funded program was to benefit students, teachers, and community members in the Technology Opportunity Centers (TOCs). The WVHTC Foundation's program for Education is active in advertising these TOC course offerings. For the most part, word-of-mouth of these valuable, free-of-charge courses keeps the enrollments high. When the waiting list gets low, the WVHTC Foundation sends out advertisements and public-service announcements. Scheduling for a particular course and registering students begins about two months prior to the start date. If enrollment for a course is not full, the WVHTC Foundation attempts to fill the remaining slots with teachers. Full enrollment is defined in terms of the number of workstations in the particular TOC.

These centers are computer laboratories located in the schools, equipped with at least 15 multi-media computers, a server, a scanner, a computer projector, and two printers. The TOCs are used day and night. During the school day, students and teachers use the lab to learn basic computer skills, integrate computers with a variety of subject matters, and develop career decision-making skills. In the evenings, students, parents, teachers, and any community members are able to enroll for the computer-skill and career-oriented courses. If a student 15 years of age or younger enrolls for an evening course, he or she must be accompanied by a parent (guardian) and share a workstation with that adult. Students of all ages can benefit from the evening courses. Computer training offered in evening courses, at no charge, has included the topics of Windows, Microsoft Office, the Internet, and Career Explorer. Courses have been designed and are offered at the *basic* level and the *intermediate* level. The intermediate-level courses cover these topics in greater depth, in addition to Microsoft Access. Many teachers have enrolled in these courses along with displaced workers and other community members. These computer labs, equipped by funds from the challenge grant, have grown in number to 21 schools in Year 4.

Each TOC has two Directors who are teachers in that school. They receive an additional salary stipend for their services as TOC Directors ($1,250 for each ten-session course taught). All of the TOC Directors are experienced teachers, most with more than 15 years in public school teaching. They teach in elementary, middle, and high school. They teach reading, sciences, English, social studies, math, computer education, business, library, music, vo-tech, and physical education. As Directors, they maintain the TOC laboratory and teach the evening courses. Each Director usually teaches four evening TOC courses per year. The evening courses usually have been enrolled at full capacity and are offered across a 10-week period at three hours per evening (6 p.m. to 9 p.m.) once per week. The 30-hour evening courses usually begin in September, November, February, and April. Depending on the needs and preferences of the Director, a different schedule can be offered. For example, a course might be scheduled (1) beginning in January rather than February or (2) operating two evenings per week for five weeks totaling 30 class hours rather than one evening per week for 10 weeks totaling 30 class hours. Two course offerings per year for a Director must be on the one-evening-per-week for 10 weeks schedule. The other two offerings can be scheduled to accommodate the Director's availability. Thus, each TOC attempts to offer eight evening courses per year (four by each director).

Findings

At the start of each evening course for community members, these adult students filled out a "Pre-test." They filled out the same form as a "Post-test" at the conclusion of the course, 10 class sessions later (after 30 hours of instruction in a TOC laboratory. There are ten application areas for the community students to rate their "knowledge/skill level" in the Basic course (computers generally, word processing software, spreadsheet software, basics of the Internet, career software, MS Windows, MS Word, MS Excel, MS PowerPoint, and Internet Explorer). Two applications (database software and MS Access) are added to these ten for participants in the Intermediate course. For each application, the community member enters a number from 0 (know nothing or no skills) to 9 (can teach others or maximum knowledge/skills).

A summary of the analyses of variance is reported in Figure 1. Recall that the alpha level selected for these tests was a conservative $p < .01$ level. As the reader will note in Figure 1, all applications showed a significant gain from pre-course to post-course. Means (but not standard deviations) also are listed in Figure 1. The analysis of variance takes the standard deviations into account in computing the F value. Taken together, the means, F values, and significance levels fully describe the findings. Thus, the Basic courses and the Intermediate courses demonstrated powerful effects in support of the hypotheses. That is, beyond any reasonable doubt, both Basic and Intermediate courses produced significant gains in perceived knowledge and skill in computer applications through 30 hours of targeted instruction and experience.

Conclusions

The climate of education in West Virginia has been positively influenced by TOC process and product. The full set of 21 proposed TOCs has been brought to productive operation with day and evening services to the broad constituency of learners. Evening courses at the TOCs (Basic and Intermediate) continue to be fully enrolled, and healthy waiting lists for all counties are maintained. Community members extol the virtues of their educational experiences at the TOCs. These adult learners consistently indicate statistically significant gains in confidence and competence. Participants in TOC courses give superior ratings of the TOC Directors, including being well prepared, being competent, answering questions, and giving individual attention to students as needed. Formative and summative, formal and informal, quantitative and qualitative data point to (1) extensive use of TOCs by community members, students in the TOC schools, and teachers in TOC and other schools and (2) extensive benefit to those who use the TOCs.

In the variety of training courses offered by the WVHTC Foundation, at no cost to the teacher, thousands of teachers have gained practical experience in use of various computer applications. They not only learn how to use the technologies but also gain experience, guidance, and networking with other teachers on integrating computer technology into student learning.

Acknowledgements

The TOC Evaluation Team (Richard T. Walls, Ranjit K. Majumder, Tatiana I. Solovieva, Lori L. Britton), the Education Programs management and staff of WVHTC Foundation (especially Lydotta M. Taylor, Vice President, Education Programs) and the partners and Directors of the WV TOCs.

Figure 1: Significance Tests of Pre to Post Gains by Community Members (Random Samples of 100 Basic and 100 Intermediate Participants) in TOC Courses

Note: Responses were on a 10-point scale from 0 = Know Nothing/No Skills to 9 = Can Teach Others (Maximum).

Application	Pre Mean	Post Mean	F Value	Significance Level
Basic courses				
Computers Generally	2.8	5.4	76.6	$p < .01$
WP Software	1.8	5.1	118.8	$p < .01$
Spreadsheet	0.9	4.8	297.6	$p < .01$
Internet Basics	1.7	5.5	143.3	$p < .01$
Career Software	0.3	3.9	204.4	$p < .01$
MS Windows	2.1	5.7	116.7	$p < .01$
MS Word	1.5	4.3	165.0	$p < .01$
MS Excel	0.5	4.9	434.8	$p < .01$
MS PowerPoint	0.4	4.9	445.2	$p < .01$
Internet Explorer	1.2	5.5	185.7	$p < .01$
INTERMEDIATE COURSES				
Computers Generally	5.0	6.3	40.3	$p < .01$
WP Software	4.1	6.0	55.6	$p < .01$
Spreadsheet	3.3	5.4	70.1	$p < .01$
Internet Basics	4.8	6.2	23.3	$p < .01$
Career Software	1.9	4.2	50.0	$p < .01$
MS Windows	4.7	6.4	49.5	$p < .01$
MS Word	4.4	6.4	63.7	$p < .01$
MS Excel	3.4	5.5	74.7	$p < .01$
MS PowerPoint	3.4	6.0	72.7	$p < .01$
Internet Explorer	4.0	6.0	47.6	$p < .01$
MS Access	2.3	5.0	100.8	$p < .01$

Integrating XML-based Courses into a LTSA-Environment

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The Chemnitz University of Technology was the first one in Germany, which was able to offer an internet-based study about information and communication technology.

The first lessons was developed in HTML, but this causes some disadvantages. To overcome the problems we changed to a XML-based approach. We identified a relevant set of XML-elements, e.g. to mark important hints, examples or personal opinions. The XML-code will be translated by different tools into a controlable HTML layout.

This concept makes it simple to generate different views. Assistents can see the answers to some exercises, while the participants get links to the "virtual seminars". The learners evaluate her progress by on-line-tools.

This design implements the main compontents of Learning Technology System Environment. It uses small tools written in Tcl and standard protocols. All data are saved in XML-documents and can be used by different tools. The components communicate about open protocols.

Collaborative Knowledge Building in Web-based Learning: Assessing the Quality of Dialogue

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Abstract: This paper addresses the question of how to qualify a knowledge building dialogue in web-based collaborative learning. It investigates the idea of qualifying the dialogue through grading requirements and through providing students with meta-awareness around their dialogue. We investigate and analyze the changes in quality of student interaction in three different deliveries of the course that emerge in response to three different types of instruction on expected behavior. From this we draw preliminary conclusions on the extent to which descriptions of expected behavior influence the interactive process and the quality of the interaction.

Introduction

Web-based learning is assuming an increasing role in education at college and pre-college levels (Bates 1999; Collis 1996; Fjuk et al. 1999). It is not only situations of continuing education and lifelong learning which call for flexible organization of the learning process, e.g. with the purpose of bridging distances. The obvious advantages in terms of a more flexible, time and space independent organization of the learning process, also within higher education, are clear (Harasim 1999). The flexible organizational design of web-based learning, by itself, does not make this method superior to other methods. Of more importance is the quality and design of the learning process. Many flexible designs offer no possibilities for interaction and collaboration among students, but are rather sterile and lack a framework to stimulate collaborative knowledge building. Others do so, but have problems - even when interaction occurs – in qualifying a knowledge building dialogue.

This paper deals with the question of how to qualify a knowledge building dialogue through grading requirements and as an effect from providing the students with meta-awareness around the functions of the requested comments in the dialogue. The paper suggests that grading requirements as well as providing awareness around the requirements related to the function of comments in the dialogue contribute to qualifying a knowledge building process in collaborative learning.

In section 2 we provide some brief information of the web-based course producing the data of our analysis. Section 3 provides an account of our knowledge building perspective and the criteria of quality used in our analysis of web-based dialogues. Section 4 addresses the communicative conditions of web-based environments, forming part of the rational behind our hypothesis. In section 5 we give a more detailed account of our research design and of the method used in our analysis, while section 6 provides the basic analysis. We reflect on the results of the analysis in section 7 and discuss future research perspectives.

Development of Dialogue Requirements in "Global Change"

Global Change (GC) is a conventional science course for senior undergraduates or beginning graduate students at a US university. It gradually has been migrated to a web base over the last 6 years, with new features being added as ancillary software has become available. Learner-centered activities in place of or supplemental to conventional lectures have been introduced.

The course consists of a sequence of learning modules on different global-change topics, each having evolved from a conventional university class time period. Each unit has a set of objectives, summary information on the topic, student-submitted collaborative (2-3 students) summary of class time discussion, "problems to ponder" as discussion starters for the electronic dialogue, and extensive lists of web and other information on the learning module topic. Each unit has its own electronic dialogue for student discussion among themselves and with outside experts or representatives of selected groups. Electronic dialogue on individual learning unit topics is graded. The course is viewed by the designers as a laboratory for experimenting with a variety of pedagogical techniques and initiatives (Taber et al. 1997).

The course went on the web in Spring 1995. Affiliated with the course was an opportunity to engage in electronic dialogue. The use of dialogue and associated instructor evaluation of student engagement in dialogue changed over the years as follows:

1995:
Electronic dialogue was available separately for each lecture topic, and 5% of the evaluation of student performance was based on whether or not a student participated. There were no minimum requirements on amount of discussion and no attempt was made to judge quality as part of the evaluation of students.

1996:
Same as 1995 except 15% of the grade depended on the electronic dialogue. Some weak attempt was made to judge quality but primary criterion was participation and not quantity or content.

1997:
Requirements for participation in electronic dialogue were substantially enhanced. For full credit, the student was required to post at least 15 entries, which had to include responses to at least 6 other students' comments. Furthermore, these entries had to elicit comments from 3 other students. They also were required to respond to 3 questions issued by the instructor and to give their views on 3 additional ethical questions relating to global change. Thirty percent of evaluation of students was based on these numbers but no evaluation of quality was attempted. A virtual portfolio was introduced for each student to manage discussion.

1998 and 1999:
Same as 1997.

2000:
Same requirements as 1998 with addition of the knowledge-building process (Stahl 1999) that required students to meet specific quality criteria in their discussion. Also, students were required to assess their own writing and demonstrate how they had met the criteria. Forty-two percent of the evaluation of student performance was based on discussion.

Criteria of Collaborative Knowledge Building in Web-Based Learning

To put our analysis of electronic dialogues in perspective, we briefly outline the set of criteria which we assert are signs of quality in a web-based collaborative knowledge building process.

In the principles of collaborative learning, the process of learning is viewed to be a fundamentally social phenomenon, regardless of the varying theoretical emphasis in each single approach (Dillenbourg et al. 1995). Several other learning theories confirm this view, e.g. Etienne Wenger in his latest book, "Communities of Practice" (Wenger 2000).

The process of knowledge building (KB) in collaborative learning, first explored by Harasim (1989), involves mutual exploration of issues, mutual examination of arguments, agreements and disagreements, mutual questioning of positions, dynamic interaction and weaving of ideas (Harasim 1989; Kaye 1992; Sorensen 1997). Mason (1993) finds this view to be in agreement with the communicative potential of the online environment, although she also points out the weaknesses of the online dialogue being that it quite often never reaches synthesis or closure (Mason 1993).

In view of the generally recognized difficulties in fostering online student dialogue that converges (e.g., synthesizing) rather than diverges (noted by Mason), Stahl (1999) suggests a set of factors that characterize quality in the KB process:

Brainstorming is the introducing of new ideas that relate to the topic or task and offer a perspective not previously considered; *Articulating* includes explaining complex or difficult concepts;

Reacting provides an alternative or amplified perspective on a concept previously introduced by a student;

Organizing refers to assembling existing thoughts or perspectives in such a way that a new perspective emerges;

Analysis includes comparing or contrasting previously articulated views or puts new understanding on existing data;

Generalization takes comments or data already presented and extracts new information or knowledge that applies to a broader set of conditions.

Implementing these learning quality criteria of collaborative KB requires a corresponding meta-functional pedagogy or instruction that facilitates and motivates such collaborative dialogue (see section 4).

Reflective Dialogue Primary to Involved Dialogue

Promoting knowledge-building dialogue within the context of collaborative learning appears to be a complex challenge. In searching for reasons for this, some research has focused on the design and nature of the collaborative activities implemented in the learning process (Collis 1997), and others on the quality and nature of the virtual environment and the evolvement of electronic inter-human dialogue (Scardamalia & Bereiter 1996; Sorensen 1993). Alternative studies have concluded the social aspect of a group process to be an essential motivator for collaboration in online learning (Harasim 1993; Cornell & Martin 1997). It seems to carry a rather high proportion of a group member's inclination to engage in any interaction with the group at all (Moore & Kearsley 1996). This seems in total agreement with the widely acknowledged insight, that inclination to interact online is sensitive to the perception of interaction (Gunawardena 1995).

Considerable research has been directed towards the role and meta-communicative behavior of the instructor (Feenberg 1989). Recent studies along this line of thinking have described the online universe as a meta-communicative world. Contrary to the physical world in which involvement is viewed to be primary to reflection (Heidegger 1986) - the virtual universe provides a context and an "ontology" in which reflection may be said to be primary to involvement (Sorensen 1999). Assuming this new dialogical paradigm, and this primary position of reflection and meta-communication, it is very conceivable, from the perspective of collaborative interaction and dialogue in Web-based learning, that also the task of scaffolding learning processes that aim at supporting both interaction and (self)reflection, must move at a meta-level in terms of creating awareness of the function in a dialogue of a contributed comment.

Research Design

In our analysis we wanted to investigate the role and nature of the instructions in the requirements given to the students, stimulating them to interact. We wanted to assess whether meta-communication in terms of providing meta-awareness of "the function of a comment" in the KB process, will improve the quality of the KB dialogue, according to the definition of quality as suggested by Stahl (1999). In our research design and analysis we make the following assumptions:

1. Characteristics of discussion and comments that contribute to a KB process are (Stahl 1999): brainstorming, articulation, reaction, organization (including synthesis), analysis, and generalization.
2. Use by students of characteristics of the KB process in written dialogue contributes to student learning (as characterized in section 3).

Our hypothesis for the analysis is then, that by explaining the characteristics of a KB-process, and by grading (Sorensen & Takle 1999) student discussion on the basis of their reflected use of these characteristics, students will measurably increase their use of these characteristics. The rational behind the hypothesis is an acknowledgement of the need in primarily reflective virtual environments (as described in section 4) for communicatively providing meta-awareness in relation to expected communicative actions (as described in section 3).

We have evaluated characteristics of student dialogue and its relationship to course requirements by assembling 10 comments from 1995, 10 from 1997, and 10 from 2000. These were drawn at random (although not strictly with statistical rigor) and represent comments made under quite different criteria for evaluation of student performance. In drawing the comments from the respective databases, care was taken to draw comments from the same (or very closely related) topics in each of the three years.

The data sets represent (a) comments with no obligations attached as far as evaluation of student performance was concerned (1995), (b) comments when numbers of responses and numbers of interactions among students were used for evaluation (1997), and (c) comments when the KB requirements were imposed. For 2000, we also have, for some database entries, the student self-assessment of their own writing. We also have assigned a numerical value from 1 to 10 representing the quality of the comment.

Analysis of Dialogues

For the purpose of our analysis we have categorized the analyzed comments in the online dialogues according to the knowledge building quality requirements presented by Stahl (1999) in section 3:

- comment with no KB characteristics
- question (a request for clarifying information)
- analysis (comparing or contrasting previously articulated views)
- articulation (the explanation of complex or difficult concepts)
- reaction (presenting an alternative or amplified perspective on a concept previously introduced)
- brainstorming (the introduction of new ideas that relate to the topic or task and offer a new perspective)
- organization (the organization of existing thoughts or perspectives)
- generalization (extracting new information or knowledge from comments already presented, that applies to a broader set of conditions)

A level of quality (1-10) was subjectively assigned to each comment. The mean quality went from 4.4 to 3.2 to 5.3 from 1995 to 1997 to 2000, respectively. In 1995 a preponderance entries were questions, whereas in 1997 there were more reactions to other students. In 2000, more student comments were characterized as articulation.

From these results, we draw the following tentative conclusions. In 1995, with no requirements on volume or quality of writing, students used the electronic dialogue for asking questions. The questions did not seem "forced" since their postings had essentially no bearing on how they were evaluated in the course. For 1997, the overall quality of the postings went down. There seemed to be more "forced" responses. More questions were of a rhetorical nature, rather than seeming to originate out of curiosity about the subject matter. We attribute this to a sense of urgency on the part of students to meet the volume obligations of the evaluation scheme. The increase in quality from 1997 to 2000 suggests that students responded to the demands for higher quality of writing by meeting the requirements of the KB process. A notable difference in the 2000 discussion as compared to previous years was the reduction in the "social" or . But at the same time, the number of comments increased. Comments were much more like individual essays and less spontaneous.

Perhaps the largest difference over the change in dialogue requirements was in the length of each entry. In 1995 the average length of the 10 entries was 88 words and in 1997 the average was 93 words. In 2000, however, the average soared to over 2,500 words. And the quality of the grammar of each posting increased markedly as well. This likely is attributable to the fact that students wrote their postings as essays in word processors on their own computers, subjected them to spell checking, and reviewed the grammar before cutting and pasting them into the course web-site. This increased quality and quantity came at the expense of spontaneity and "social" content.

Discussion and Future Perspectives

How do we evaluate the results of our analysis? Assuming that meta-awareness (Gutwin et al. 1995) of KB characteristics among students as well as grading of comments increase the process of collaborative learning, and accepting the value of the KB characteristics used in our analysis, we think it is fair to say that our experiment has proved itself to be relevant. Over the three trials the quality of student comments has increased, both as a result of grading requirements and as an effect from the meta-awareness around the functions of the requested comments.

Our sample size was quite small and therefore the results are subject to large uncertainty. Therefore, the extent to which the results can be generalized may be questioned. The selected comments, however, were drawn at random and taken out of the social context of the specific dialogue in which it appeared. Perhaps this could be considered a problem of the data set, since the KB requirements are concerned with the sequential development of online interaction.

As pointed our, the largest difference over the change in dialogue requirements was in the length of each comment, and the increased quality of the grammar used. It seems that the more carefully composed essay-like style of comments as well as the increased quality and quantity came at the expense of spontaneity and "social" elements in the interaction. It is conceivable that dealing with electronic dialogues and an electronic comment in terms of a request for reflection on its function, is inhibiting the evolvement and practice of a spontaneous and dynamic dialogue.

As such, the question could be posed, whether the strong meta-reflective requirements enforced on a dynamic phenomenon as human interaction (even though it is not in terms of formalization) appears problematic. Or perhaps whether the lack of recognition of social elements in the interaction works against an incitement to engage in collaborative interaction or knowledge building with others. Moreover, it may be pertinent as a basis for a potential conclusion around this aspect to specify, whether one is using data from an off-campus course (where the students have no complementary social interaction) or an on-campus course (where social interaction among students is part of daily life) as in the present study.

In the data from our experiment there is some indication, that the "forced requirements" on the collaborative dialogue actually functioned like a "kick-off" to engage in dialogue, and that it actually caused more interactivity than required to appear. But we find the data set from this study too small to conclude more precisely around this aspect. It is beyond any doubt, though, that - as default - to be forced to reflect on the function of one's action before carrying it out is likely to decrease spontaneity, phatic behavior and high interactivity. Above all, we believe that the optimistic results of our analysis have demonstrated that, once again, the problem is a complex one. And perhaps the usual controversial points to discuss in this respect will be "how" to do it and "to what extent". All these are questions to be further studied and pursued in the future.

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VIDEOGAMES AND GAMEPLAY

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Abstract

Aside from the scientific and mathematical knowledge required to work in the videogames industry, there is also the relevant artistic and cultural discourse. Of particular importance here is the concept of *gameplay*, regarded as the most important aspect of a successful game. This paper addresses the key components of gameplay, and then suggests what the effects this gameplay can have upon the player. The implications these effects have, particularly in relation to education and the future uses of gameplay, is then discussed. The intention is to shed light on the often oblique interactive nature of videogames.

Videogames and Gameplay

The purpose of this paper is to describe some of the key aspects of a central pillar of contemporary digital content – videogames and the videogames industry. At the ICDC we recognise that videogames are one of the most vital elements of modern culture and industry. For those interested in working within this industry, the potential rewards are huge. Videogame design is, essentially, an art. However, It is still regarded as axiomatic in the games field that programmers (i.e. mathematicians), are not 'creative types', and vice-versa. As far back as 1982 the legendary games designer Chris Crawford suggested that:

> *"Games must be designed, but computers must be programmed. Both skills are rare and difficult to acquire, and their combination in one person is even more rare"*
> *Chris Crawford (1982), p.47*

And the chairman of Nintendo has said that it is "artists, not technicians, who made great games" (Sheff, 1993, p.37). So we need to understand the fundamental concepts underlying this art, if we are to progress it. To begin however, I shall briefly describe the scale of the industry.

The Industry – Size and Constitution

The global leisure software industry is now worth nearly $17 billion. The European leisure software market is now on a par with the US market – worth $5.96 billion in 1999, expected to rise to $6.27 billion this year, that's $2 billion more than the Japanese market (ELSPA/Screen Digest). Britain is a crucial player in this trend. The videogames industry in Britain has now rather famously surpassed the combined revenues of the British film and video industries:

> *"The leisure software sector recorded a positive balance of trade in 1998 of £218 m compared to a total net trade deficit of £195m recorded by the film and TV industries combined" (Interactive Leisure Software Market Assessment and Forecasts 1999 – 2003)*

Britain is one of the European leaders in terms of creative output. Before this 'transition period' we are currently in, there were approximately 6000 people working in 250 British development studios. Titles such as Rare's 'Goldeneye', The 'Tomb Raider' series and 'Driver' by GT Interactive were award-winning global hits.

But then, Britain is a gaming nation: Last year, total spending on hardware and software in Britain rose by 10% to almost £1.4 billion. 31% of UK households own a modern console. This is especially remarkable when one considers that in Britain the console is a comparatively new development. We were all playing on our ZX Spectrums and Commodore 64's when the biggest seller ever (Super Mario Bros. 3 - $500 million dollars in the US alone) was released (on the NES, which hardly anyone in Britain bought). This *home computing* legacy is a key reason why we have a tradition of programming. Many top development houses and publishers, such as Codemasters, formed Richard and David Darling, and Rare, initially called Ultimate Play the Game and formed by Chris and Tim Stamper, started life in the bedrooms of home computing fans.

With the release of Playstation 2 (October 26th), Microsoft's 'Xbox' and the Nintendo GameCube and GameBoy Advance, the lull in the vibrancy of industry will dissipate, and growth rates are expected to become the fastest ever. So with this in mind we can see that the potential for work in the games industry is massive. The problem here is that this home programming generation is getting old – we need to train new generations of game designers, and fast. This is why the International Centre for Digital Content, formed the MA Digital Games in 2000, and many other courses are emerging globally.

So, what should we know about games, aside from the technology, to help us find work, and contribute? Most of us will have played games, but can I suggest we have played them without thinking too much about the processes that make the experience so compelling and attractive. I will now suggest what these processes might be. In order to do that, a little history might be useful.

'Crashes'

Two crucial events occurred during the Seventies and Eighties that, for both the industry and gameplayers, provided vital lessons as to what might make a game successful. These were the two *'crashes'*, both of which almost crippled the games industry.

The first of these 'crashes', which has been called the *'Hardware Plague'*, occurred in 1977, the era of handheld machines which played one embedded game.

The rise of cheaper microprocessors led to a flooding of this handheld market, forcing prices down and bankrupting many new companies. Fortunately, the industry soon recovered, simply because machines such as the Atari VCS 2600 became available, which could play *more than one title*.

In fact, the second 'crash', a *'**Software Plague**'* in 1983, occurred when these home machines had become what we now call *'consoles'*, capable of playing many separate game *cartridges* rather than one. Before long, far too many low-quality cartridges became available, the market flooded again, and consumers, unable to discern the quality without first paying a substantial fee, once more abandoned the industry.

Prices tumbled, and, famously, Atari made a loss of $539 million, and buried 'thousands of over-stocked cartridges in a New Mexico landfill" (Herz, 1997, p.39). At this point the videogames industry in the US had almost completely collapsed. If it were to recover again, then some standards would be required in order to avoid another glut of poor software. Exactly what it was that made some of these titles so awful became clear – the *interaction*, now a common expression, had to be of primary importance. Without doubt, the developers who recognised this, and rejuvenated the industry, were Nintendo. Formed in 1889 to produce playing cards, or *hanafuda,* by Fusajiro Yamauchi, Nintendo was taken over by Grandson Hiroshi, and in 1969 (Sheff, 1993, p.26), he created a games division. The hiring of a young designer, Shigeru Miyamoto, was crucial – his understanding of these new priorities led him to develop some of videogames' most legendary titles – *"Donkey Kong", "Super Mario Bros.", "The Legend of Zelda"* and many more.

A kind of *'Golden Rule of Games'* emerged: that of the two, it was *Software*, not hardware, which determined the success of a game. One only needs to look back to the demise of the Panasonic 3DO, one of the most advanced home consoles available in the mid-Nineties, to see that, with a roster of low-quality software, the hardware is redundant.

Developers now accept that technological advances in graphics, sound and processing power, whilst essential in terms of increased verisimilitude, and indeed still highly attractive to games players, were essentially cosmetic, and that conventions borrowed from other visual cultures, usually cinema, whilst predominant, were also not intrinsic to a 'game'. The conclusion was simple: It is these *'rules of the game'* - the *processes of interaction*, that largely engage the player. The term we of course now use is *Gameplay.*

Ian Livingstone, designer of both board and video games, and chief executive of major publishers Eidos, typifies this approach:

> "When people ask what are the three most important things in a computer game...I say, "Gameplay, gameplay, gameplay" (Edge, Iss. 65, p.118)

So it is this notion of gameplay then, that is at the heart of what constitutes interactive digital entertainment. Yet clearly it is somewhat oblique: rarely defined and regarded in almost mythical, metaphysical terms by reviewers. It is an interesting paradox - gameplay is regarded as the single most important element of games (perhaps even the only important one), by an industry which continues to devote thousands of pounds and column inches to graphics, sound and processing power, which are easier to identify and write about. But I must make it crystal clear that whilst gameplay is *the* most important element, one *must* always temper this with the fact that more sophisticated graphics and processing power are extremely attractive to videogame fans.

One of the most useful attempts to define gameplay can be found in 'Edge' magazine, issue 12 (September 1994), in an article entitled 'The Rules of the Game'. Whilst the article lists several elements that combine to create 'gameplay', I would argue that several are actually only conventions – not *intrinsic* to gaming. For example, 'Save Points' or 'End of Level Bosses', whilst common, are not always necessary. Indeed, I would like to suggest that these elements are subordinate to three in particular: the concepts of *Incentive, Risk, Reward,* and, acting as a counterbalance, *Frustration* (Edge 12, p.48).

By definition, the playing of a game must involve some justification for continued play. Whether it is the retrieval of some prize, the rescue of a loved one, a high score, or the completion of a narrative, all games provide constant *incentive*, often with a dense structure of mini incentives. These incentives encourage the player to take *risks* in the game, and will, if the risk was successful, turn into *rewards*. If the incentive is too little in relation to the risk involved, then the game will fail. Similarly, if the challenge is too simple for such a vital reward, then any sense of achievement will be lost:

> "Whether applied to the game as a whole, or to any activity within it, you must always feel that it is worth your while carrying on....A game should make you confident that higher risks will result in higher rewards" (Edge 12, p.48).

This is why most games will involve an equal amount of *frustration* - compelling the player to refuse failure and to try again. Frustration, the article notes, is an extremely difficult thing for the designers to 'get right'. Herz notes that videogame companies carry out "market research about stress levels and frustration thresholds of adolescent videogamers" (Herz, 1997, p.119), in order to ensure that the frustration is extremely finely balanced. This process – balancing – takes up a great deal of the designer's time. One can argue that Shigeru Miyamoto's success is largely down to his remarkable ability to pace and balance a game to perfection.

Frustration also occurs when, due to bad programming, the game or the computer appears in some way to 'cheat', or permit 'cheating'. As we all know, computers cannot make mistakes, *so "If something goes wrong, you should feel that it is entirely due to your own mistakes"* (Edge, Iss.12,p.49). Imagine spending hours perfecting fluid 'combos' on *'Soul Calibur'*, only to be beaten by a novice pressing as many buttons as possible. Any games where the rules seem to 'shift' or appear inconsistent will seem unrewarding, and invariably be switched off.

These incentives are at the heart of that concept often associated with games, *addiction.* The idea of '*just one more go*', is essentially bound up with the replacement of one reward with another, greater incentive, i.e. the promise of a greater reward, and so on. If you design a game which harnesses the power of 'just one more go', you are on to a winner. *'Tetris', 'Championship Manager'* and *'Tony Hawks Skateboarding'* are all examples.

There is another gameplay element to add to these three, which exists in some form or another in practically every videogame: *Levels.* Whilst the insertion of levels, or 'waves' or 'stages' might seem (and often are) merely a convention, the use of the term is necessarily broad - and at times levels are less delineated and difficult to recognise in a game. A game, which provides no increase in challenge - *the ladder of challenges*, will be quickly abandoned, and indeed, the length of time a game will last is dependent entirely upon the exhaustion of 'levels'. Stages usually *increase in difficulty*, as one might expect, although easier 'breather' levels have also proved popular (perhaps one can argue that the use of hierarchical levels are a reflection of cultures reliant upon capitalism). This *'Ramping of Difficulty'* is again a difficult procedure, and one, which differs depending on age and culture. Japanese games are regularly 'balanced' (i.e. made easier) before they become available in the West, to suit American 'frustration thresholds'- "They [the Japanese] judge products on how long it takes to complete it and not the quality of the experience". (Herz, 1998 p.120)

These aesthetics, which are as equally applicable to 'Pong' as they are to the very latest games, can be regarded as somewhat constant, and so are useful in that they are less susceptible to the massive technological advances that can often make arguments quickly seem outdated. It is crucial to remember that there are always far more low-quality third-party games in the shops than there are good games (much like the video and music industries), so these 'rules' are still ignored by more exploitative developers. But these devastating crashes taught not just developers but also the *consumer* lessons about how to avoid bad titles. Unlike other cultural industries, it has become generally accepted that the biggest - selling games are amongst the best. However, aggressive marketing occasionally disproves this, as anyone who has compared EA's 'Fifa Soccer' to Konami's 'ISS Evolution' will testify.

The Effects of Gameplay Upon the Player

Having defined gameplay, we need to address exactly what effects these processes have upon the player. I shall concentrate upon the effects of more immediate, reflex-based games. The racing game is an example, as is the 'First-Person Shooter', such as 'Quake'; and we would expect it to deliver an immediate, visceral experience than, say, a Real-Time Strategy. These have become known as 'Twitch' games, some have even described them as 'Thumb Candy'.

Let us take a specific example of a reflex-based game I'm sure many of us know – 'Tetris', developed at the University of Moscow by Alexey Pajitnov. In this puzzle game, seven shapes, each constructed from four squares (hence the title - a form of the Greek 'four') fall in random order from the top of the screen one at a time and land in a pile. By rotating the shapes and moving them left and right, the player can 'fit' the blocks into solid lines, and upon doing so, the line disappears, hence the ability to keep the pile low - increasing one's score.

Vital to the interactivity in 'Tetris' is the box, on the right of the screen, which indicates what shape will fall next. It is close enough to the action to allow it to be seen from the 'corner' of the player's eye, so that one needn't glance at it. This constant process, of manipulating one shape to fit 'best' whilst another is 'in mind', radically affects the gameplay – a *trance-like* gaming experience occurs. It's designer has described puzzles as:

> "metaphors and mirrors that reflect nature, emotion and patterns of thought....games were sublime examples of the intersection of logic and humanity. *They worked because of logic and mathematics, but also because of psychology and emotion"* (Sheff, 1993, p.298, my emphasis)

So, what we have is the *emotion* of identifying and engaging with the gameplay structure, and the underlying science of the puzzle. This emotion, or identification, is key. For psychologist Sherry Turkle, the *interactivity* of games is crucial, in that there is a combination of identification and action, which provides a *'special kind of hold'* (Turkle, 1984, p.83), one which, for example, cinema cannot provide because it relies upon identification alone. As anyone who has played 'twitch' games will know, one of the crucial factors is *pace*. These games require immediate, extremely fast reflexes.

One might not expect such a visceral, demanding experience to always be that pleasant, but as Turkle has suggested,

> "For people under pressure, total concentration is a form of relaxation" (Turkle, 1984, p.84).

Turkle likens this process to *playing the piano*, requiring knowledge of *improvisation, memory and repetition*, all in a split second:

> "It's more than just thinking - in a way it is beyond thinking. The hand learns what to do and does it automatically" (Turkle, 1984, p.68)

So these types of action-based games create a very particular response in humans. This high paced identification / action contains the ability to provide a *release of tension* – a *rush* can be achieved, much like when watching or participating in sport, when the body naturally releases *endorphins* – "proteins that mask pain and cause a sense of euphoria" (Sheff, 1993, p.205). Like when a jogger hits 'the wall', the release of endorphins is a natural 'high'. In fact, because they are natural painkillers, it has been noted that interactive software therefore has the potential to be used in a therapeutic context. 'Distraction therapy', where interaction is used to distract the patient from painful ailments such as arthritis and wounds, is now possible, and we can expect to see it become a common practice over the coming decade. With the rise of physical software such as 'Dance Dance Revolution' (Dancing Stage) will surely increase the potential for this 'rush', as well as being a healthy activity. Perhaps the next Jane Fonda will be virtual!

We can see then, that in many ways games have the potential to provide very positive benefits. Yet these benefits are often obscured, because of the very masculine, violent games that dominate the headlines. Let us now look more closely at this.

Benefits: education and skills

Currently, forces of moral outrage are again attacking the videogames industry. The High School shootings in the USA, and in particular the one Columbine, have been associated by both parents and the media with violent games, and in particular *Quake.* Research into the effects of violent media is almost always inconclusive, for every report making a link between the two, one can find another suggesting that there is no connection. Regardless of one's own personal experiences or opinions, what we can immediately make is an obvious but vital observation – that in countries with tougher weapon laws, there is less gun-related violence. The National Rifle Association is a powerful lobbying group in America, with the resources to maintain a strong pro-firearms agenda, based upon defending the Second Amendment of the Constitution. As a result, from afar it can seem nonsensical that the US seems willing to ban lightguns, but not handguns.

This *moral panic* – for that it what it is – is dangerous, because it does indeed obscure a more sober, objective analysis of games, which might actually reveal this potential for games to *improve and educate.* We have already described 'distraction therapy', so are there other elements of interaction which can be seen as positive? Patricia Marks Greenfield has looked at potential benefits. She suggests that "they incorporate types of complexity that are impossible with conventional games" (Greenfield, 1984, p.96), and illustrates several examples:

"Parallel processing"

Whereby one can process information from a multitude of sources simultaneously, is recognised as a skill which can be developed by games playing and is extremely useful when applied to contemporary IT jobs.

The ability to observe 'interacting dynamic variables'.

The behaviour of several 'elements' can reveal information as a result of their *interacting* - information which would be impossible to discover if the elements were in isolation. One is reminded here of the suggestion that "certain things that are incredibly abstract and confusing in two dimensions can seem intuitive in three" (Herz, 1997, p.220), essentially, games can teach the player to observe *processes* that can be difficult to otherwise comprehend.

'Spatial integrative skills'

Involving the ability to better comprehend perspective and dimensional depth, can developed by interacting with games that exploit conventions of point-of -view. The advent of 3D game engines - such as the ones used to such dramatic effect in 'Mario 64' and 'Tomb Raider', make this skill ever more possible. There is the use of *memory, repetition and improvisation*, for example, in "deciphering the logic of the game" (p.68), and "a socialisation into the computer culture" (p.67), again crucial in terms of contemporary information-based employment.

Also, David Sheff, author of Nintendo history 'Game Over' suggests that:

> "Video games...help develop problem-solving abilities, pattern recognition, resource management, logistics mapping, memory, quick thinking and reasoned judgements" (Sheff, 1993, p.207)

Finally, compiling research, Griffiths also highlights the suggestion of directly therapeutic uses: building a rapport with therapists, releasing aggression, learning to co-operate, and building self-esteem (Griffiths, 1999, np). Whilst the American Conservative Eugene Provenzo claims that "games are pointless to most educational, social and cultural needs", it is claimed that "There are many authors who ardently support the use of video games for educational reasons" (Griffiths, 1999, np). Several benefits can be gained from games playing in an educational context - including their use as a 'catalyst' in motivating education, boosting confidence in children who lack it, and promoting social interaction (Griffiths, 1999, np).

To conclude then, those who are interested in becoming games developers should bear these potential benefits in mind. Firstly, because moral panic presents a very real threat to the games industry – linked as it is to censorship. Secondly, because it is in these areas – of the development of social, spatial and cognitive skills, and of harnessing the artistic power of emotion and psychology, that games can and perhaps should progress. At the ICDC we are investigating educational software - we have a group of kids helping us to design a game – and we believe that educational software is often 'found out' by kids, to be over-worthy, slow and dull. They much prefer Lara Croft and Pokémon, and as we have seen they can learn from these titles. The educational software industry is in almost constant crisis. If we can harness the attractions of commercial software – the fact that it is 'cool', then we can use digital content to improve the quality of education, perhaps for all ages. Imagine a 'Quake' where instead of shooting each other, kids hunt down plans and information, then co-operate to build a bridge to one another. The educational potential is huge. We should exploit it.

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Competences for Online Teaching & Training

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Abstract: This paper explores issues concerning the skills and competences of online teachers. We report on an international two-day workshop with practitioners and researchers. We cover a range of ways of understanding online teaching, including competence, humanistic and cognitive perspectives. The main emphasis here is on a competency-based approach. We suggest a starting point based in current practice and research that is aimed at how online teachers might be recruited, trained, assessed and certified. We elaborate our view of the roles of the online teachers and report work leading to a framework and set of associated competences.

The Centre for Studies in Advanced Learning Technology (CSALT) at Lancaster University and the International Board of Standards of Training, Performance and Instruction[1] (***ibstpi***) organized a two-day, international conference in Windermere, England, in June 2000[2] to address issues pertaining to competences and standards for teachers involved in designing and delivering online courses and course materials. This presentation provides a summary of the outcomes of the conference.

Participants included 9 ***ibstpi*** Board members (including university and corporate representatives from Norway, the Netherlands, the UK, and the USA), and about as many professional online educators from the UK (representing Lancaster University, Glascow University, Motorola University-UK, Sheffield College, the Open University, Portsmouth University and several governmental organizations and projects). There was a mixture of university and professional practitioners and strong international representation. The aims of the conference were to create an improved understanding of the competences (abilities, attitudes, knowledge, and skills) involved in planning and implementing effective online education. The focus was primarily on distance education for adult learners, including university students and workplace learners.

The impetus for the meeting came partly from requests for standards and certification for online teachers and partly from growing concern with wide variations in the quality of online teaching. The Board recently updated its instructional design competences to reflect the impact of technology on the design of instruction. Additional motivation came from current projects underway in the UK that raise issues about competences for online teaching. The outcomes of the meeting were a preliminary set of competences and a commitment from the Board and to continue the effort. This presentation is the first formal presentation of the draft set of competences for online teaching developed at that conference.

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[1] ***ibstpi*** has internationally recognized established standards and competences for technical trainers, instructors, instructional designers, and training managers; the Board is considering how to define standards and competences for online teachers in response to growing concerns with quality and divergent practices.
[2] This workshop was co-sponsored by the Centre for Studies in Advanced Learning Technology at Lancaster University, the Joint Information Systems Committee of the UK universities funding councils, and ***ibstpi***. Participants included academic and industry representatives in the UK and sponsors.

1. The growth of online learning and teaching

There is very little sound research on the extent and effects of online learning and teaching. Many commentators and analysts are making dramatic claims about growth in the market(s) for online learning, though it is hard to find such claims being made by people who do not have a vested economic interest. Drucker (2000) suggests that the market will grow to hundreds of billions of dollars in the near future.

While it is possible that a shift towards greater use of online learning may reduce the relative cost of teaching staff, online teaching continues to be labor-intensive. The UK Open University, for example, aims at an average of 25 students per online teaching discussion group. The for-profit University of Phoenix operates in learning groups of 8-15 students, each with an online teacher. This implies a substantial growth in demand for online teachers in the next few years. The Open University Business School has recruited and trained 400 online teachers in the last 4 years and seeks to recruit and train another 100 in the coming year (Salmon 2000). The newly established US Open University is currently recruiting Associate Faculty across *all* disciplines and programmes. They will be trained to work entirely online with their students. How should such online teachers be recruited and trained? How is competent online teaching performance defined? What competences should be used in recruitment? What should be the objectives of a training course for online teachers and how can they be assessed or certified? These are pressing issues for many companies and universities. Researchers on defining competences for online teaching often builds on earlier accounts of competences for distance teaching and sometimes starting anew (see Cyrs 1997). The following section briefly reviews a first draft of such competences.

2. Competences for online teaching

Major roles for online teachers included the following: advisor, assessor of progress and outcomes, designer, manager and administrator, researcher, process and content facilitator, and technologist. These roles represent clusters of related competences. A partial elaboration of the content facilitator cluster is:

Informing participants	pointing to and finding resources
	suggesting and negotiating time frames for activities
	suggesting and negotiating criteria and terms for completion
Managing learning activities	designing learning tasks
	identifying and integrating suitable challenges for learners
	maintaining focus
	organizing activities and learners

3. Conclusions

The Board has developed an initial set of competences based on the Windermere meeting and subsequent ***ibstpi*** meetings and focus groups. In February 2001, ***ibstpi*** met in Amsterdam to refine the initial set and produce a more comprehensive set of competences for the large survey. The project team has created a model of online teaching and refined the initial set of competences and performance statements. Further refinement will include an international survey of professional practitioners to determine the frequency and criticality of various online teaching skills and activities.

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Technology-related Promotion & Tenure Guidelines

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Instructional Technology has become an important teaching tool in the classrooms of Colleges and Universities all over the country. Instructional Technology is still a new tool and as such, the benefits, cost of creation, and cost of implementation are still being realized. The need to reward faculty for their involvement with Instructional Technology, however, is both immediate and real. In 1999, the Southeast Missouri State University Information Technology Faculty Roles and Rewards Action Team developed guidelines for evaluating the effort put forth by faculty involved in creating and implementing Instructional Technology. The final document describes the importance that the use of Instructional Technology by faculty should have in the promotion, tenure, and merit process. The document was written to include the faculty and administrators involved in promotion tenure decisions who may not be familiar with the uses of Instructional Technology. The document was first implemented in the fall 2000 semester.

Novel Client Representations for the Collaborative Virtual Learning Environment sTeam

Projektgruppe sTeam
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Abstract:
The Paderborn Open Source Project sTeam (Information Structuring in a Team) currently develops a net based environment to assist cooperative learning in virtual communities.
The following paper describes the activities of a group of students involved in the project at the University of Paderborn, who researches various approaches for presenting information, interaction and communication structures in a virtual learning environment. A prototypic implementation of a two- and three-dimensional client for the sTeam system does create new ways of interaction between learners and the learning materials in a virtual space.

Introduction

Learning is a socially embedded design process. But most of today's hypermedia systems fail to properly support both the design-related and the social aspects of learning. Authoring and web-publishing systems aim to support the authors' design process. Consequently, learners' activities are confined to selecting and reading. Based on some fundamental reflections on the role of technology in learning processes, we conclude that top priority must be given to the construction of infrastructures that support cooperative learning processes if we are to properly harness technology's potential.

In Paderborn we focus on a learner-centered – wholly java-based – approach for structuring information in teams (sTeam). (cf. http://steam.uni-paderborn.de) The key concept in sTeam is the virtual space. It draws together cooperation and communication, at the same time embodying the common external memory of a (virtual) learning group. Therefore the focus is not on interactive systems for individual accessing of knowledge bases, but rather on the cooperative management and structuring of distributed knowledge bases.

Since the emerging of the World Wide Web, knowledge management consisted of creating and providing information on CD-ROM's and WWW-Servers.

Because of the difficulties in actively providing structured and organized information, most users were forced into the consuming role. Even today, providing information in the World Wide Web, needs a lot of patience and the knowledge of at least one programming language of the WWW.

In its basic sense, distributed knowledge organization means the cooperative generation, management and maintenance of artifacts embodying knowledge. Artifacts represented by documents, graphics, notes and comments, and their linking by learners, thus form the basis of any method for supporting learning processes using suitable environments and tools. Asynchronous mechanisms for handling multimedia learning components or hypertexts, such as are frequently familiar from document management, are combined with strongly synchronous approaches from the area of session based systems. Such a synthesis allows new, less familiar, hybrid forms of asynchronous and synchronous cooperation between learners.

Thus the sTeam system combines the idea of a room-based virtual world with the basic functionality of document management. Rooms function not only as a social meeting-point and center of a virtual learning community but also as a collaborative external memory, providing the primary media functions (cf. Hampel & Keil-Slawik 2001) as a basis for cooperative learning.

This paper presents the work of a students group of the University of Paderborn, who develops new forms of Java frontends for the sTeam system.

Both a two-dimensional and a three-dimensional client visualization were developed (Java/Java 3D). These clients evaluate novel ideas to support the user in navigation and interaction in these structures:

The three-dimensional visualization shows an isometric view of a room. A simple avatar representation of the learners was chosen. The camera position is determined by oneself, which allows one to freely navigate within the room. Various thematic rooms are connected by doors or semantic links (teleporters).

One goal of our work was to evaluate novel forms of interaction within such a virtual world. This includes both the structuring of communication within the room and the semantic structure of the room's objects.

A good example for the structuring of the avatars communication within the room may be the concept of chat circles. Avatars may easily form a so called chat circle by approaching a virtual conference table. The range of the chat is limited to the members of one particular chat circle.
This mechanism can for example represent the usual structure of a tutorial or a course, in which students in small groups work on different topics and compile their results afterward as a group.
One advantage of presenting information in three-dimensions is that a large amount of objects (documents, graphics) are easier to position and to display than in a two dimensional space. Additionally, semantic relationships between the objects can easily be represented through grouping them in space or simply by proximity. The realization of the various approaches in a two- or three-dimensional client explore these relationships in particular.

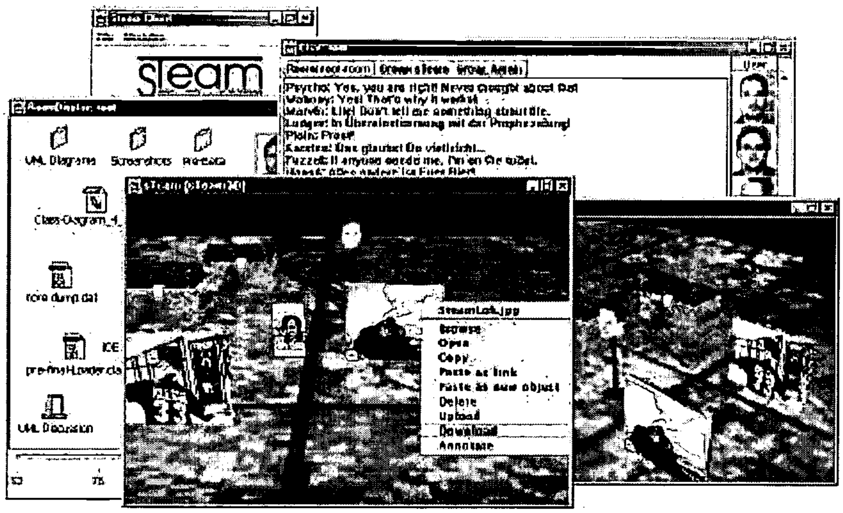

figure 1: two different client representations for the sTeam system

In the virtual space different avatars have different ways to interact. Documents can be given to others by simply dragging them with the mouse. Each sTeam user owns his personal virtual backpack in which he/she can store and transport documents between rooms.
In a virtual sTeam room various objects and materials (media) can be created, which support the cooperate learning process. These objects include for example graphics, hypertext-documents, links to external web-sites, but also tools such as a cooperative shared whiteboard.
The content of the documents can be viewed and altered in conventional browsers or in a sTeam-module especially created for a certain type of document. Objects representing graphics are displayed in the virtual space and can be viewed there.
Those two approaches correspond to different views on the same information structure of the presented data. They are not competing ways of presentation but rather combine different but basics ones.
The strength of the three-dimensional client is certainly in the field of communicating the information structure. It surely will be attractive to users who explore virtual communities for the first time and are not expert users. The communication in groups is viewed as a main feature and can easily be done for all users.
The two-dimensional client offers main advantages for daily use and structuring of learning- and educational material, because its functionality and look and feel are like conventional applications.

Future sTeam developments will explore in particular further ways of interaction in virtual learning environments and extend the interconnection with the daily learning- and working environment.

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Novel Client Representations for the Collaborative Virtual Learning Environment sTeam

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The Paderborn Open Source Project sTeam (Structuring Information in a Team) currently develops a net based environment to assist cooperative learning in virtual communities.

This poster presentation describes the activities of a group of students involved in the sTeam project at the University of Paderborn, who researches various approaches for presenting information, interaction and communication structures in a virtual learning environment. A prototypic implementation of a two- and a three-dimensional client for the sTeam system creates new ways of interaction between learners and the learning materials in a virtual space.

In the virtual space different avatars have different ways to interact: e.g. objects/documents can be exchanged simply by dragging them with the mouse. Each sTeam user owns his personal virtual backpack in which he/she can store and transport documents between rooms.

In sTeam various objects and materials can be created, which support the cooperative learning process. These include for example graphics, hypertext-documents, links to external web-sites, but also tools such as a cooperative shared whiteboard.

In the field of supporting the learners' communication the three-dimensional client offers new approaches. Discussion groups may be formed just through spatial closeness of the corresponding avatars. (Learners sit together at a "virtual conference table").

Avatars may easily form a chat circle by approaching the table. The range of the chat is limited to the members of one particular chat circle.

For further information cf.: http://steam.uni-paderborn.de

MediBook: Combining Semantic Networks with Metadata for Learning Resources to Build a Web Based Learning System

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1. Introduction

This paper gives an overview of MediBook, a joint project of the Medical Department of University Gießen (Germany) and the Department of Electrical Engineering and Information Technology at Darmstadt University of Technology (Germany) funded by the Hessian Ministry for Science and Arts (HMWK). The goal of the project is the enhancement of education in Medical Schools by means of a flexible system. The flexibility of the system aims at self-studying, independently from space and time. MediBook is a system which provides tools for storing, managing and especially locating and combining learning resources. It offers means for both describing single sources (thereby putting them into a context) and combining single resources to courses. Thus MediBook represents a knowledge base with efficient access and tools to generate arbitrary coherent courses from single information units.

2. Knowledge Base

The basis of MediBook is a formal representation of the medical domain. The formal representation consists of the important medical concepts -- e.g. colon, kidney, bacterium -- which are associated with each other by semantic relations -- e.g. colon 'is_part_of' digestive system. For this formal representation we introduced the notion ConceptSpace. Information units -- in MediBook the notion MediaBrick is used -- are associated with concepts, whereby each MediaBrick is described by metadata. Furthermore MediaBricks are associated with each other by rhetorical-didactic relations in such a way as to put them into a context -- e.g. MediaBrick A 'deepens' MediaBrick B -- thus building the MediaBrickSpace. Since in MediBook we are dealing with educational content we use the Learning Objects Metadata (LOM) [1] for the description of the information units. Using this widespread IEEE proposal for a standardized description of "learning objects" other systems are able to access MediBook resources. MediBook is designed to deal with resources of different formats such as plain text, images, graphics, video, audio or animations which may contain information, theses, motivations, exercises, etc. Existing resources shall be integrated in order to support reuse of multimedia-elements which creation often is very expensive. The basic approach to describe MediaBricks on different levels -- LOM, rhetoric-didactic relations, associations with concepts -- is not limited to the medical domain. It can easily be applied to other knowledge domains by defining the concepts in the ConceptSpace and if necessary adaption of the set of semantic relations.

3. Scenario

In MediBook we define three roles which are supported:

- *Author*: The author is a physician and an expert in the medical domain to be modeled. The problem of building the knowledge base is divided into three sub tasks which are: generating the ConceptSpace, integrating the contents (MediaBricks in the MediaBrickSpace), and associating the MediaBricks with the corresponding concepts.
- *Teacher*: The teacher (physician) selects the MediaBricks which are relevant for his course and puts them into the appropriate order and structure. To achieve better coherence the teacher can create transitions between the single information units. In the process of navigating through the knowledge base the teacher is assisted by the system in such a way that the system is showing the relevant details adaptively according to the teacher's user profile.
- *Learner*: The learner can either follow the way proposed in a stored course or he can navigate through the knowledge base quite like a teacher can, though in a read-only modus. The view on the knowledge base is adapted by means of individual user profiles.

4. Outlook

Currently learners in the context of MediBook are students of Medical Schools but the system can easily be used for advanced education of physicians or as an information system e.g. for patients. Therefore only the knowledge base has to be extended with respect to content -- an extension of the system is not necessary.

In a further step of this project it would make sense to give the learner the possibility to annotate learning material, to define bookmarks or to work through interactive tests. Furthermore the automatic generation of lessons and courses by the system is desirable, particularly regarding a heterogeneous group of users. This necessitates extended user profiles and a rule-based system module which compares the profile entries with the MediaBricks metadata in order to select the relevant MediaBricks and present them as a course including a table of contents.

While the LOM-Editor [10] and the ConceptSpace-Editor described later in this paper are already implemented and the authors are working with the tools, the presentation generator is still work in progress.

5. Architecture

MediBook integrates the access to different information systems, managed at different locations. This scenario requires a broker oriented middleware, to combine the metadata descriptions of the physical resources with the formal representation of the specific domain. With this architecture users have a single point of access not only to different types of informations, but also to information which is managed and stored at different places. Figure 1 gives an overview of the MediBook architecture. Retrieval, tagging and composing requests from all clients are passed to the broker middleware which is responsible to select and query the appropriate database.

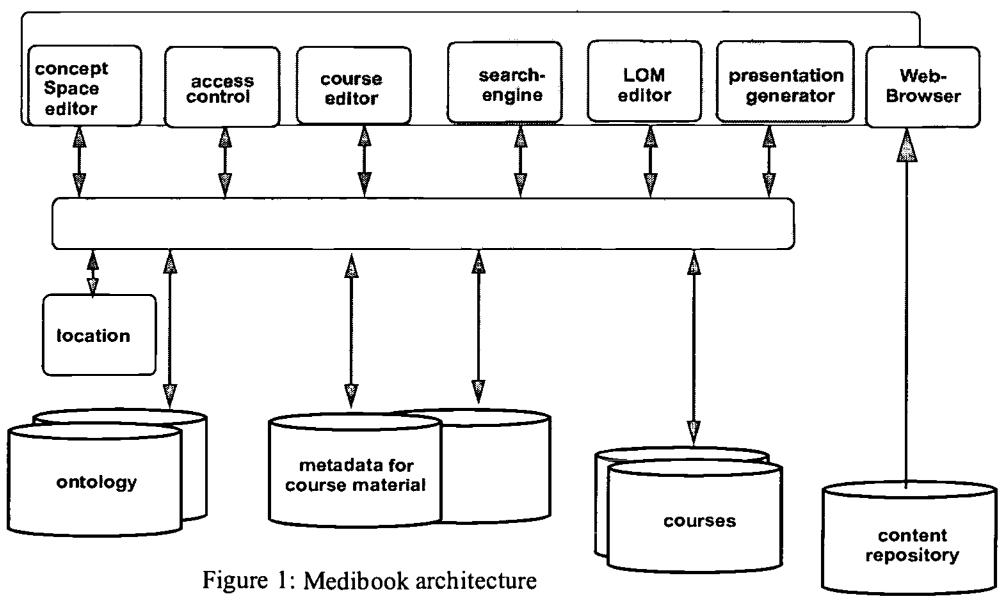

Figure 1: Medibook architecture

Access to the databases is realized by a query based architecture. In opposite to index based techniques, where full indices of the data managed by the different databases are exchanged, a query based system implies a more transparent global data management. The Open Archives Group [2] has specified a simple harvesting protocol to access arbitrary databases. The problem is, that this protocol is limited to a restricted set of metadata. In MediBook we are using the Learning Objects Metadata (LOM) from the IEEE to describe the learning resources and the courses. According to this set of metadata, we have defined a query protocol based on the LOM approach. To integrate a database which manages LOM descriptions the database is registered by sending a message to a central content location service. This announcement includes the kind of metadata the database is responsible for. The content location service is contacted from all retrieval services inside Medibook. Examining the request from the clients, the content location service is choosing the appropriate databases for executing the query. The service collects all the results from the different databases and sends them to the requesting client. Currently we are using the relational database Oracle 8i and the XML database Tamino to store the metadata. Therefore the protocol must be capable of mapping the requests from the clients to an SQL- and also to a XQL query. Regarding the fact, that there are already solutions available to map

between XML data structures and relational schemes [3], our query protocol is XML-based. The mapping is realized with the freely available JAVA-based framework Castor [11]. Based on a LOM-XML-DTD published by the IMS Consortium we have developed a LOM Working Draft 4.0 compliant DTD to describe a search request. The clients, described in the next chapters, are using an object model representing the LOM approach.
In addition to the integration of different databases, the MediBook middleware also has to implement the connection between the metadata and the semantic network. The Ontology Inference Layer (OIL) [12] is an approach to standardize the description and exchange of ontologies. However we are using a proprietary approach, the Smalltalk Frame Kit, to combine the different information, as there is an integrated development environment at hand. An integration of the ISO-Standard Topic Maps is not planned.
The amount of information which currently is available through the Web has lead to the development of different metadata standards like Dublin Core [13] for general resources, LOM or MPEG7 [14] which is used to describe multimedia resources. A crucial point for a widespread use of metadata standards is the question how the user has to deal with this amount of information. The problem with metadata information like LOM is mainly the accurateness and the amount of time a user has to invest to describe a resource. Although many of the LOM elements can be generated automatically, there is still a significant number of elements, where the user has to decide about the entries. In the area of semantic networks the situation is even worse. Building an ontology does not only require knowledge about the domain. Regarding the available tools a user also has to be an expert in computer science and data structures to build an ontology.
In the following chapters we want to describe two client tools we have developed for Medibook and we want to show how we deal with these problems in every tool. The next section will give an introduction and introduce the ConceptSpace-Editor which is used to build the ontology. The last tool will be the presentation generator. In this section we will describe how an on-line available course can be presented out of reusable modules described with LOM.

6. The ConceptSpace-Editor

Throughout the following section we focus on how the medical knowledge to be represented in MediBook can be modeled with our editing tool, the ConceptSpace-Editor. We give a brief survey on how the ConceptSpace- Editor works and which requirements it meets in the MediBook project. We are concerned with the logical layer of the ConceptSpace-Editor, which was implemented using the Smalltalk Frame Kit (SFK) [7]. Knowledge Representation in our system MediBook is based on an ontology. An ontology is (formal) conceptualisation of a (knowledge) domain [4]. From our point of view modeling special domains of knowledge always has to fulfill certain tasks. In consequence ontological design as a first step of ontology engineering already has to investigate the later use of the ontology [5]. In our case the ontology is a networked structure which allows browsing and navigating through medical termini. Moreover MediaBricks are attached to the medical knowledge which originally is independent from the media. A logical and consistent ontological design requires types of concepts to reflect the entities within the knowledge domain (i.e. medicine), relation types to model the relations between concepts, and axioms [Staab/Maedche]. Axioms supervise the process of knowledge modeling logically, they come into play while building conceptual and relational instances. For example we use inverse relations, which are automatically triggered, when a relation is drawn between two concepts. Another example is the maintenance of hierarchical relations. We have to formalize rules, which guarantee the establishment of a relation like 'diarrhea is caused by bacterium x' whenever we draw a relation 'bacterium x causes diarrhea'. If we order concepts hierarchically, we want to avoid relations like 'the skeleton is a part of the bones', if we already have the relation 'the bones are a functional part of the skeleton' [5].
The Smalltalk Frame Kit (SFK) is a high-level programming language, which enables us to create an ontological scheme, i.e. a data model for an ontology. Such a scheme contains types of concepts and relations and additionally axioms. It is filled with the actual domain specific concepts by a medical expert. Our approach tries to make this kind of work easier for the expert: he or she should focus on the actual concepts, their classification and relations, the 'weaving of a web' [7]. Formal logic, axiomatic definitions or implementation techniques are due to a software engineering process, which we keep apart from the knowledge engineering process. What we get is a division of labour: the ontology is designed by a software engineer, ontological contents are modeled graphically and intuitively by a medical expert, who relies on the SFK-procedures, which are invisible to him or her, but work as a solid background. Without any idea about implementation, the medical expert is able to use necessary axiomatic support. Of course the software engineer using the SFK and the expert have to keep in touch closely and to discuss, how the knowledge should be organized basically. In the MediBook project we elaborated four concept types: DiseaseOrSymptom, Cell, Substance, Aspects (other concepts). We minimized the number of concept types for the first version, because SFK,

embedded in the object-oriented Smalltalk environment, allows extensions of an ontological scheme rather than changes: we could re-import the instances already modeled by the expert into a more fine grained second version. This means that starting with a more abstract scheme may be followed by instantiating and evaluating it by the expert. This does not have to be followed by a loss of data when implementing a new model. The SFK works with and is based on frame classes. We describe them as semantic entities, which carry attributes called slots. The slots may be restricted concerning their range (defining which frame types are permitted for a slot) or cardinality (how many values might be attached to a slot), whereas other facets of the slots describe its relational properties: in our previous examples this means defining an inverse slot or adding acyclicity and the extinction of short cuts (direct relations to a superconcept if there are other superconcepts from the hierarchy in between). The SFK yields a rich archive of meth-

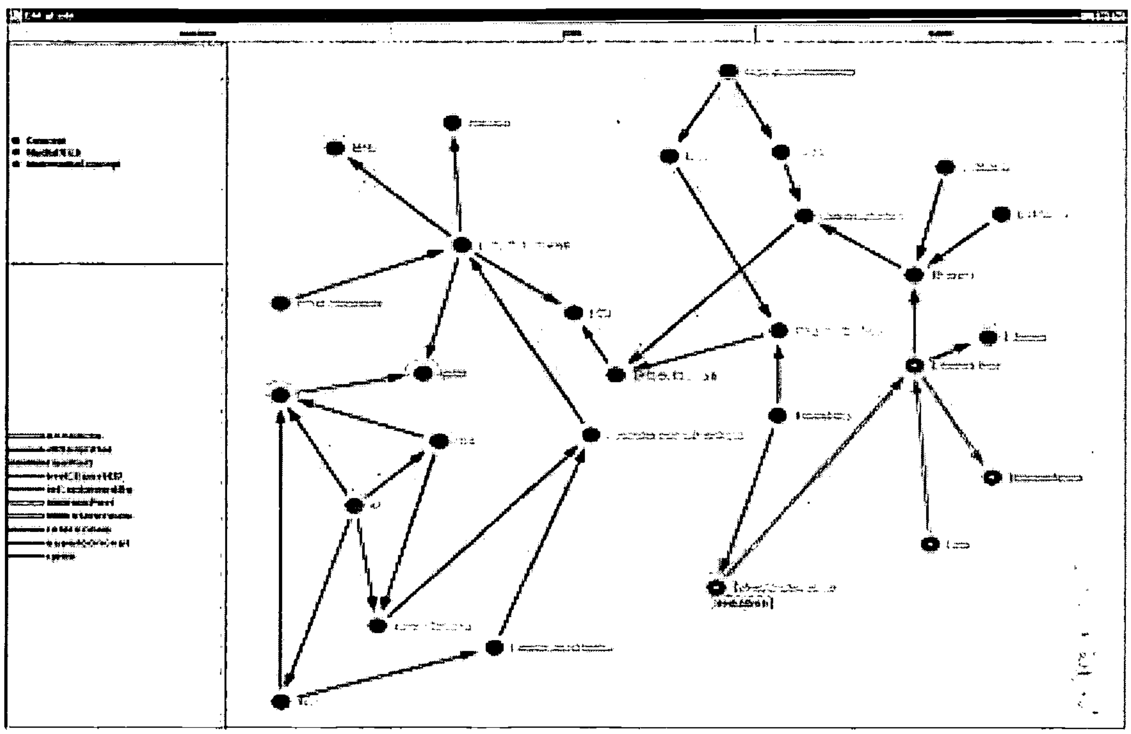

Figure 2: GUI of the ConceptSpace-Editor

ods, which compute additional frame instances and their slot values (or extinct or overwrite frame instances and their corresponding slot values). For example a transitive hull is computed in the background whenever a facet 'transitive' induces triggering new relations automatically. The features reflected by the relational property facets cover the systematic collection of axioms for ontologies described by [8]. An ontological scheme implemented with the SFK-support is a hierarchy of frame classes, which become interconnected by defining slots. This can be done either using SFK as a programming language (in our example: stating that is 'functional part of' is a 'hierarchy-relation-up-slot' in a model method before the classes from hierarchy is generated) or entering the classes from the hierarchy just created to assign 'acyclic' and 'no Short Cuts' to the slot corresponding to 'functional part of'. Inconsistencies like naming conflicts are identified by the system right after the installation of the class hierarchy as an ontological scheme.
The SFK continuously exports the state of the instanciation of a scheme. For this purpose it uses XML, which is the input for a Java client, which is able to visualize the export. On the other hand, all actions (creating a concept by selecting a node of one of the special concept types and naming it, deleting and renaming nodes, drawing or deleting a relation between two concepts) at the client side are sent via XML to the SFK. The SFK tests, if the actions are correct according to the scheme, if so the new state of the ontology is sent to the client, if not a warning is sent and a rollback takes place. This would be the case, if the skeleton would be indicated as a functional part of the bones after the relation 'the bones are a functional part of the skeleton' already had been created. The Java client is the medical

expert's tool, the SFK is the software developer's tool. Together with their XML-communication they form the ConceptSpace-Editor, which combines a visualization of arbitrary graphs with the logical checks necessary in ontology engineering.

7. Presentation Generator

The module named presentation generator generates presentations of the courses, which were produced with the course-editor (see Figure 1 for a detailed overview of the modules). The courses to be presented are composed of lessons, that are an enumeration with a fixed sequence of MediaBricks. Lessons are realized by a LOM object, that references all containing MediaBricks by their metadata objects with a *HasPart* relation. Vice-versa the referenced MediaBricks of a lesson references the lesson by *IsPartOf* relation. Both types of relations used to build lessons are part of the LOM specification. The tree-like structure of the courses, where leaves always contain MediaBricks, results in the possibility to refer to lessons as parts of lessons. This rule defines sublessons in lessons. Without this sublessons there would not be any possibility to compose MediaBricks to a complex structured learning resource like books or lectures. Figure 3a shows a part of a slightly abstracted structure of a course. It should explain the logical context of lessons and courses. The file-formats HTML and PDF are primarily suitable for the automatic generation of presentations of these courses. We assume a learning scenario with a learner working with the computer, but also another scenario, where the leaner uses a portable printed version of courses without any computer. From this, two in principle different requirements emerge for the presentations. That leads to two different solutions for the generation of presentations.
One of the advantages of HTML presentation is, that a learner can directly work through the course at the computer without any further software installation except a web browser. However the most important advantage with the generation of HTML pages is the probability to use continuous media, like sounds and videos, in the presentation. This shapes a multimedia presentation in the sense of [9]. In the presentation generation process the MediaBricks are composed to small units that correspond to HTML files. Working through the course and locating the relevant learning resources should be simplified by it. Figure 3b shows an example for the presentation of the course in HTML files.

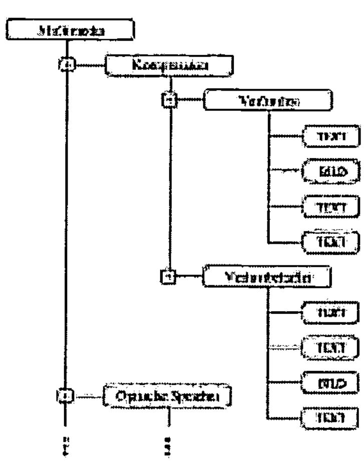

Figure 3a: Course structure

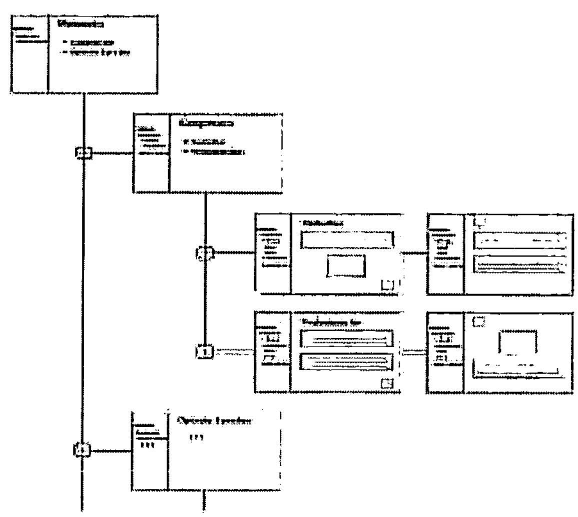

Figure 3b: HTML-Version of the course

The presentation of the MediaBricks assigned to a course as a PDF file is predestinated for print outs, but can also be viewed easily and comfortably at the computer. However the course representations as PDF files is mainly suitable for printing them on paper. For this reason, the presentation of the courses is restricted to MediaBricks with static content, like texts and pictures. Unlike HTML presentations in the presentation of the course as a PDF file the MediaBricks are not composed to small units. Rather the MediaBricks have to take a linear order, in which they are printed sequentially in the PDF file. The proper order of the MediaBricks results in a pre-order traversal of the course tree. However before a presentation is generated by the presentation generator a description of the course is generated.

This description can be stored as an XML file to speed up later generations of presentations. Together with the path within the course, that points to the lesson from which a presentation should be generated, and the XSL stylesheet that should be used for the generation of the presentation, the presentation can be generated automatically from this description. There is no difference in generating PDF presentations of courses when distributing them over the web or storing them on CD-ROM, but there is a slight difference in generating presentations of courses in HTML files because of the storage and access to the file. While all resources of HTML presentations, that are distributed over the web, may be accessed via web servers, all resources of a local presentation on a CD-ROM have to be stored on this CD-ROM. Therefore there have to be different HTML files with different links in the presentations depending of the way the courses are distribution or stored. Additionally to an HTML presentation of a course the structure of the course is displayed as a table of contents. This table of contents is presented by a JAVA Applet and should support the learners in the navigation through the course and give them the opportunity to get an overview of the course. The lesson actually shown is always highlighted in the table of contents to ensure that the learners do not lose track of the course by the well-known lost in hyperspace syndrome.

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Concept mapping as a collaborative activity: Using concept mapping software in a distributed learning environment

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Abstract: As part of an ongoing study into distributed learning environments, this paper examines the effects of concept mapping software when used as a collaborative learning tool. Preliminary findings are explored in relation to pre-service teachers' endeavour to distribute their learning collaboratively while working with the software in small groups.

Collaboration and concept mapping

Collaboration is seen as an important element of a distributed learning environments. Many designers of software design for the isolated and individual learner, and many programs reflect the belief that the interactions will be made by a single user. Group use of computers does not guarantee collaboration (Hooper, 1992). Katz and Lesgold (1993) point out that collaboration is more than cooperation: 'Cooperation ... involves a division of labour in achieving a task. Collaboration happens synchronously; cooperation is either synchronous or asynchronous' (p. 289). It is through discussion with others that students are able to negotiate the meaning of a concept by questioning existing understandings as well as explaining, evaluating and clarifying new and developing understandings. This process can be likened to a scaffold where the teacher and more capable peers support students as they work within their zone of proximal development (Vygotsky, 1978). Forman and Cazden suggest that true collaboration is not simply working together but also 'solving a problem or creating a product which could not have been completed independently' (cited in Repman, Weller, & Lan, 1993, p. 286). A number of researchers have explored how concept maps can be used as collaborative tools (e.g., Van Boxtel, Van Der Linden, & Kanselaar, 1997). Concept maps can be used in a variety of educational contexts and for many purposes such as: addressing students' misconceptions, assessing learning, determining prior knowledge, reducing anxiety in low ability students, and designing instructional materials (Jonassen, Reeves, Hong, Harvey, & Peters, 1997; Kennedy, & McNaught, 1997). In many of these settings, concept maps are used by individuals, or by a single student with a teacher, to delve more deeply into the student's understanding. However, when used as collaborative tools, they appear to promise far greater learning returns.

The study

Broadly, this study explored the implementation of computers as cognitive tools in an environment that acknowledged the distributed and shared nature of learning. In keeping with the view that learning is enhanced if it is distributed across a variety of sources found within the learning environment, students were encouraged to exploit their own intellectual resources (e.g., prior knowledge, metacognitive knowledge), physical resources (e.g., computers, journals) symbolic resources (e.g., diagrams, tables) and social resources (e.g., the teacher, peers). This paper focuses on the distribution of learning that occurred when the social resources were maximised in conjunction with the computer. In particular, it describes the preliminary findings that emerged when small groups of preservice teachers collaborated around the visual concept mapping tool *Inspiration* (Helfgott & Westhaver, 1997) in a graduate unit which examined cognitive theories of learning.

Students undertook weekly tutorials in groups of three, collaborating around the computer, with the computer and through the computer (Crook, 1996). For example, as part of the module exploring a categorisation of learning strategies, the groups were invited to critique their own lesson plans or videotaped lessons to identify the different types of learning strategies they typically encourage in their classes. Each group negotiated the existence of strategies in their lessons, which were subsequently built into an ongoing map for this topic. The evident imbalance in the maps enabled the students to realise that teachers often place greater emphasis on cognitive learning strategies to the detriment of metacognitive and resource management strategies. These maps became the starting point for subsequent topics which encouraged students to make links between concepts and build a solid profile of an effective learner. While working on these sorts of tasks, four groups of students were audio-taped on three occasions. These students were also individually interviewed and kept self-reflective journals in which they recorded thoughts about their learning as it unfolded over the semester. This data was transcribed and imported into NUD.IST (Qualitative Solutions & Research, 1997) for analysis.

Preliminary observations

From day one, the computers served as motivational tools that engaged the students in activity and discourse. A preliminary examination of the data generated in this situation has seen the emergence of several themes:

Negotiation of meaning: This was clearly evident in the students' discourse where discussions often revolved around the formation of consensus in relation to the addition of a new concept or the linking of one concept to another. This negotiation process was unique to each group.

Metacognition: The visual representation of material encouraged the students to not only articulate their thoughts, but to reflect upon them in a metacognitive way. As a group, they often monitored their progress, evaluating and proceeding accordingly.

Cooperation vs: collaboration: There was no 'division of labour' in an attempt to work cooperatively rather than collaboratively, and concept maps were created synchronously rather than asynchronously. Students enjoyed collaborating and welcomed the opportunity to pool interpretations in an effort to understand concepts.

Group dynamics: The groups observed remained focused on the tasks and consistently engaged in the process. While group dynamics were certainly more productive in some groups than others, it was rare to find a non-contributor to the process. Students provided scaffolding for each other's developing understanding of concepts.

Visual learning: One of the strongest findings was the students' high regard for the visual representation of the subject matter. Throughout the tasks, in the interviews and journals, students noted that being able to picture the formation of their understandings provided them with a solid, meaningful record for later study and as a springboard for the development of subsequent topics. Most students said they would probably continue to create concepts maps in their future studies even if *Inspiration* was not available.

Limitations of software: As the maps grew in size, however, students were frustrated that they could only view one or two sections at a time. The outline view, which is a text version of the nodes, did not reflect the links between concepts as the students interpreted them. The outline view, therefore, was not an accurate summary of the interrelationships between concepts and could not be used as a point of reference for later study.

Conclusions and further study

In keeping with Vygotsky's (1978) contention that all mental functions have social origins and occur between individuals before they become internalised within the individual, this study capitalised on the potential offered by collaborative group learning. The mental functions that occurred within these groups were mediated by the use of *Inspiration* software, which is also aligned with Vygotsky's belief that individuals act through tools in their environment to gain greater control over their world. In this regard, the classroom resembled a learning community where the construction of knowledge was shared and distributed across a variety of resources. Further analysis of data will focus on the exploration of more data-driven themes and patterns, and will investigate other issues, such as the quality of the concept maps produced by the students, the influence of the electronic setting, and the students' discourse associated with actions such as revision and the creation of nodes and links.

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The Development of Pedagogy for TeleLearning Within Knowledge-Building Communities

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Abstract: In the development of a knowledge society in the Canadian province of Newfoundland and Labrador, selected rural high schools are collaborating in new ways. An on-line Digital Intranet facilitates collaborative approaches to teaching, learning and the building of new knowledge. This paper examines the role of synchronous and asynchronous instruction and symmetrical and asymmetrical knowledge advancement in the development of pedagogy appropriate to this new educational environment.

Five years ago Betty Collis (1996) noted that telelearning is the future of distance learning. This paper supports her claim based on current research in rural Canadian school districts in which schools have been brought into new relationships with one another. The academic and administrative interfacing of dispersed classes as sites within electronic teaching and learning networks challenges the institutional autonomy of traditional schools. As teleteaching and telelearning are integrated into the life of classrooms and as more schools link with one another to enable virtual classes to construct and deconstruct, new ways of teaching, organizing learning opportunities and managing increasingly complex multi-media classrooms have to be considered. The development of virtual classes to include areas of the curriculum not previously available in rural communities has provided new pathways for learners and created a need to develop new pedagogy for teachers to facilitate the interaction of on-line and face to face teaching.

Pedagogy for TeleLearning

Teaching in classrooms that are electronically linked to other sites requires different lesson preparation and delivery skills from teaching face to face. For teacher – student interaction in a new electronic educational structure to be effective, the strengths and weaknesses of the new environment have to be understood by those who participate within them. Students often have more independence in managing their learning in open electronic classes but most have to be assisted by teachers in the setting of goals, the meeting of deadlines and in evaluating their progress (Stevens, 1999). Teachers are effective in open electronic classes if they can be flexible in ways that they allow students to participate in on-line lessons. Strategies and protocols for on-line teaching have to be developed between participating schools if all students are to be able to fully participate (Stevens, 2000). The introduction of a rural school to an open electronic network considerably improves its resource base for both teachers and learners although it is often difficult to coordinate timetables between sites to enable synchronous instruction to take place. A considerable measure of inter-institutional and intra-institutional cooperation is required for effective collaboration.

This research focuses on synchronous and asynchronous teaching and learning and the development of symmetric and asymmetric knowledge advancement in virtual classes. From this matrix, preliminary evidence of "student types" in knowledge-building communities are being explored.

Knowledge-Building Communities

The relationship between synchronous and asynchronous instruction in a digital Intranet and symmetrical and asymmetrical knowledge advancement is shown in the following matrix. From this relationship four types of knowledge-building can be identified.

	Synchronous Instruction	Asynchronous Instruction
Symmetrical Knowledge Advances	Type One	Type Two
Asymmetrical Knowledge Advances	Type Three	Type Four

Type 1: Symmetric Knowledge Building in a Synchronous Learning Environment
(Students primarily learning from other students simultaneously)

Type 2: Symmetric Knowledge Building in an Asynchronous Learning Environment
(Students primarily learning from other students in delayed time)

Type 3: Asymmetric Knowledge Building in a Synchronous Learning Environment
(Students primarily taking instruction from the teacher, simultaneously)

Type 4: Asymmetric Knowledge Building in an Asynchronous Learning Environment.
(Students primarily taking instruction from the teacher in delayed time).

This research can be considered in micro and macro terms as part of the preparation of Canadian students for a digital world (Information Highway Advisory Council, 1997). At the micro level pedagogical issues of the balance between synchronous and asynchronous teaching in digital intranets require teachers to evaluate the role of each mode of instruction in assisting students to build knowledge. At the macro level the policy issue of academically and administratively linking schools across dispersed sites has produced new educational structures that complement traditional schools. Teachers appointed to schools have been teaching across networks of interacting sites. There are resource as well as labour issues to be considered in the proliferation of this dimension of telelearning. Since the initial digital Intranet was created in Newfoundland and Labrador, other intranets in the province have been created and links between them are currently being extended. In the new telelearning environment schools are becoming sites within teaching and learning networks and teachers are being encouraged to collaborate between schools in ways that were not considered in the past. The next challenge is to adequately prepare teachers for life in virtual and collaborative environments as well as for traditional, face to face classrooms.

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Expectations Of Technology For Learning Communities

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This theory paper analyses the role of technology in creating a space for shared knowledge and facilitating knowledge sharing in learning communities. All organizations need to be knowledge organizations managing knowledge across individual, group and organizational levels, and hence be learning communities.

A SYSTEM APPROACH TO MANAGE EDUCATIONAL CHANGE IN A WEB-BASED EDUCATIONAL SETTING
A PROPOSED INFRASTRUCTURE
by

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Abstract

Technology and educational changes force educational systems to modify their infrastructure to offer new teaching services to the learning community. The aim of this research paper is to present an infrastructure from a broader systems perspective that help educators understand the relationship between a web educational system and its environment. The outcomes of such an analysis should allow the readers of this research paper to assess the impact of the various supra-systems and sub-systems on a web educational learning environment. Furthermore, the results of the analysis should facilitate the identification of the particular functions of a web educational system.

Introduction

Educational institutions like other organizations in our society are faced with ineluctable changes brought on by new communication technologies. Various web educational models are developed and implemented to meet new demands in education and to survive in a highly competitive educational world. According to Salisbury (1996), transformational change can only be achieved when a systems view is applied appropriately to the specific institutional context and the interrelatedness of the various sub-systems is fully understood.

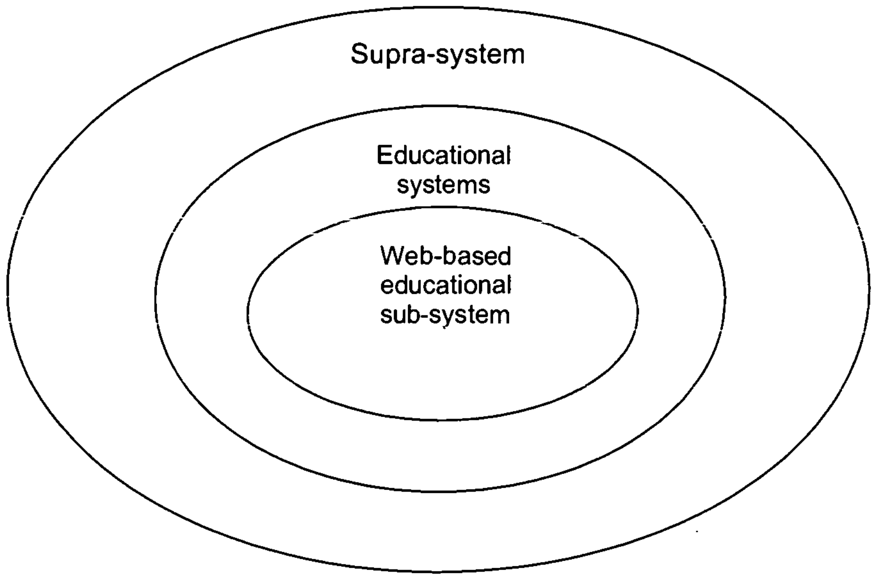
The conceptual frameworks provided by the writings of Salisbury (1996), Banathy (1992), and Moore and Kearsley (1996) allow the author of this article to examine a web-based educational setting from a systems point of view. The aim of this paper is to present a conceptual infrastructure, using a system approach, to describe the components of a web educational system that are affected by changes in the environment such as technology.

Educational Environment as a Supra-System

In education, the concept supra-system could be defined as an integrated framework that includes all the different education bodies and agencies seen as sub-systems. A system is an integrated entity that is focused on a set of objectives. Most systems accept inputs and transform them into outputs. The different sub-systems of a larger system can be perceived as environments with distinctive boundaries and at the same time multiple interrelationships. Each sub-system can be viewed as part of several supra-systems such as educational, technological, and economic, namely. Figure 1 shows the relationship between a web-based educational sub-system and the supra-system.

A closer look at a web-based educational environment reveals its elements generally identified as learners, instructional resources, behavioral objectives, goals of instruction, etc. (Salisbury, 1996). These new web educational system must present a system of instruction that provides for easy registration, access to relevant content, and the means to self-assess one's progress. This is accomplished primarily as the result of the Internet communication tools.

Figure 1 A Web-Based Educational Setting and the Supra-system

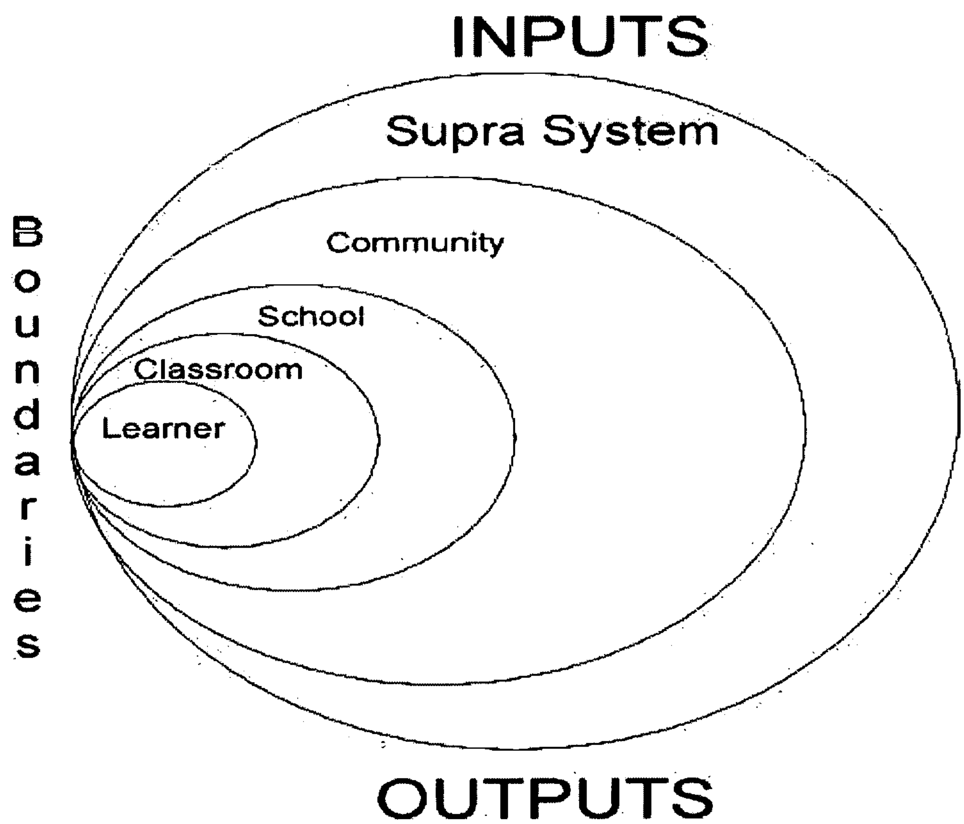


The emergence of these new technologies has forced many teachers to review their traditional perceptions of their roles in the teaching process and to engage themselves in a learning process that addresses the gap between their actual and expected technological competence. The fact that this gap also exists within society in general is another reason why educational organizations need to address this problem and enable their students to better cope with this new reality. Traditionally, educational institutions have seen themselves as a relatively closed environment. However, by analyzing how business organizations have reacted to changes within the supra-system, they have created inter-organizational systems to be able to survive and grow in a highly competitive environment.

Systemic Environment and Systems Boundaries

Figure 1 illustrates the relationship between the supra-system and its components, the sub-systems: learning community, schools system, classroom, and the learner. Figure 1 tries to represent the embeddedness of the learner within his/her educational environment. This diagram helps the web learning system designer to understand which components have to be taken into consideration if the web educational system is going to reach its intended goals.

Figure 1 The interfaces in an educational setting and its relationship with the Educational Supra-system



When assessing the design of a web teaching system, the owner of the system has to determine whether the educational model has actually attained the goals it set out to reach. The system and its environment are separated by permeable boundaries. Inputs enter in the system through breaks on the boundaries and are then transformed into outputs. Another important aspect is the capacity of the system to adapt to change, i.e. to transform feedback from all stakeholders into the appropriate adjustments to the system itself.

The first consideration in the analysis of the various inputs from the educational environment is how the mission and goals of the organization are related to the instructional delivery. The mission should be closely aligned with the goals of the web-based educational system. The Functions/Structure lens (Banathy, 1992) allows to see the educational system at a given moment in time. It is a snapshot of what is happening in an educational program. Did the educational system, for example, begin with a careful formulation of the goals and missions of education and then work backwards from there to create alternative visions of systems that might be designed to perform the functions necessary to accomplish that purpose (Salisbury, 1996)?

The rising popularity of the Internet forces traditional educational institutions to offer new services to educators and learners. Rising education costs, emerging opportunities for new revenues for colleges and universities, and better services to students will compel these institutions to adopt an e-business strategy (Katz and Oblinger, 2000). Virtual and modern educational settings will emerge in this educational network infrastructure where educators and learners will expect a better educational product from the supra-system. Colleges and universities will have to reengineer their educational processes to adapt to new learners demands. Culture and change could be important factors to manage properly in order to assure educational growth in the supra-system. They are more complicated to implement than technology. E-business technologies and media will provide improved and expedited benefits, increased process efficiencies, and competitive training to lifelong learning.

According to Moore and Kearsley (1996), typical components that constitute inputs in a web education system are students' characteristics, students' access to resources, response time, and institutional cooperation and support, etc. Instructional design should therefore start out with a thorough needs analysis of the potential learners, provide access to the appropriate technologies, and continually update the content and technologies used to deliver the instructional materials to the learners. In her book on creating a virtual classroom, Porter (1997) outlines criteria for determining the effect of instructional design and the kind of processes needed to make sure that inputs will result in effective outputs. For example, student characteristics, computer interaction, learning style, involvement, and participation should be part of the inputs the design team would have to consider before determining the instructional strategies of the educational program.

From a systems view, outputs can be viewed as functions of the system that achieve their purpose. Evidence of output functions that correlate with the statement of the intended learning goals will be investigated in order to determine whether the outputs actually relate to the inputs. Moore and Kearsley (1996) list several 'output' components in education systems that provide valuable information of the overall effectiveness of the system, e.g. student satisfaction ratings, student achievement scores, and completion rates. The question that the stakeholders of the educational system should ask: is the web-based educational system doing what it was intended to do? The learning should be structured in such a way that it delivers skill-based instruction in various processes to enhance learning outcomes.

Training programs and professional programs are essential to help teachers learn basic skills necessary to develop sound and effective web-based teaching systems (St-Pierre, 1999). If the educational organization realizes that, after all, the training participants do not put into practice the skills introduced in the training program, there should be an adjustment or adaptation in the system process with respect to the originally intended skills or knowledge (Salisbury, 1996). A thorough evaluation of output, i.e. what results from the transformation of input during the learning process, is obviously important to determine the overall effect of the training. The development of the appropriate strategies and tools to close the gaps between the current performance level of the training participant and the expected performance level should be the major focus in the development of any training necessary to promote learning outcomes in a web educational setting (Brethower, 1995).

The stakeholders of a web-based educational system, living in a supra-system, must identify instructional inputs and outputs from a traditional teaching perspective to transform them into a modern web teaching setting where new technology can help to design new instructional tools and media to promote learning outcomes. While the selection of new media allows for some learner control and also takes learner motivation into account, the instructional design has to expand outside its established boundaries and exploit deeper situational learning concepts that could be developed from a wider systems view. For example, a collaborative virtual learning community could be created through its web-based educational system to exchange ideas, knowledge and teaching products with its environment. St-Pierre, Bettin, Dillinger, and Ferraro (1999) present in their paper the components that an integrated community learning system should have while offering educational services to learners on the Internet.

Functions/Structure Analysis for a Web-Educational Sub-system

The main goal of this section is to describe briefly the functions/structure model for a web educational system as shown in Figure 3. This web educational system includes at least six main functions that are integrated to help educators develop web instructional models to promote learning outcomes.

Web Registration Function

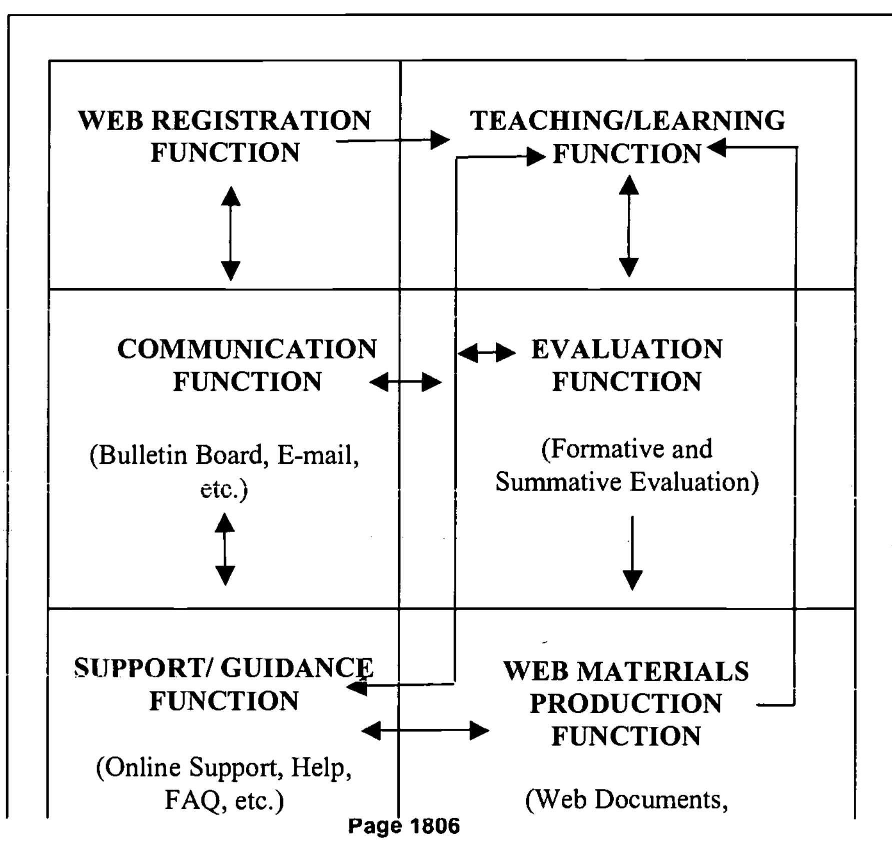
Anyone who intends to take a course has to register by filling out a web-based registration form. The data entered in the registration function are processed through CGI-technology specifications and recorded into a database. The sub-system will produce a form displaying the UserID and the password required for accessing the teaching/learning component of the educational sub-system. There is a direct relationship between the registration and the teaching/learning components of the web educational system.

Teaching/Learning Function

The teaching/learning function includes learning modules that the student can choose from. The web learning modules, divided into numerous short lessons, provide contents that help the participants acquire the basic knowledge and develop technical skills. After having completed the learning modules, the participants may use the communication media to correspond with tutors and other participants or move on to the evaluation function. There is a direct relationship between the communication process and the teaching/learning function.

When computers are connected through the Internet, web media provide appropriate means for communicating and delivering instructional materials (Zellner, 1997). Well-designed web-based instruction provides an efficient delivery medium for the instructor and attractive course content delivery for the students in the classroom (St-Pierre, 1999). In addition, mediated forms of delivery using the web make it easy to update dynamic, constantly changing information; a very important aspect for a course that introduces to rapidly changing web.

Figure 3 Functions/Structure Model for a Web educational Sub-system



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Evaluation Function

Within each lesson, the learners have the opportunity to complete the so-called "Try it" exercises. They have to use basic concepts, knowledge, and skills acquired from the teaching/learning function to be able to solve problems presented in these exercises. The participants can work on these exercises on-line or off-line. The evaluation function will monitor the lessons and exercises throughout the teaching process at different points in time. Every time the participants return to the web educational learning model, the Lesson Status page could display a report showing their progress and suggests which lessons to work on next. Also, at the end of each lesson, the participants may complete an evaluation form if they wish to give feedback to the teacher on the course content or other topics of concern to them. There is a direct relationship between the teaching/learning function and the evaluation function.

Communication Function

During the learning process, the participants can use web media such as E-mail and the bulletin board to communicate in an asynchronous manner with other participants. At any time during the learning process, the participants can create a conference room with the tutors to obtain explanations on concepts or skills presented in the teaching modules. There is a direct relationship between the communication function and the major components of the web educational system, such as web registration, teaching, evaluation, and support functions.

Support Function

The participant can click on the Help icon to access a list of FAQ that will answer questions about online procedures, navigational cues, or curriculum issues. Also, the participant may send an E-mail message to a tutor and will (allegedly) receive a quick response within 48 hours. There is a direct relationship between the support function and the teaching/learning function.

Web Materials Production Function

The teaching/learning model uses a web platform to deliver curriculum and instruction. This platform is easy to maintain and can be accessed by a large population of educators and learners.

The participant can display and/or print the web training contents in an HTML or Adobe format. There is a direct relationship between the web materials production and the teaching/learning function.

In conclusion, the analysis of the different functions of the web educational sub-system show that these functions are indeed all interrelated as suggested in Banathy's Functions/Structure model. The web instructional teaching system has to be well designed from a technical point of view and present good design features (interface design, navigation, progress report, etc.) to motivate the potential participant to register and engage into an effective learning process.

Conclusion

The analysis of the systems environment, the functions/structure components of the web educational sub-system, and the processes involved in the transformation of inputs into the intended outputs brought to light the complexity of managing changes in a intricate educational system living in its supra-system (environment). This experience also underscores the necessity to look at change processes as an ongoing endeavor that continually attempts to improve the system's capacity (web-based model) to adapt its goals to the changes in the environment.

The continuous progress of technology will have direct consequences on the educational setting that will have to be revised repeatedly. In addition, new teacher generations will no longer need basic Internet training because they will have already used the web extensively at home and in school. In addition, effective feedback systems should be implemented in educational settings to provide relevant information for the necessary adjustments of the system. Furthermore, educational changes should take place on a continuous basis to develop a competitive educational system in an open educational supra-system where major technological changes threats its survival.

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The Formative Evaluation of a Computer-Managed Instruction Module: Metric Instruction for Pre-Service Elementary Teachers

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Abstract: A Computer-Managed Metric Instruction Program (CMIP) providing instructional units on basic metric concepts has been developed. A blending of Gagné, et al. (1992) and the developmental theories of Bruner (1966) provides the pedagogical basis for the instructional design. The instructional design model used to create each lesson utilizes a system of "branches" allowing a student who has difficulty with a specific lesson to be routed to appropriate remedial exercises. Results indicate that the use of concrete materials adds a learning dimension to those students who need a transition between the "hands-on" learning modality and the more abstract learning module presented in the CMIP.

Introduction

One of the new facets of the elementary science methods program at Idaho State University is the increase in the science and mathematics general education requirements. These additional science and mathematics requirements were spawned by a survey that indicated a serious deficiency in the science content knowledge of elementary school teachers (Strickland & Horejsi, 1999).

One alarming feature found in the analysis of the survey data was the apparent lack of knowledge and understanding of the metric system within teacher work samples. A parallel survey was conducted of pre-service elementary students and the results were similar: Lack of science content knowledge and, of particular interest for this research, a serious lack of knowledge of the metric system. Two decades ago, Strickland (1980) reported a similar lack of science and metric system knowledge among pre-service teachers at Indiana University.

The solution at Indiana University was a computer-managed program using the PLATO computer-learning system. After using PLATO for five weeks (i.e., five 3-hour sessions on the system), the metric performance among pre-service elementary teachers increased by 86%, and there was a corresponding change in science content knowledge and science teaching in the elementary school classroom. Apparently, as evidenced by the survey data referred to earlier (Strickland & Horejsi, 1999), the issue of science and metric illiteracy has resurfaced.

Idaho State University has embarked on a much larger research effort focusing on the design and development of a Computer-Managed Metric Instruction Program (CMIP). The CMIP software comprises instructional units providing basic metric concepts for each of the following measures: Length, area, volume, mass, force, and temperature. Uniquely, this instructional package consistently uses a pedagogical model based on the behaviorist views of Gagné (1962, 1968, 1970), and Gagné, Briggs, and Wager (1992). While each of these theorists offers the premise that correct sequencing of conceptual knowledge in conjunction with a mastery approach leads to meaningful learning by the student, the design team for CMIP felt the most effective sequencing model would be a blending of Gagné, et al. (1992) and the developmental theories of Bruner (1967). Bruner (1967) stresses that the effective use of information is found only when the learner has successfully translated the information into a form the learner normally uses in problem solving. Without this translation, according to Bruner, "Though it is logically usable, it is psychologically useless" (p. 53). To this end Bruner has applied a multi-branching model to learning. This model is incorporated into the metric instructional units discussed in this research.

Additionally, Rodrigues (2000) highlighted several fundamental differences between behaviorist and constructivist views as they impact multimedia development. These views are expressed in the following excerpt:

> Some of the strengths of behaviorist tutorials – for example, repeat practice, reinforcement, and control – are almost the opposite to goals advocated by constructivist philosophies (Heinich, 1984), where the notions of reflection, active construction, personal relevance, and autonomy (Lebow, 1993) are considered crucial constructivist learning facets. (p.1)

The instructional design model used to create each metric lesson utilizes a system of "branches" (as opposed to linear programmed learning). For example, a student who has difficulty with a specific lesson, or who shows deficiencies in command of a subject (identified by pretest results), can be routed to a review section or to remedial exercises, meanwhile all other students progress through increasingly more difficult exercises. Thus, the system is simultaneously a "Tutor, Tool and Tutee" (Taylor, 1980). As a result, this research concentrated on the design and development of the metric area module as the first module of the entire metric system course (and to act as a prototype for the remainder of the modules).

This selection, based on metric pretest data (see Table 1), indicated a serious deficiency among the students' ability to perform calculations in determining area (mean score = 4.620) and volume (mean score = 4.440).

Section		# questions	N	Mean	SD
Length	1	15	56	7.425	1.84
Area	2	15	56	4.620	2.30
Volume	3	15	56	4.440	1.77
Mass	4	9	56	3.717	0.98
Force	5	8	56	2.200	0.83
Temperature	6	8	56	2.680	0.68
Total		70	56	26.65	1.56

Table 1: Metric Unit Pre-Test Data

Metric area was selected instead of metric volume since the skills and concepts needed for the volume module were subsumed by the area module.The wide variation (SD = 2.30) in score on the metric area was an additional rationale for selecting this module to be first.

Computer-Managed Metric Instruction Package (CMIP): Unit Design

The CMIP software package (Fig. 1), has four primary elements; (1) the introduction to metrics module, (2) the pretest and skill assessment module, (3) the metric instructional module, and (4) the posttest and analysis of results module.

The introduction to metrics module is composed of an overview of the CMIP metric instruction. The student is guided through an array of examples which depict the metric system being used to measure length, area, volume, mass, force, and temperature.

The pretest and skill assessment module is designed to access the students preknowledge of the metric system, rudimentary mathematics skills and selected learner aptitudes.

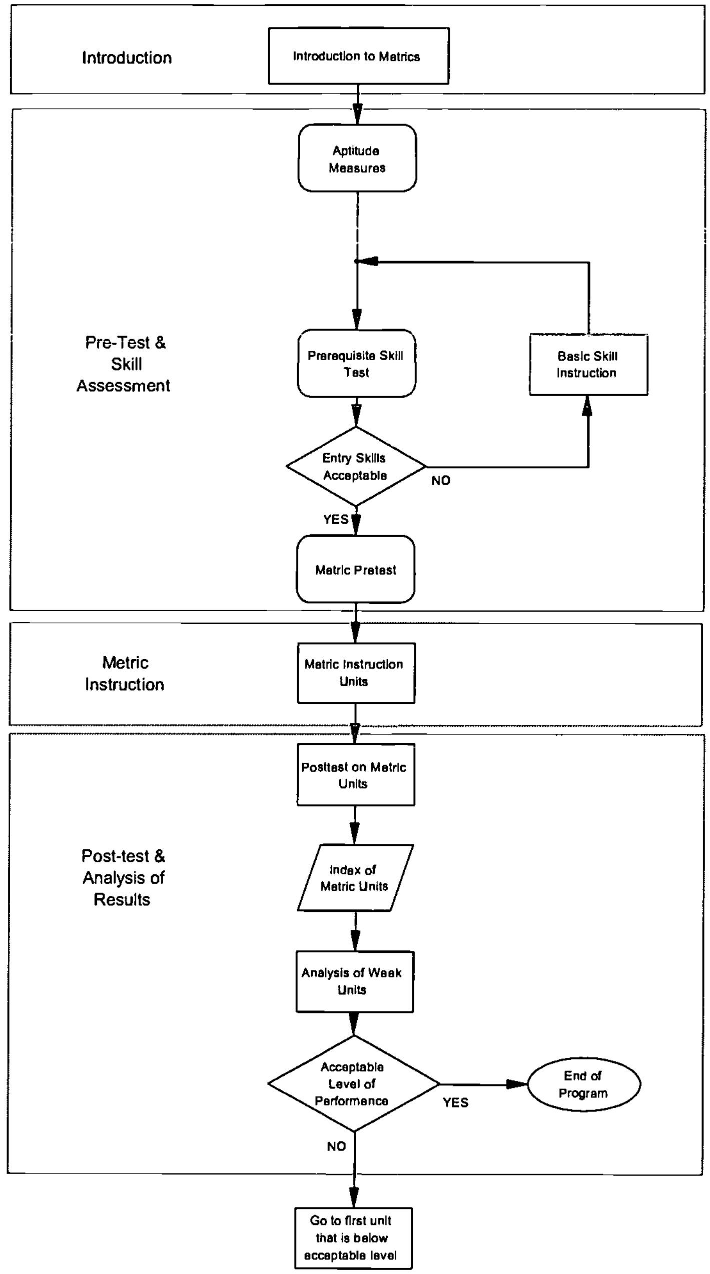

Figure 1: Computer-Managed Metric Instruction Package (CMIP) flow chart outlining the elements of the metric instruction. If the student does not meet acceptable level of performance they are returned to the first unit that was below the acceptable level.

The metric instructional module consists of six metric instructional units (Fig. 2): Length, area, volume, mass, force, and temperature. Each unit describes the basic unit of measurement and explores units, which are smaller and larger than the base units.

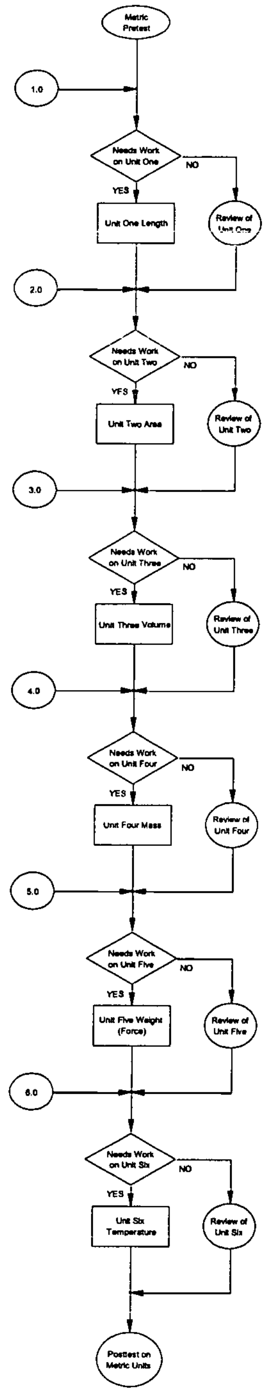

Figure 2: Expanded flow chart of the Metric Instructional Module of CMIP. The Metric Instruction Module uses data from the pre-test module to determine the appropriate lessons for the student.

The posttest and analysis of results module is designed to measure the performance level of each student. If the performance level is acceptable then the student passes the metric course, if weakness (low performance) exists in any unit the student is guided back through that unit until an acceptable performance level is reached.

Formative Evaluation of the Metric Area Module

The metric area unit consisted of four segments (Fig. 3): (1) An introduction to the module, (2) the base unit module (square meters), (3) three modules with measurements smaller than the base unit (square decimeters, square centimeters, and square millimeters), and (4) one module with measurements larger than the base unit (square kilometers).

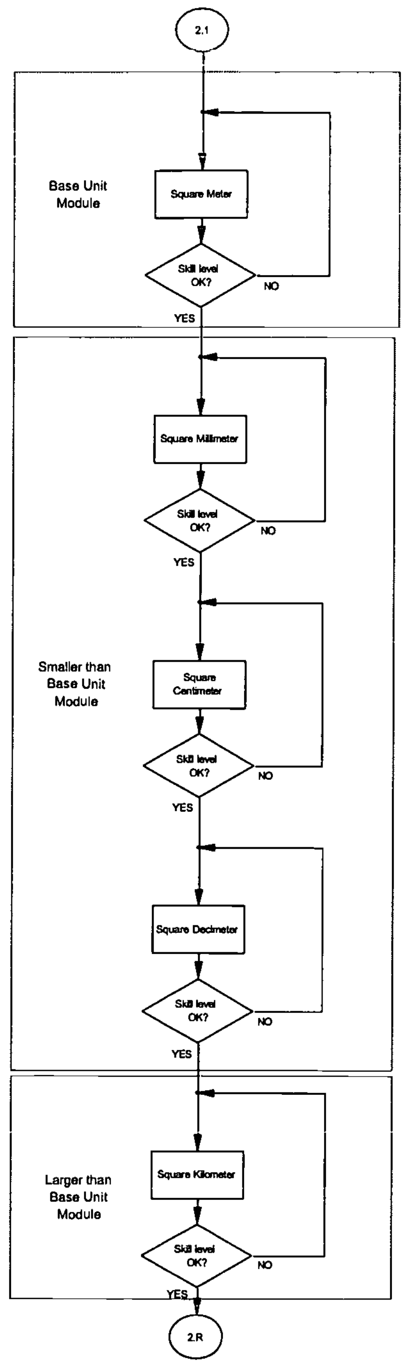

Figure 3: Metric Area Unit flow chart. After a brief introduction (2.1) the unit begins with the base unit of area and ends in a review and post-test (2.R) of the area unit.

The pre-test data for the metric area module consisted of 15 questions, 3 each on the following square unit segments: Kilometer, meter, decimeter, centimeter, and millimeter. The mean of the square kilometer was lowest ($X = .20$, $SD = .09$; out of 3); thus, this module was selected to be the initial module segment to be tested. The square kilometer segment (Fig. 2) consisted of several large regular shaped objects (scaled to fit on a standard monitor), such as New York's Central Park. Central Park is rectangular in shape and made a good first example of the area calculations for large objects. After several similar examples, the instruction moved forward to irregular shaped large objects, such as a large reservoir in the geographical area. A scaled one-square kilometer area was used with the technique of summing whole and partial grid squares. The instruction produced a significant change in the performance on the module segment ($X = 1.35$, $SD = .57$; out of 3).

Summary

The analysis of the data collected during pilot test of the Metric Area module: Square Kilometer segment was critical in determining alterations needed to this module segment and additional components. This data analysis has shaped the instructional process for each of the remaining modules. While observing the students participating in the computer-managed module segment on square kilometers, it became apparent that each module must be constructed with some use of a manipulative, as well as the computer software. Apparently, the use of concrete materials adds a learning dimension to those students who need a transition between the "hands-on" learning modality and the more abstract learning module presented in the computer software.

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Creating A Web-based Graduate Core Course in Technology for International English Speaking Students

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Abstract: A doctoral level Instructional Technology course was delivered to 48 Taiwanese students in their country via WebCT. This was the first course developed by our College for complete on-line delivery and the first one taken by many of the students. The design consisted of 7 components and engaged U.S. doctoral students from an Instructional Technology cohort group two years ahead of the Taiwanese in the terminal degree program. The design, development, delivery, and evaluation of the course will be discussed in this presentation and paper.

Introduction

The College of Education at Idaho State University offers a required core course within its Educational Leadership doctoral program entitled, Instructional Technology (EDLP707). This class is designed for all levels of technology users.

The College accepted 48 Taiwanese students into the Educational Leadership program in the summer of 2000. All of these students enrolled in this course from their homeland of Taiwan during the fall 2000 semester. This added an extra dimension to the inaugural on-line delivery of EDLP707: The design needed to consider students whose second language was English.

Review of Literature

In many ways, the use of the World Wide Web for delivering instruction is still in its "pioneer" days. For users who choose, for whatever reason, to engage in this learning style, the technology is not ubiquitous in today's environment.

Foshay and Bergeron (2000) hold the view that web applications must be designed for a 28.8 Kbps modem. They caution developers to remember that today's world, particularly in the home, is a slower connect situation and will remain so for some time. A developer, then, should design for the 28.8 Kbps environment, or look toward a specialized clientele that will have faster connectivity.

As many course developers have discovered when adapting to a technological delivery mode, presenting content through a computerized system is not the same as instruction. Merrill (1994) cautions developers to remember that classroom (face-to-face) learning includes feedback and practice, and this must be brought into the computer-based world, as well. The author also warned that the technology driven training should not be just electronic pages, but there should be ways for the learner to interact with the technology to increase their knowledge base and interest in the scholarly pursuit.

Course Design

Idaho State University has adopted WebCT as its on-line course development tool. The on-campus students who selected Instructional Technology as their program concentration helped in the development of the components. This doctoral cohort group were approximately two years ahead of the targeted students in this course. The development group met on a weekly basis to receive final feedback and proceed with the uploading of materials.

The curriculum for the Instructional Technology course examined seven elements within each chapter of the text:

1. An extensive Review of the chapter contents, including Review Questions for students to submit and receive feedback from their assigned "tutor-mentor."
2. Resources that provided expanded understanding of the principles as well as hypertexted web site addresses (URLs).
3. Extensions, designed to broaden the information beyond the textbook chapter.
4. Explorations could be considered peripheral, but meaningful. These "side trips" were also tied to the bulletin board discussions for the chapter content.
5. Bulletin Board discussion topics were initiated as the "participation" portion of the course and served as a communication device for intellectual discussion.
6. Quizzes was taken on-line and pertained to the textbook chapter, the Resources, Extensions, Review and Discussion. Since Review was provided, and the assigned tutor-mentors provided constructive feedback, one quiz attempt was considered appropriate.
7. Projects were included as synthesis of the student's knowledge. These were communicated through email attachments.

Discussion

The instructor and the development team feel the experience of producing and delivering an on-line course to doctoral students in Educational Leadership who are not native English speakers has been a moderate success. Students experienced average to above average success with the course materials. In addition, the instructional design process served as a practical grounding for doctoral level students in this specialty. These same students have been involved in the revision of the course materials and sequence

Certainly, our doctoral program, and probably our master degrees, will include on-line courses, or supplemental on-line portions to classes taught in the traditional face-to-face mode. The College is carefully examining the EDLP707 fall 2000 course, including the support for continued development and evaluation. As the first course offered fully on-line within the college at the doctoral level, future offerings will benefit from this experience.

As our College of Education moves toward more course delivery via distance learning, methods for totally on-line components will be perfected. We do not anticipate that this teaching/learning method will replace all other forms of course delivery, but the College does see it as a means for expanding our offerings to students who do not reside either on, or close to, our physical campus.

Creating web-based programs for international delivery: Curriculum and faculty concerns

Abstract:

This paper addresses curriculum and logistical issues which have arisen during the first year of Idaho State University's international doctoral program in Educational Leadership. Currently there are 54 Taiwanese students in the program, 48 of whom are taking classes from Taiwan on-line; six are taking classes at ISU. As the capabilities of the World-Wide Web make international on-line classes not only possible, but more common, the experiences of ISU's College of Education are timely and relevant. Planning and delivering a program of on-line courses to foreign countries touches upon such issues as administration, hypermedia systems, multicultural instruction, instructional design, and the creation of on-line communities.

Introduction

Idaho State University's College of Education offers a doctorate in Educational Leadership to graduate students within its service area of 40,000 square miles The College of Education recently accepted a large contingent of Taiwanese students into the doctoral program. Currently there are 48 Taiwanese students in the program who are taking a core (required) Instructional Technology (EDLP707) course from their homeland of Taiwan. An additional six Taiwanese students remained in Idaho to take courses. These groups are divided into three sections (one based in the United States and two in Taiwan). The College of Education is working to ensure an outstanding doctoral program for these students, both in Idaho and overseas.

As the capabilities of the World-Wide Web make international on-line classes not only possible, but more common, the experiences of ISU's College of Education are timely and relevant. Planning and delivering a program of on-line courses to foreign countries touches upon such issues as multimedia and hypermedia systems, virtual universities, design principles (cf. Eastmond, et al., 2000), and the creation of on-line communities.

Several key issues have risen during this first year of the "international" doctoral program. These issues can be sorted into four major categories, each one of which will serve as a topic for discussion for the panel and the audience. These categories include design, logistics, administration, and community.

Design

This panel will address the particular issues in developing a doctoral level course that is a core element in a terminal degree program. The design of the course — textbook, on-line features, and projects — will be discussed, as well as future implications for this type of course delivery to students for whom English is not the primary language.
It is hoped this panel discussion will lead to greater dialogue among international colleagues who are delivering similar courses at the advanced post-secondary level. The merits of timing, communication, and scholarly discussion opportunities are all components for consideration when attempting to replicate the same teaching/learning environment enjoyed in a traditional (e.g., not on-line) environment.

In addition to the design considerations cited above, design elements vary from culture to culture, and the design of instruction and the medium of instruction in any international program must take these cultural differences into account (Heaton, 1998). This panel will also touch upon cross-cultural differences as one of several factors to consider in instructional and multimedia design.

Logistics

Weston (et al., 1999) identify nine important components of on-line learning which must be considered when evaluating the success of the delivery. These nine components include: impact on learning, student computer literacy, student computer access, infrastructure, interactivity, navigation, evaluation, accuracy and recency, and loading speed and bandwidth. A logistical challenge for the international doctoral program has been to assess each of these components, especially those dealing with practical considerations, such as student computer competence, bandwidth, loading speed and access between the United States and Taiwan, and time differences. The panel will discuss practical, logistical constraints on the international program's on-line offerings.

Administration

The Doctoral Program is administered from the College of Education Dean's Office. The Assistant Dean for the College has primary oversight responsibility for assuring that the program meets its goals and provides a positive learning environment for all students. Separate funding for the program serving the Taiwanese students was secured to provide the resources to meet the demands of this program. In addition, new faculty positions were added to meet the needs of the program. The Dean, the Associate Dean, and the Assistant Dean have all assumed roles, including teaching, in helping to ensure success. Among these roles have been budget management, all-campus coordination for student services, planning, developing non-academic programming, providing resources, and others.

The panel will provide opportunities to discuss administrative challenges and solutions with colleagues involved in similar programs

Community

An on-going challenge in any computer-mediated communication is to develop a sense of community among the users. It has been noted that listservs, emails groups, news groups, and chat rooms create small groups of people with similar interests, essentially "virtual communities" (see Jones, 1997, for an excellent overview of the concept of virtual communities). ISU's Taiwanese doctoral program has also sought to create a virtual community, not only among the Taiwanese students, but also between the Taiwanese students and their faculty, and their American counterparts. The panel will discuss how the enlistment of American doctoral students as mentors for the Taiwanese has helped to create a coherent doctoral cohort that communicates through a variety of computer media. The panel will also address means of drawing experts from around the world into the students' virtual community.

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The Use of Technology to Improve Mathematics Performance Among Elementary School Students.

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Abstract: The goal of this research study was to increase achievement elementary school mathematics through the application of an instructional model designed to emphasize all aspects of mathematics instruction, one which utilized technology where appropriate. Over 430 fourth grade students participated in the year-long effort. The primary conclusion of the study was that student achievement showed a marked increase in achievement.

Introduction

Concurrent publication of two texts in 1989, *Everybody Counts* (NRC) and *The Curriculum and Evaluation Standards for School Mathematics* (NCTM), launched a reform movement in school mathematics in the United States. Carlson (1992), describes this latest in a line of reform movements as part of the continuing tug of war between a "back to basics" or "drill and practice" orientation versus an approach based on "understanding mathematics" and "problem solving." A basic imbalance is always present when "meaning" and "skills" compete within the mathematics curriculum. *Neither makes a complete math program.* To teach all required skills, an instructional model must emphasize computational skills, conceptual skills, and problem solving skills. Students need them all in order to use mathematics.

Research Goal and Plan

The research goal was to raise math achievement by testing an instructional model designed to cover all aspects of mathematics instruction. The population selected for this demonstration project included fourth grade students in SE Idaho. Since Idaho gives benchmark ITBS tests to 5th graders in October, it was determined that fourth grade students should receive the year-long instructional program in order to prepare them for the fifth grade testing.

The treatment group teacher sample included 19 teachers in eight schools from six different school districts spread over 200 miles in SE Idaho. The control group included 15 teachers from the same geographical area. Students included in the sample were in these teachers' classrooms. The treatment group began with 512 students, but fell to 434 students by the end. The control group had nearly the same rate of attrition, falling from 428 to 364 students.

Since the purpose of the study was to raise achievement in mathematics for Idaho's testing program, The Iowa Test of Basic Skills (ITBS), mathematics section, given by the State, was the only achievement test that could be used for the final evaluation. The choice of a test for the diagnostic portion of the project was the Stanford Diagnostic Mathematics Test (SDMT).

Methodology

Treatment group teachers were provided with (1) diagnostic test results for their students to use in planning; (2) math manipulatives to be used in teaching math skills; and (3) five computers and the appropriate software to integrate technology into the daily math instruction. Teachers were trained to use these materials during two three-credit semester classes, one in the fall and one in the spring. The teachers were asked to provide "seamless integration" of technology into instruction

Computer efforts utilized several different types of software. Children did computations on the screen as the computer checked every step of every problem. Students worked routine word problems on the computer. They were asked to identify the operation needed to solve a word problem, to enter the numbers into an algorithm, and if that work was correct, they completed the computational work on the screen to obtain the answer. Finally, students solved non-routine problem situations including interesting "game-like" activities.

Data collection consisted of collecting ITBS scores as pre- and post-test measures, as well as the SDMT pre- and post- test measures. Observations were made in all classrooms over the entire course of the year, as the researchers visited classrooms, worked with students on the computers, and examined the data stored in the computers on students' work and achievement records.

Means and standard deviations were calculated for the pre- and post-test results of both the Stanford Test and the Iowa Test of Basic Skills. These were calculated for the total sample as well as the individual schools. In addition, the basic percentile rankings for each school and for the total sample were calculated for both tests. These percentile rankings can be used for a quick overview of the scores for the total sample and for each school.

Statistics were calculated, the entire set of scores were subjected to an ANOVA test to see if there were significant differences between the pre- and post-test scores on both the SDMT and the ITBS. Finally, if the "f" test was significant, the Tukey test for differences between means was used to determine which results differed from what would be expected by chance.

Findings and Conclusions:

Student scores increased on the SDMT from a mean percentile level of 35.1 on the pre-test to a mean of 63.4 on the post-test for the total math battery. On the ITBS the mean for all students increased from a national percentile rank of 40.3 to 58.9 for the total math score. This shows an increase on the Stanford of 28.3 percentile points and on the ITBS an increase of 18.6 percentile points. Both of these were statistically significant changes in student performance. Control group students showed no such gains.

The major conclusion is singular: Given an instructional model incorporating precision teaching, manipulatives, and technology, Idaho children can and did increase performance in mathematics. The teacher-training model implemented was a low-impact model; the researchers did not force an instructional plan upon all teachers. But the differences between classroom achievement test gains are clearly explained by each teacher's level of implementation. Therefore, higher test score gains are directly tied to the teacher's use of the total model.

Using metadata for re-using material and providing user support tools

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Abstract: The reuse of learning content in educational technology attracts much attention. This is mainly caused by recent initiatives for standardization of learning technology, but also by the necessity of a more efficient usage of valuable learning resources and development time. Standards for reuse can provide uniform specifications for exchange of learning content. To make reuse efficient, metadata is needed to find and select relevant content. Metadata, information about data, describes this data on a higher level, so that material can be identified, ordered, categorized and selected. However, adding metadata can be very time-consuming. This paper describes a support system for users, like educational developers, teachers and learners, to add metadata to existing learning content and courses.

Introduction
The faculty of Educational Science and Technology started a faculty wide implementation of Telelearning with the TeleTOP project in 1997. The aim of the project was to support teachers and students with a web based database driven environment. In three years time educational designers created a very large quantity of learning content stored in more then 600 courses. It is very beneficial if this set of learning content could be reused in different courses.

Metadata
Metadata can be seen as descriptive information; description as in providing more information about data. This is analog to the information such as found in a card index in the library, where information can be found about the stored books. Metadata is used to structure the collection of books. The better the material is organized, the better and faster a useful selection can be made. The themes used in a library (Nature, Science, Sports) are standardized and very easy to understand, even for non-experienced readers. So, these themes are used to guide the library visitor trough the large collections of books. Returning to educational technology, using metadata can guide non-experienced users trough a large collection of useful learning material. Presently, in the TeleTOP system metadata is already added to the content to structure learning content a within a course. The set of metadata was kept minimal because filling in a data set of metadata is often a boring and time-consuming task. Beside that, creating metadata is not considered important or useful by the users, as it is not direct beneficial for them.

Standards
Standards for reuse can provide exchange specifications. For instance, the Advanced Distributed Learning (ADL)[1] developed the Sharable Content Object Reference Model (SCORM) that applies state-of-the-art technological developments from groups such as the Instructional Management Systems project (IMS)[2], Global Learning Consortium, Inc., Aviation Industry CBT (Computer-Based Training) Committee (AICC)[3] and the Institute of Electrical and Electronic Engineers (IEEE) Learning Technology Standards Committee (LTSC)[4] to a specific content model to produce recommendations for different target groups. The recommendations can be used to structure learning material in a consistent format so that different learning management systems can make use of the material.

[1] ADL: http://www.adlnet.org
[2] IMS: http://www.imsproject.org
[3] AICC: http://www.aicc.org
[4] LTSC: http://ltsc.ieee.org/

A support tool for metadata application

SCORM can be used as a basis to specify the metadata within the TeleTOP system. However, only a small part of the metadata that is needed to be SCORM 'compliant' is currently available within in the present TeleTOP system. Additional metadata that is needed is available in the general administrative databases. For this purpose, we developed a tool that offers support in adding metadata that makes use of different data sources. The TeleTOP system users (the teachers) that are involved in the reuse process of material, and therefore in the metadata creation process, have to deal with 4 aspects: 1) adding metadata, 2) finding material based on metadata, 3) selecting useful content and 4) making the content available for use. The application of these 4 aspects should be as easy as possible for the users. One way to do this is to automate the creation of metadata as much as possible. This automation promotes the usability of the system and the acceptance of the users.

The support tool guides the user in retrieving data from the administrative and educational system and combines the data in a SCORM compliant metadata set that is stored in a database. This database can be used to search for relevant learning content. Because of the structured storage of the metadata, the user can also search on categories, authors or dates. Search engines are provided to make full-text searches on the metadata available. Relevant hits can be previewed and selected immediately for re-use. An software agent makes reuse available for the users. After selecting material, the software agent copies the needed material to a new target learning environment. Users do not have to make links themselves; the database generates needed links on the fly. The tool makes it possible to add metadata to existing material and using for these process external data sources.

Challenge, future plans

Research is necessary for the use of metadata in different situations in learning and for different users. Research should focus on the different support tools needed for this settings and if a general metadata set can be extracted that is useful for most situations.

E-Learning for Corporate Training: A Review of the Literature

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Abstract: Few people debate the advantages of e-learning – accessibility from any place at any time, significant cost savings, standardization of content delivered to large groups, and control of content quality. The levels of interactivity available through much web-based training increases these advantages. Although managers' enthusiasm for online training runs high, most have not measured the effectiveness of their net-based programs. Systematic research is needed to confirm that learners are actually acquiring and using the skills that are being taught online, and that this is the best way to get to these outcomes. This paper provides an overview of successful e-learning programs.

Corporations are constantly looking for more cost-effective ways to deliver training to their employees. E-learning is inexpensive compared with traditional classroom instruction. In addition, many expenses – travel costs for employees or trainers plus employee time away from the job – are greatly reduced. The other advantages, such as convenience, standardized delivery, self-paced learning, and variety of available content, have made e-learning a high priority for corporations. It is still early to find conclusive results about the measurement of actual learning that takes place as a result of e-learning, but we can analyze the somewhat controversial results that have come out of mainly academic-based distance learning programs.

How Do e-Learning Instructors Feel?

A number of studies have clearly supported the value of e-learning across a number of fields. For example, in a recent survey conducted by eCollege.com, 85% of the faculty said their students learned equally effectively online as on campus. Some said their students did even better online than in traditional classroom settings. A California State University at Northridge study shows that students in a virtual classroom tested 20% better than did students who learned in a traditional classroom. Sixty-two percent of 130 faculty respondents in another study said their students learned equally effectively in the online environment; 23 percent of faculty stated that their students learned better online; while 90 percent indicated that they were satisfied with online teaching. One faculty comment was: "Online students participate more, perform slightly better than, and are at least as satisfied as their on-campus counterparts. From that I conclude that online education appears to be very effective!" (TeleEducation, 2000).

How Do Learners Feel?

The majority of 1,002 students who were enrolled in online university courses responded to a survey, saying they chose the online format because of the flexibility and convenience of the program. Comments included: " I love that I have the flexibility to continue to hold a full- time job, . . . and study any time that best suits my busy schedule; I travel extensively and . . . I was able to work with my instructor, receive tremendous technical support at all hours of the night, and gain the same quality content and evaluation as my peers taking the same class on campus." The survey reports that 75% of those students online were employed and 68% of the learners worked more than 30 hours per week (*Survey Finds Online Education,* 1999). This fact makes this study particularly relevant for corporate trainers who have to fit e-learning into an already demanding work schedule.

Differences Between e-Learning and Traditional Instruction

Bates (1996) pointed out that "the potential for developing higher order skills relevant to a knowledge-based society is a key driver in developing computer-based distance education courses." Examining how learners engage higher order thinking is the topic of a recent research study at Massey University in New Zealand. White (1998) examined strategies of 420 foreign language learners at the university. White reports that distance learners made greater use of metacognitive strategies – what individuals know about their own thinking – compared to classroom learners, most notably with regard to the strategies of self-management and advance organization and, to a lesser extent, revision.

A comprehensive research bibliography on e-learning has received much attention. Compiled by T. L. Russell (1999), *The No Significance Difference Phenomenon* may provide one of the most quoted rationales for the power of e-learning. This body of research demonstrates no significant difference no matter what media you use for learning. In many of these studies, the model is asynchronous learning delivered to the learner on demand. The findings demonstrate that even with no instructor or face-to-face interaction, there are no significant differences in the amount of content learned. A related website includes extracts from more than 355 research reports, summaries and papers supporting the *No Significant Difference* phenomenon. This is one time that a finding of no significant differences is actually a compelling advantage. If corporations can get *all* of the advantages of e-learning with the same level of results as an instructor-led classroom situation, the economic element becomes even stronger.

The research results continue to improve for e-learning in general. Nettles, et al., (1999) report that, while the majority of the 49 studies they examined reported no significant difference between e-learning and traditional classroom education, "nearly 30% of the studies report favorable outcomes based on student preference, better grades, cost-effectiveness, and greater homework completion." An alternate website features comparative studies that *do* show significant differences, most of which report positive results. For example, Maki, et al., (2000) evaluated a Web-based Psychology course and reported that content knowledge, use of the WWW, and use of computers for academic purposes increased while computer anxiety decreased. Navarro and Shoemaker (1999) reported ". . . that Cyberlearners performed significantly better than Traditional Learners."

In a study of corporate learners, Redding and Rotzien (1999) report that "the online group is the most successful at cognitive learning as measured by the end of course examinations. . . . The results of the study do provide strong support for the conclusion that online instruction for individuals entering the insurance field is highly effective, and can be more effective than traditional classroom delivered instruction."

Content Quality Measures

In addition to the need for more research about e-learning results, more attention is being paid to the quality of the online education product itself. The National Education Association and Blackboard, Inc., examined case studies of six higher education institutions that provide Internet-based degree programs ". . . to ascertain the degree to which various measures of quality identified in previous studies are actually being incorporated into the policies, procedures, and practices of institutions that are e-learning learners. The final outcome is a list of 24 benchmarks that are essential to ensure quality in Internet-based distance education" (Forrester Research, 2000).

New e-learning evaluation guidelines were tested at 20 organizations by first determining an e-learning course's relevance toward an organization's needs, then analyzing content quality, usability, and instructional design methodology. These guidelines ". . . provide a robust and comprehensive set of quality criteria shaped by experts in the field" (ASTD, 2000) and have been adopted by the Canadian government.

Corporate Feedback on e-learning

Few people debate the overwhelming advantages of e-learning. Until a more solid research methodology is developed for e-learning results, however, we must rely on the feedback from corporations that have been using e-learning to deliver their training. Firms praise online training as a cost-effective and convenient way to deliver corporate education. Early studies seem to demonstrate that e--learning is a win-win proposition for all—the learner, the instructor, as well as the corporate world.

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The Faculty Development Center as a Means of Cultivation of Needed Skills in interface Design, Multimedia and Hypermedia

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Abstract: Information Technologies at the University of Maine established The Faculty Development Center as a direct response to the growing need to develop UM faculty skills in multimedia, hypermedia and interface design. The Faculty Development Center supercedes the simple act of making available electronic and multimedia resources by actively fostering, even encouraging among faculty members the necessary skill-sets in properly and effectively utilizing these resources. The following paper outlines how the Faculty Development Center achieves these goals through innovative and multi-level strategies.

Introduction

The Problem: Clearly the integration of new technology into the classroom, especially that of a higher education institution, is no longer just an academic advantage, but a necessary step to align education with the needs of a wired society. However, use of new technology in the University has been typically limited to trained students, and specialized staff and IT organizations on campus. The philosophy of "well do it for you" leads many unskilled faculty members to believe that adding online or multimedia content lies outside their own capabilities and time restraints. Despite the growing ease of use of relevant software and availability of hardware, the resulting atmosphere of "technological intimidation" has faculty still operating in what has been aptly called a „pre-Gutenberg" skill-set. Given the growing expectations of the academic community for multimedia and hypermedia course content and supplements, university faculty must be easily brought up to speed with the information age and its demands.

The Solution: In response to these demands, the Faculty Development Center was created at the University of Maine to specifically provide comprehensive technical education and support to faculty and staff. The key to performing these functions has been to replace intimidation with encouragement, and the notion of „we,ll do it for you‰ with „let us show you how." Specifically, the Center has approached its mission with the following multilevel strategies: providing education and support in all areas of multimedia, hypermedia and interface design; acting as a working liaison between faculty and other technological administrative and support services; and providing Faculty Stipends for academic projects that utilize electronic media.

Education and Support

Providing education and support to faculty is, itself, a multilevel task. Any person who calls or enters the doors of the Faculty Development Center will have a differing level of familiarity with technology and specific needs than the next. Therefore, the staff at the Faculty Development Center must have a firm understanding of all levels of multimedia and hypermedia and current trends in design and function of those media forms. This is imperative. Through this expertise, the staff of the Faculty Development Center is capable of assisting faculty with needs ranging from preparing graphics for a PowerPoint presentation to digitizing and streaming audio and video from their course Web sites. While there are organizations on campus that can help with any one of these problems specifically, the unique centralized nature of the Faculty Development Center ensures that faculty Can access support on a horizontal level as well as vertical.

Education also exists on multiple levels. At the most basic level, the Center offers workshops covering everything from PowerPoint to web-editing skills using Dreamweaver, or online course builders like WebCT or BlackBoard (CourseInfo). On a functional level, these workshops provide an introduction both to the skills and program being used, and to the center itself. Alternative or more in-depth instruction is offered more or less on each faculty member,s own terms. Assistance may be arranged individually or by group covering any needs within electronic media.

As a Liaison

Despite the wide range of skills and services offered by the Faculty Development Center, there are certain functions that it cannot provide. Therefore the second variety of support offered comes in the form of providing liaisons between faculty members and appropriate campus technical or administrative organizations. This is key to eliminating the intimidation factor inherent in technology. Within the University there are various administrative levels having to do, for instance, with either creating appropriate access to resources (for instance, creating WebCT accounts) or having information stored on an appropriate server for online viewing. Having a knowledgeable go-between operating on behalf of the faculty member removes a great deal of confusion and misdirection, while initiating the faculty member in the processes necessary for enhancing their course content.

Stipend Awards

Finally, the Faculty Development Center is actively involved in offering Faculty Stipends sponsored by Information Technologies for work done on course-related projects presented in part or in full through electronic means. The award is offered essentially as a compensation for time and resources spent outside of regular duties on these projects. However, the projects produced are also made highly visible to the campus community and are ultimately presented to the University at large though a Faculty Technology Fair.

Last year,s Faculty Technology Fair, set for November 9th of 2000 has already received a great deal of response from the University community and is expected to be a great promotion of faculty involvement in multimedia and hypermedia course supplementation. Through this process the Faculty Development Center actively encourages use of technology through direct reward, while simultaneously creating a highly visible front to the University,s new technology projects.

Summary

It is the University of Maine,s belief that the university system, as a center for higher learning, should be a leader in using technological resources to foster the highest level of academic enhancement. From inception to present the Faculty Development Center has been a working experiment in not only supporting but also encouraging that same enhancement. Providing support and education, active liaisons between faculty and staff, and even monetary reward within a centralized location has been our means to the end. The end, simply put, is making high technology accessible and used effectively by our educators. The resources are there and the academic community certainly recognizes the need. The Faculty Development Center is best described ultimately as a catalyst in building enhanced course content, ensuring that available hypermedia, multimedia and corresponding interface design of such are effectively used to the benefit of the University and its students.

The Use of Hypermedia and Multimedia in course related projects at the University of Maine

Andrei V. Strukov

Hypermedia and multimedia course content serve so many purposes that indeed it is a necessary movement. Throughout their academic careers students are taught how to analytically judge traditional print resources and how to use those to back up their own critical thought. Simultaneously they are taught how to intelligently use those sources. In a world saturated with new media, the appropriate and responsible thing for higher education to do is to teach these students to judge and learn from these new media sources. As this proposal begins to outline, the use of hyper- and multimedia course content is fast becoming a necessary part in the students, learning process in becoming responsible and useful members of the wired world.

Building On-Line Community for Professional Development

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Abstract

This paper describes the early phases of an examination of the role played by Internet-based teacher professional development for K-12 teachers in the implementation of an innovation. The cases developed describe the effect of this professional development intervention on the teacher implementation of the knowledge construction tools in the *StageStruck* CD-ROM .

The current phase of the research has established the most appropriate web site design for on-line professional development to be the online community of practice. The hallmarks of an effective on-line community were determined from literature and available cases. These hallmarks have guided the web site network's technical development and continue to inform the study as it seeks to gauge the critical factors in building and sustaining the social interaction for on-line community.

A web site portal or hub (http://www.stagestruck.uow.edu.au) has been designed specifically to build and support a community of practice. The web site development continues to be an iterative process informed by review of the literature, practice in the field and the contributions and ongoing evaluation of the community members.

Background To The Study

StageStruck, produced by Wollongong University and National Institute for Dramatic Art (NIDA), was one of ten CD-ROM titles produced in the *Australia on CD,* a Creative Nation[♦] federally funded Cultural program. Despite widespread distribution of *StageStruck* , across Australia (free to every school) and International acclaim for the teaching tool, preliminary discussions with educators indicated that most were unaware of *StageStruck's* existence let alone its educational benefit. This suspicion was borne out when in a state-wide promotion many teachers replied to find out where to obtain copies of something already distributed to their school. It became evident that a mechanism was required to both promote the program and support performing arts K-12 teachers in the in their professional development. In broader educational contexts, reviews of traditional professional development (as part of widespread educational reform) have proffered Internet technologies as possible cost-effective and efficient training and development delivery mechanisms. This research sought to explore the issues lessons to be learnt in such Internet-based solutions.

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[1]Creative Nation Australia's Cultural Network http://www.acn.net.au/articles/1998/05/ozcd.htm

Questions Addressed In This First Phase Of Research

1. Which professional development experiences/resources will assist teachers in their implementation of technological innovation (*StageStruck*)?
2. What Internet technologies and architectures best support those teacher needs
3. What are the hallmarks of an effective on-line community?
4. How can Internet activities/resources be designed and developed to attract and sustain a community of users? What cases exist to guide this development?

The Related Bodies Of Theory And Literature

This research draws from three critical areas of literature; innovation and change , professional development and on-line communities. There is a thread emerging from between these seemingly disparate bodies of research. For *innovation* it is critical that change begins with teachers and their professional development. In *professional development* there are well researched hallmarks of best practice which describe opportunities for teachers teaching teachers. And in *on-line learning* heterogeneous communities have been shown through participant activity and leadership to support teacher directed just-in-time learning. The connecting thread is the teacher centred community of practice as the hub of the professional development experience.

> *A central tenet of professional development and school reform is the creation of an enabling participant-driven environment for students and teachers alike. Web technology shares and promotes this same imperative. The key dynamics of the World Wide Web and school reform are exactly the same.* (Tenenbaum 1997 p485)

Traditional professional development has been criticised as being fragmented, unrelated to classroom practice and lacking in the focus and the follow-up that teachers require. The 1996 National Commission on Teaching and America's Future report *What Matters: Teaching for America's Future* (NCTAF, 1996) raised as one of it's five major recommendations to "Reinvent teacher preparation and professional development" to ensure "continuous high quality learning opportunities" for all teachers. This reinvention and continuation is supported in the locally produced Ramsey Report (NSW DET 2000) into revitalising teaching in critical times and choices. There is clearly an imperative for new professional development strategies and for teachers themselves to take more control of their personal professional development.

Principles of effective professional development (Bull et al 1994, ACOT 1995, US Dept Education 1996, Grant 1996, Loucks-Horsely & Hewson 1998, Stager 1998) define ongoing activity that builds on current practices, in a climate where teachers can take risks as part of a learning community. This "learning community" is a place or space where teachers support and learn from each other and take the time to reflect on the effectiveness of change. Joyce, Weil & Showers (Joyce et. al., 1992) reported that the most effective teacher professional development activities are those that combine theory, modelling, practice, feedback and coaching for application, particularly peer coaching. Novices in a community may collaborate with peers, work alongside experts, share, explore and learn as part of a network. Learners can be given opportunities through the community for 'reciprocal teaching' (Vygotsky, 1978). Teachers teaching teachers and teachers as learners are both concepts integral to this idea of reciprocal teaching and reform in professional development. For the contemporary social constructivist the "zone of proximal development" (ZPD) may be established through the community of novices and expert practitioners enabled in their social interactions by appropriate Internet-based activities, resources, opportunities and practices, beyond the physicality of being together in the same place at the same time. There is a body of practical work to indicate that the Internet does have more than just the potential to effectively facilitate teacher professional development. One example is an international on-line project EdNet@UMass (Reilly, 1999) that has shown evidence of the value of educational Internet communities. EdNet@UMass involves educators from the USA and 29 other countries in what is described as a forum for "promising practices" and exploring possibilities. The value lies in the networks both technological and social.

> *Educators are "islands of excellence" with no ferry service to connect them to each other or to groups of their peers.* (Reilly, 1999, p60)

Wilson & Ryder (1998), Tinker & Haavind's *Concord Consortium* (1997), Ravitz(1997).McMahon (1997) *The Mathematics Learning Forums*, Tenenbaum's (1998) *Media Center Project* and Cannings & Stager 's (1999),*NetAdventure* projects have all demonstrated the way a community of practice springs from web site activity. The thread is the need for a teacher centred community of practice to be the hub of the professional development experience.

It is recognised that the best work with on-line communities of practice is still to come. It is suggested that this will happen when the technology becomes more accessible and projects develop that embody the research findings (Ravitz 1997). With rapid and now widespread penetration of high speed connectivity in schools in Australia (and growing in homes) this research project is poised to address both the research understandings and to test the effectiveness in practice of on-line communities of practice.

Defining this on-line community

Community is a much-argued concept. Long before the "community" went on-line social scientists had disagreed about what a community was. Thousands of print and web pages are now devoted to trying to adequately define, refine and finesse what an on-line community is.

These definitions vary from:

In 1992 Howard Reingold (p1) said *...virtual communities are cultural aggregations that emerge when enough people bump into each other often enough in cyberspace.*

Palloff and Pratt (1999 p21)describe *People seeking commonality and shared interests formed groups and communities in order to pursue the interests that distinguished them from other groups.*

Amy Jo Kim (2000 p28) suggests that *A community is a group of people with shared interest, purpose, or goal, who get to know each other better over time.*

Wellman and Gulia (1997) define two types of community, *personal* and *group*. The group community most relevant to this research. *A group community is a social network of people who interact with each other regularly to provide sociability and support.*

In order to design and build an on-line community, we may be better served by identifying the essentials for on-line community rather than bogging down in the semantics. As quoted by Nancy White (1999) a federal judge said *Community is like pornography, I don't know how to define it, but I sure know it when I see it.*

It is evident from the literature that when the community as a concept is no longer confined to place and space, discussion has been sidetracked by arguing whether a listserv, a discussion space or a chat is a learning community. We would not argue whether the meeting hall or a telephone were a community. They are enablers to the activity of the community. In support Joseph Cothrel (1999 p52) writes ... *"community" is about something more fundamental than location or mode of interaction, though we may not all agree what that 'something more is'.* It is therefore meaningful to aggregate the attributes or hallmarks of communities, as suggested by the theorists and practitioners across education, edutainment and enterprise and distil from those attributes some essential qualities for, or hallmarks of on-line community.

What follows is table of attributes proposed by a sample of theorists and researchers (Table 1) and the subsequent distillation of these attributes for the on-line community for *StageStruck*.

Figallo (1998)	• Member feels part of a social whole • Interwoven web of relationships between members • Ongoing exchange between members of commonly valued things • Relationships between members last through time
Etzioni (1988)	• Bonding, not one to one, but a group of people to each other • Shared set of values and culture – much more than interest
Mueller (1999)	• Frequent, multilateral and for a certain period durable communication contacts • Commonly shared norms, values and collective practices • Defined boundaries between inside and outside, and development of common identity
CLN On-line **(1999)**	• Promotes discussion, sharing, and active collaboration • Provides responsive resource for those seeking assistance and information • Is driven by the participants, as a real grassroots initiative
Hagel & Armstrong (1997)	• Distinctive focus • Integration of content and communications • Openness to competitive information/access • Commercial orientation • Valuing of member generated content
Preece **(2000)**	• Clear purpose for the community • Help to create social policies that guide not stifle • Support social interaction • Sociability built through trust, collaboration and appropriate styles of communication
Galston (1999)	• Limited membership • Shared norms • Affective ties • Sense of mutual obligation

Table 1 On-line community attributes

The attributes of community across all the appropriate sectors (school , tertiary and corporate) were examined and commonality began to emerge that could be synthesised into a few succinct hallmarks for community. These hallmarks are:

- Clear focus driven by the members (ownership)
- Employ appropriate technologies and styles of communication
- Members feel part of a social network where their expertise, leadership, content and contributions are valued
- Provides ongoing discussion, sharing of, and collaboration on, commonly valued things.

Designing for online community

So it was that this research embarked on the design of this online community to support the use of *StageStruck*. However it very quickly became evident that there were four distinct stages in working toward this true online community. Community might be the end product of this four step process, it was not the result of any one. Each of these stages is vital and does in turn inform the development and understanding of the next stage toward development of an online or web-based community for professional development:

1. Decide on the goals of the professional development and the needs of the teachers.
2. Design and build a web site architecture to support the goals and needs.
3. Establish a network of people as members in the interest group.
4. Build up the trust and ownership of the members as a community.

The StageStruck On-line Community Web Site http://www.stagestruck.uow.edu.au was developed after a year of research into teacher needs and on-line community-based web sites. The site was launch at the end of 2000 and the first participants joined the net work in February of 2001. The site is now between the third and fourth stages of the development process towards community. Members have registered and begun to contribute and share resources.

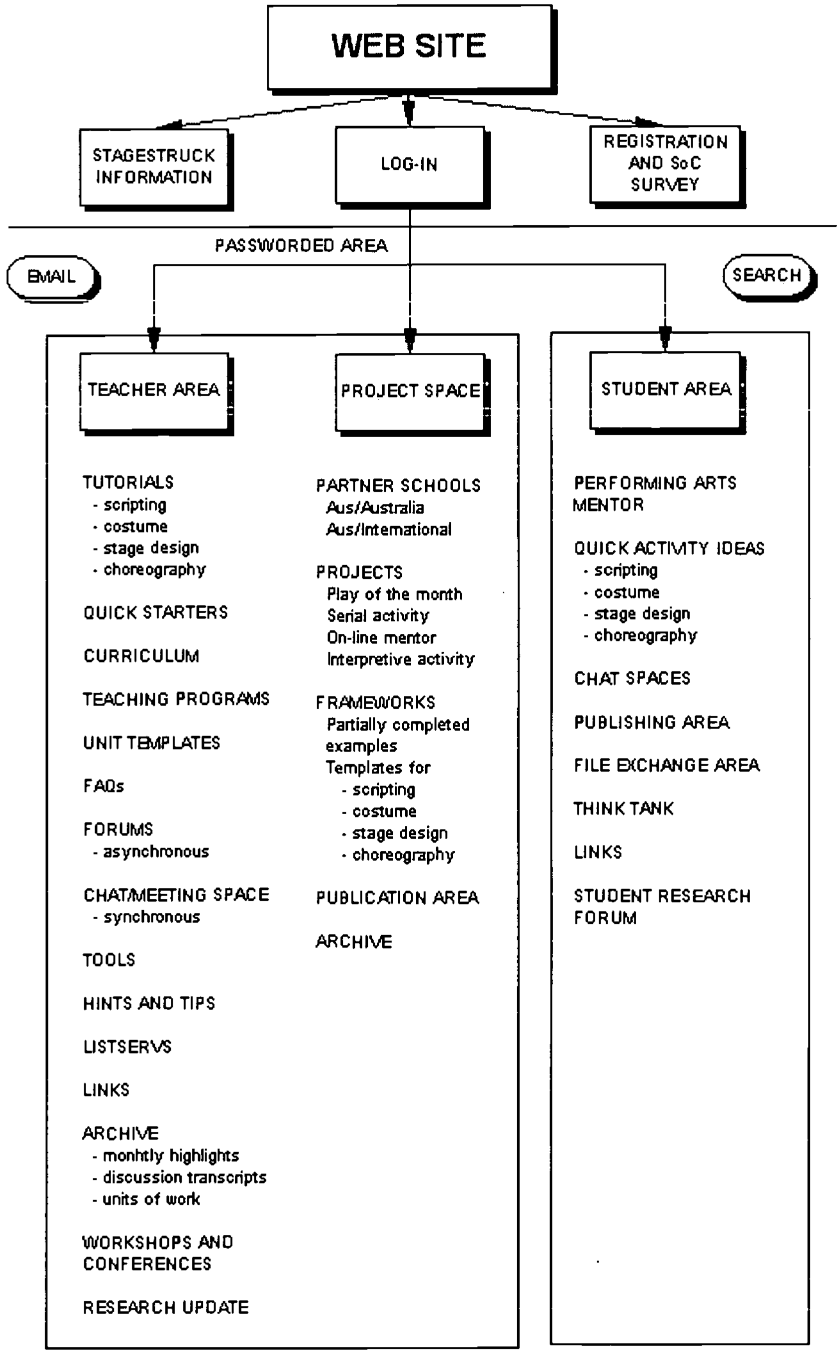

Diagram 1 The Initial StageStruck On-line Community Web Site Design

The StageStruck On-line Community will over the next two years test Tenenbaum's tenet. The data will be collected from the network or community (depending whether community is achieved) and its members in various ways. The Concerns Based Adoption Model, CBAM (Hall et al 1973) instruments will be used to gauge levels of implementation of *StageStruck* from chosen community members. As a key instrument the CBAM Innovation Configuration Map will be developed over 2001 in consultation with teachers in the community to describe practices that are the variations of implementation into the curriculum. This map will be used to define teacher implementation and to feed back into the professional development process as a self assessment and planning tool for teachers. Quantitative measures will be used to review the web site activity in terms of access, paths taken, time spent, numbers of contributions and statistical data from systems logs. This data will track member activity as well as activity in specific areas and for all the Internet technologies employed by the community. Data collection for these cases will involve qualitative practices such as observation of teaching, interviews and focus groups, work samples, text analysis of web site contributions and documentation for units of work. The research program will run into 2002 with final data presentation to be as a series of cases of adoption of *Stagestruck* and data (qualitative and quantitative) will be analysed for trends in general levels of activity and individual involvement in the community over the two years.

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Constructing the On-Line Classroom: Interaction in the Synchronous Chat Room

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Abstract: This paper examines chat room interactions in an on-line course given at Teachers College, Columbia University for their power to construct the traditional class frame in the on-line environment. Utilizing the framework of conversational analysis, I explore the effect of the affordances and constraints of synchronous communications devices on interactional sequences. The paper culminates in suggestions for practice in expanding the on-line course experience beyond traditional modes of text-based classroom discourse.

Introduction

In this paper I will focus on the ways in which my students and I attempted to construct the on-line classroom through interactional sequences in the synchronous chat room. I will investigate the ways in which the synchronous chat is akin to a face-to-face conversation, and how the constraints and affordances of this communications technology influenced the nature of the interactional sequences.

Description of the Class

The class that I taught was Instructional Design of Educational Technology offered through the Distance Learning Project at Teachers College, Columbia University in the spring 2000 semester. The class had 28 students and was conducted completely on-line, except for an optional last class meeting. The students had the choice of joining either the synchronous chat sessions or the asynchronous discussion boards. There were a total of 14 synchronous chats held during the semester. The chats were held on Saturday afternoons at 4pm and Monday evenings at 5pm. An average of six students attended each chat. All of the 28 students attended at least one chat, though many attended only one chat, several attended the majority of the chats. The students showed a clear preference for either synchronous or asynchronous communication.

In the transcript I will use for analysis purposes, an alphanumeric code is substituted for the participant's name and a symbol is used to delineate between a participant logging on and making a comment. The transcript shows the exact time (hour/minute/second) of any activity by an individual occurring in the chat room.

Establishing the Frame

On-line synchronous communication comes closest to establishing the traditional classroom frame in distance education. Synchronous communication allows the participants to jointly occupy temporal space and to create the illusion of physical proximity through spontaneous conversation and the sharing and contributing to the contents of one screen of information. The fact that each participant is using the same software and is therefore seeing the same thing visually adds to this illusion of a shared physical space. Varenne and McDermott (1998) describe the 'well-specified interactional sequences' which signal the beginning of a class: "...a class cannot start in the absence of specific acts (reorganization of focus, synchronization, greetings, etc.)." (p.184). A transcript of a chat conducted in my class shows the above patterning of interaction in establishing the class frame:

03:42:59 PM: lb818 logged in

04:01:07 PM: as130 logged in
04:01:41 PM: as130 > Hello...
04:02:31 PM: lb818 > Hi, Adrienne. I thought maybe I had the wrong day....
04:03:03 PM: as130 > I was thinking the same exact thing...
04:03:25 PM: as130 > How is your group project going?
04:03:53 PM: lb818 > We're done. But there were only two of us in my group. Groups with more members will obviously take longer. How's yours?
04:04:19 PM: as130 > We're a little delinquent in getting our initial paragraph handed in.
04:04:36 PM: lb818 > Is it due this Wednesday or last?
04:04:55 PM: mf914 logged in
04:05:00 PM: as130 > This past Wednesday - Florence sent me a note saying it was supposed to be handed in already.
04:05:08 PM: as130 > Hi Michelle.
04:05:11 PM: lb818 > oops. What's yoru topic? Hi, Michelle.
04:05:17 PM: mf914 > HI everyone :-)
04:05:19 PM: as130 > Adult Learning
04:05:29 PM: lb818 > Good topic. Lots of stuff involved.
04:06:29 PM: as130 > We're going to do a site on the benefits of using bulletin board systems for adult l;earning. We can definitely hand in a paragraph, but I don't want to do it without consulting with the other 3 group members
04:06:43 PM: as130 > What are the two of you doing?
04:07:03 PM: mf914 > I thought the assignment due wed was the proposal for the final individual project..
04:07:22 PM: fs184 logged in
04:07:36 PM: lb818 > I didn't think we were allowed to do a whole site. You may want to check on that. I thought it had to be one page.
04:07:37 PM: mf914 > Hi Florence
04:07:42 PM: lb818 > Hi, Florence
04:08:01 PM: as130 > Hi Florence

In this chat, three students arrived before I did and began having a discussion about the assignments. When I arrived the students stopped interacting with each other and began interacting with me. This pattern can be seen as the re-organization of focus away from each other and to the teacher. This re-organization also occurs in the traditional classroom when the teacher enters the room, or when the teacher begins to verbally address the class. The cultural patterning of deferring to the teacher so that the 'beginning of class' interactional sequence can occur is played out in the chat environment.

The Phatic Function

Establishing verbal communication between teacher and students is a key component to the beginning of class interactional sequence. This establishment of verbal communication is termed the 'phatic function' by linguists. The phatic function in face-to-face conversations may be checked through visual cues. If the teacher is establishing verbal communication with the students, he is able to verify this by making eye contact with selected students. The phatic function plays a key role in the execution of interactional sequences and in the construction of a traditional class. The phatic function in the on-line chat room is equally important to the construction of the class. As aforementioned, the chat software used in the course allowed chat participants to hyper-link to a list of people in the chat room. However, many students either did not know about this function, or did not trust it to be accurate.

04:01:37 PM: rw684 logged in
04:03:30 PM: mf914 logged in
04:04:02 PM: rw684 > Hi Michelle
04:04:05 PM: mf914 > hello?
04:04:17 PM: mf914 > Hi Rob, I thought I was all alone :-)

In this exchange, Rob logged in approximately two minutes before Michelle did. When Michelle arrived, she did not realize that Rob was there. After about 1/2 minute Rob says hello to Michelle, who is somewhat surprised by his presence. The only visual cue available to Michelle in the chat room is the hyper-linked list, which she apparently was not aware of.

Since eye contact cannot be made in a chat room, directing a comment to an individual could only occur through the use of the individual's first name. In a discussion of emerging conventions in Internet Relay Chat (IRC) environments, Werry (1996) states "...it has become entirely conventional for speakers to indicate the intended addressee by putting the person's name at the start of an utterance...Such a high degree of addressivity is imperative on IRC, since the addressee's attention must be recaptured anew with each utterance." (p.52). The use of the first name in the chat room was not only important for executing the phatic function, but also for delineating conversational threads, which I will soon discuss. In the first half of the semester we used the convention of typing the entire first name of the individual being addressed.

> 04:24:53 PM: fs184 > Adrienne, I lost the thread, what would be very complicated to create?
> 04:25:02 PM: mf914 > Florence, what do you think of logo/microworlds?
> 04:25:08 PM: nk762 > Robert, I agree. Adapting instructional design to individual learners means realizing that students need different degrees of structure.

By the second half of the semester we had switched to just using the first initial of the individual being addressed followed by a slash:

> 04:31:17 PM: fs184 > R/ perhaps the objectivists are right regarding natural laws and the constructivist are right about the best way to learn a natural law?
> 04:32:08 PM: rw684 > A/ I think the shared understandings are more in question for novice learners then experts.

While the phatic function was still being executed through using a participant's name, the convention evolved from the full name to the first initial over the semester. There are two reasons why this convention evolved. First, only typing the first initial saved space on the text line, allowing the participants to see more of the substance of his/her own comments before submitting it. Second, it allowed for a more rapid response time permitting the chat to flow at a rate closer to face-to-face interaction. According to Werry (1996), "On IRC, a combination of spatial, temporal and social constraints act as important limiting conditions that influence the size and shape of communication in roughly analogous ways...In order to keep up with the flow of conversation it is often necessary to respond quickly and this means that unless one can type very rapidly, messages must be kept short." (p. 53).

What is perhaps most interesting about executing the phatic function on-line is the ease with which one can be ignored. As there is no physical means of insuring that one has established communication, there is also no means of insuring a response to a direct query. Twice during the semester I directly posed a question to a student in the chat room, which the student chose to ignore. The student did this by simply not responding at all. While I could have continued to query the student, doing so would have negatively disrupted the flow of the chat. Also, when I directly query a student, others may feel they cannot respond and this slows the overall flow of the chat. I did continue to directly query students when I thought a further explication of a previous comment would benefit the conversation as a whole, but I was also conscious of the other students and I would sometimes generalize the query to all of the students.

Finally, a note on a technological constraint in regards to the phatic function. Occasionally, a participant will be involuntarily logged off the chat room. This is a technical malfunction beyond the control of the participant. The biggest problem with this particular malfunction is that the only way to know that the malfunction has occurred is through the lapse in the conversational flow appearing on the screen. However, it is not uncommon for a lapse in the conversation to occur in the on-line environment. I was involuntarily logged out of the chat room only once during the semester, but it took me quite awhile to realize that his was the case. At first I thought that a conversational lapse was occurring, so I made several content related queries in an attempt to rouse the student's interests; when no one answered, I asked people to confirm that they could read my comments. There was no response. At this point I realized I had been logged out of the chat room, so I initiated the log in sequence, which takes approximately three minutes to accomplish. By the time I arrived back at the chat, the students had ended it and left.

04:47:20 PM: fs184 logged out (Involuntarily)
04:56:02 PM: mf914 > great! it seemed to go so fast! do you think Florence is coming back?
04:56:24 PM: as130 > I think the chat went pretty smoothly other than some technological problems. However, I just realized that Florence isn't in the chat.
04:56:35 PM: lb818 > I'm not sure. She's been gone a while. It did go fast, though.

I was involuntarily logged off at 04:47:20 PM. It is interesting that the students carried on the conversation for several minutes before realizing that I was no longer in the chat. The first mention in the chat of my absence occurs at 4:56:02 PM. The chat then ends at 04:58:58 PM. The role of the teacher in the chat room is clearly decentralized in this example. My presence was not necessary for the class to continue. It is highly unlikely that in a traditional classroom a teacher could, without comment, leave the room and have the class continue without interruption.

Turn-Taking and Participant Roles

This decentralization of the role of the teacher is an affordance of the technology. In traditional classrooms, the classroom discourse typically centers on the teacher's contribution, either through lecture or what researchers have termed the IRF (Initiation, Response, Follow-up) communication pattern. According to Warschauer (1999) "Numerous studies have shown that this pattern [IRF] is the dominant structure of classroom discourse in the United States and other countries (Cazden, 1988; Lemke, 1990; Mehan, 1985; Poole, 1990)." (p.64).

My experience with the chat is that everyone who came to the chat also contributed to the conversation. However, participation was not equal, and students who speak English as their second language tended to contribute less to the dialog and tended to attend the chats infrequently. Since there was the discussion board option, the ESL students could contribute in that forum and most seemed to prefer it.

Sacks, Schegloff and Jefferson (1974) enumerate two methods of turn taking in face-to-face conversations: current speaker selects next and self-selection. (p. 705). Both methods occurred in the chat room discussions. In general, I would begin the chat discussion by posing a question to the students. Usually, some combination of students would self select and respond to the first query. I found that in the beginning of the chat I would need to employ the current speaker selects next method in order to propel the conversation. So, I would follow-up with a prompting question to a given student; sometimes I would contribute several prompting questions to several students. Soon, however, the students would be responding directly to each other's comments and self-selection would become the more dominant mode of turn taking in the chat room.

Sacks, Schegloff and Jefferson (1974) also discuss turn size in face-to-face conversations: "Turn size is not fixed, but varies." (p. 708). However as Werry (1996) pointed out, the technological constraints of the chat room system cause the turn size to be relatively brief. The shortness of the text line and the relatively rapid flow of the conversation combine to contribute to brevity in comments. One of my students found a way around this particular limitation by rapidly entering and sending a few words of her comment, followed quickly by the next few words, effectively controlling the chat room.

04:51:22 PM: ub225 > F/ It s interesting you should say that
04:51:36 PM: ub225 > because in Robbie's class of 23-25
04:51:53 PM: ub225 > people there was only one group formed which was rather
04:52:05 PM: ub225 > counterproductive and hence finally it was further split
04:52:19 PM: ub225 > into two groups. But what I observed in this class
04:52:34 PM: ub225 > was that it took the whole class more than two
04:52:48 PM: ub225 > months to wade themselves thriought different topics that
04:53:02 PM: ub225 > they were going to tackle for the semester and finally it
04:53:19 PM: ub225 > was Prof. Robbie's suggestion that we focus
04:53:32 PM: ub225 > the attention on revamping the existing CCTE web site
04:53:46 PM: ub225 > and hence it was only in the latter part of March that we all
04:54:00 PM: ub225 > got galvanized into that endeavour.
04:54:15 PM: ub225 > But, I feel we lost a considerable time in the semester not exactly
04:54:36 PM: ub225 > knowing what to come up with. Is this how C generall works?

This individual through her method of rapidly sending a series of five to six word phrases to the chat room was essentially able to hold the floor for three minutes while she made her point. As one can easily see from reading the other transcripts in this paper, this student's method was highly unconventional.

Schism

Sacks, Schegloff and Jefferson (1974) note that when more than four parties are involved in a conversation there is a possibility that a second conversation will begin within the group. They term this phenomenon "schism."

Schism occurred regularly within my classroom chats. Related but distinct strands of the initial conversation were routine features of the twice-weekly chats. When one is reading the comments posted by others, it is an after-the- fact action. One does not see the comment as it is being typed, but rather one sees the comment in its entirety once it has been posted. This technological feature allows many people to post comments at once, something that is not possible in a face-to-face conversation. I encouraged the practice of schism through my prompts and queries to students as a method of furthering the conversation:

04:12:06 PM: fs184 > Is every content area ripe for the discovery learning method?
04:12:11 PM: mf914 > giving up control of a learnign situation is, I think, difficult for many teachers
04:12:19 PM: rw684 > I know I thrive in this environment, but I wonder if all students comfortable with discovery learning.
04:12:22 PM: as130 > Florence, guiding a discovery isn't really the discovery method, but I think that it would be more beneficial and more acceptable to many people than a true discovery method.
04:12:46 PM: fs184 > Adrienne, why would it be more beneficial?
04:13:10 PM: sg439 > I think that it can work in all areas, but often some elementary knowledge is needed
04:13:18 PM: fs184 > Michelle, is one really ever in control of a learning situation?
04:13:34 PM: mf914 > we had a discussion about this in computer mediated communication...I think many adult learners are uncomfortable withthis area because most of us were taught in a very traditional way
04:13:42 PM: mf914 > no, I don't think so
04:14:03 PM: mf914 > I think you can have a plan, and hope that things will go in the directions you hope
04:14:06 PM: as130 > Florence, I was thinking it would be more beneficial than the traditional method of instruction where everything is focused and directed and tuned towards standards.
04:14:11 PM: fs184 > It's hard to break free of the ways we all were taught.
04:14:18 PM: rh810 > Very hard....
04:14:25 PM: mf914 > but, as teachers I think we are often required to "tap dance" or go with the flow
04:14:46 PM: rh810 > and time is a major force in choosing what process we use.....
04:14:47 PM: mf914 > (I tap dance often, because our hardware is old
04:14:52 PM: fs184 > Michelle, is this due to school or community politics?
04:14:52 PM: sg439 > Good point ,Michelle, I taught some adult classes and many people were upset when I wouldn't give THE right answer
04:15:29 PM: as130 > But don't we start off as discovery learners as children? It seems like when we enter school that we learn the "traditional" method of learning, which is more artificial.
04:15:40 PM: mf914 > school departmental politics
04:16:14 PM: mf914 > need to beg for every dollar
04:16:18 PM: rh810 > I would tend to think it's community based.....our schools reflect the society and communities around us.....
04:16:18 PM: fs184 > Adrienne, excellent point! I agree this is exactly how we learn as children, it seems much more natural.
04:16:44 PM: mf914 > ADrienne, I agree
04:17:23 PM: mf914 > although, with children going to school at such young ages, that may change
04:17:36 PM: fs184 > Can designers be effective in creating electronic discovery learning environments?
04:17:56 PM: rw684 > Adrienne: But the things we learn as young children tend to be more open ended then those we learn as older students.

The above sequence is a good example of two strands of a conversation about discovery learning taking place at the same time. The first strand revolves around teacher control of the learning experience vs. student control. The second strand revolves around the benefits of guided discovery learning. Both strands are occurring at the same time. The teacher vs. student control discussion is the primary focus of mf914, rh810 and sg439, all of whom contribute to the discussion. The second strand is primarily pursued by as130 and fs184, but eventually they are joined by rw684, andmf914. This interactional sequence is lifted from an ongoing conversation. There are several examples in this exchange where I used a query to act as a prompt to a particular student or to the group as a whole (04:12:06 PM, 04:12:46 PM, ,04:13:18 PM, 04:14:52 PM, 04:17:36 PM). Since the students are responding to my queries at the same time without virtue of knowing what each other is saying, the opportunity for schism increases. Utilizing the IRF technique, I followed up two of the student responses with more questions, thereby reinforcing the multi-threaded nature of the conversation.

Conclusion

Does the chat room constitute a class experience? Did my students and I construct a classroom through our interactional sequences? The chat room session is certainly an event that is constructed by a number of people, and, in the context of discussing texts and ideas, it is educational. The interaction and temporal sections of the class frame are present, and the virtual space shared could be considered a stand-in for the physical school building. The student participants and I both brought our previous cultural experiences of 'class' with us to the chat room, and we interacted in ways that are typical teacher-student interactions. As a group we followed some of the well-specified interactional sequences discussed by Varenne and McDermott. For the most part, I began and concluded each chat session. Students waited for me to open the discussion with a prompting question and they waited for me to signal the end of the chat before exiting the chat room.

Yet, the very nature of the technology itself allowed for something other than the traditional class experience to occur. As Warschauer indicates: "Student-centered discussion tends to be the norm in synchronous computer-assisted classroom discussion." (p. 65). I have never witnessed a traditional face-to-face class that afforded equal time and space for all class participants to ask questions and make comments. The chat format allows for and requires the student's participation. It encourages and allows the students to converse directly with one another and, as Warschauer (1999) has termed it, socially construct knowledge. The interactional sequences that took place in the chats for my class always included insightful comments from students and a great amount of give and take among the students themselves and with me. The technology itself affords a qualitatively different class experience. It seems to me that a class can be constructed on-line, but the question is, do we want to try to re-create the traditional class frame? Or do we wish to dream of new ways to learn, interact and educate in the technological environment?

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Telematics Simulation: Recent Developments & Issues

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Abstract: Recent developments in Internet technologies have enabled new, more flexible forms of telematic simulation and have raised issues that were not considered in the early days of networked learning. Ultimately, these questions revolve around (1) the learning cost-effectiveness of telematic simulation (quality and quantity of learning as opposed to development, technology and specialised training costs), (2) the necessary rethinking of learner and teacher roles, on the one hand, and institutional commitment to change, on the other, and (3) a variety of issues related to access. The panel members discuss Project IDEELS telematic simulations in terms of enabling interdisciplinary learning, matching learner needs with technologies, supporting learner independence and responsibility, evolving teacher/facilitator roles, and balancing research, evaluation and validation needs without compromising the quality of the simulation experience.

Introduction

Project IDEELS is a Socrates/ERASMUS-funded curriculum development project (CDI) that brings together a diverse group of educators and researchers from five tertiary institutions in four European countries who share a common interest in using simulations and games in educational settings. The Project team develops, tests, implements and evaluates simulation scenarios and provides a range of accompanying materials (language practice, team-building, cross-cultural awareness-building, cognitive and thematic activities as well as glossaries and other information resources) to meet the increasingly diverse needs of an expanding user base.

IDEELS owes much to its direct predecessor and inspirational role model, Project IDEALS, a US-based, FIPSE and NSF-funded telematic simulation project directed in the early 1990s by David Crookall at the University of Alabama, and to ICONS, an outstanding telematic simulation program with an International Relations focus directed by Jonathan Wilkenfeld at the University of Maryland. We have learned a great deal from both programs, but rather than trying to repeat a successful project like IDEALS or compete with an established, ongoing program like ICONS, IDEELS looks for ways to learn from their experience and build on their successes.

The diversity of the current project group has allowed us to benefit from the insights of an unusually rich mix of disciplinary perspectives in all phases of our work. Over the first 3½years of the project, members have developed and implemented a series of simulation packages with a distinctively European flavour. The thematic focus of the scenarios varies: education (November 1998 & November 1999), immigration (November 2000 & March 2001), the impact of technology (September 2001), water (November 2001). Participants so far have been students at tertiary institutions in five European countries; at least ten different academic fields and as many different nationalities have been represented. Throughout the project, recursive evaluation of all aspects of the project has played an important role; two

Supporting Interdisciplinary, International, Collaborative Learning

Learning Objectives

A combination of broadly defined shared and class- or discipline-specific and individual learning objectives allows participants to focus on their own learning needs while maintaining some common ground. The shared learning objectives fall into three main areas: co-operation/collaboration, socio-affective, and interdisciplinary/cross-cultural.

IDEELS' Shared Learning Objectives

co-operation / collaboration:
- develop team skills (listening, contributing, organising, giving feedback)
- accept responsibility for achieving group goals
- create and maintain an atmosphere of mutual respect

socio-affective:
- learn to trust
- learn to learn
- become more aware of one's learning styles and needs
- take responsibility for one's own learning
- develop the ability to respond flexibly to unexpected situations

interdisciplinary / cross-cultural:
- increase awareness and appreciation of, and respect for cultural differences
- develop cross-cultural and interdisciplinary communication skills
- apply these skills to the simulation process

Figure 1: Learning Objectives

Each group is expected to incorporate the shared learning objectives into its preparatory and debriefing activities; in addition, teacher-facilitators develop learning objectives consistent with their class' content and objectives, and students, in turn, are encouraged to set personal learning goals for themselves. The only constraint on the latter two sets of learning objectives is that they must not conflict with the shared learning objectives. This multi-tiered approach ensures a necessary degree of continuity while providing a highly adaptable learning opportunity for students from a wide range of disciplines. It also formalizes a commitment to learning in several areas not taught in most traditional educational settings: working in a team, taking responsibility for one's own learning and for one's part in the group's success, and becoming more aware of interdisciplinary and cross-cultural factors affecting successful communication.

Meeting Learners' Needs with Appropriate Learning Technologies and Situations

Possible Role of Personality Factors in the Use of Educational Technology

Since the early 1990's computer systems have supported computer mediated communication in ways which permit relatively naturalistic communication styles (e.g., e-mail, IRC, e-discussion lists), although this did not include video or audio conferencing except in rare research settings.

There appears to be little doubt among researchers that personality factors are of great importance in determining the successful use of information technology in educational settings (Clements, 1995; Hartley, 1998; Calvert, 1999; Harris, 1999 and Shavinia, 1999). Anecdotal evidence from composition and ESL/EFL teachers (including IDEELS project members) suggests that some students who rarely contribute to class discussions become quite outgoing when communicating via e-mail or in chat rooms. On the other hand, participants in IDEELS simulations rarely choose to communicate with other members of their own team via the software provided, preferring face to face communication, telephoning (or "SMS-ing"), chatting and e-mail using their regular accounts. Clearly, this is an area of human-computer interaction in the IDEELS context that deserves further investigation.

Appropriate Use of Technology

Computer conferencing systems are usually designed to support asynchronous transfer of text, pictures, and sometimes sound and, less frequently, live video signals. These facilities have led some to propose that the medium of computer conferencing might have potential as an environment for the teaching of language (Warschauer, 1997), since the supported features match those thought to be vital in language acquisition.

The OPUSi conferencing platform used in IDEELS simulations supports both intra- and inter-team asynchronous conferencing, synchronous teleconferencing, and – to a limited extent – collaborative writing. So-called "awareness tools" are almost entirely lacking, but there is a facility that allows for the creation of a "virtual library" of links to external web-based resources, including the IDEELS web site.

As about half the IDEELS project members are language teachers, language- and communication-related factors have played a role in several of the decisions taken regarding further development of OPUSi. A conscious decision was made, for example, not to incorporate video conferencing capabilities; it was felt that by using text-based conferencing, participants would respond to others' use of language rather than to other factors revealed in video conferencing (e.g. age, gender, physical appearance). This has interesting implications for language learning, as the likelihood of mis-communication – both of misunderstanding and of being misunderstood – increases when the usually available visual or auditory clues are missing; often a kind of information gap results that 1) spurs learners on to further attempts at communicating, 2) that can encourage analysis of the unsuccessful communication, and 3) that can encourage learners to consider how they might prevent a recurrence – all of which are useful activities that support language acquisition.

It is equally important to recognise and respect that many students and educators will not wish to experience electronic conferencing systems – at least not initially – regardless of any bells, whistles, or ergonomic qualities they may offer. Moreover, some recent research has indicated that relying exclusively on cyber interactions may be psychologically harmful for some users (Brenner, 1997; Kraut, et al, 1998; Sleek, 1998). An important issue we have tried to address is the challenge of providing adequate opportunities for such learners in the context of telematic simulation. One possible solution involves encouraging students in a group to organize themselves to allow each individual to "play to his or her strengths" – at least at the outset.

Personality Factors in Collaborative Work

Students' communication when working in groups is strongly predicted by those students' Myers-Briggs personality Type Inventory (MBTI) scores (Kagan et al., 1987). Modern computer-based teaching systems place an emphasis on collaboration, and the overall activity and types of interactions undertaken by a group are known to be also under the influence of MBTI types such that the overall combined MBTI types of the individuals in a group accurately describe and predict that group's behaviour (Stever, 1995). This means that it is possible for an educator to accurately gauge the overall MBTI types of a particular cohort of students before formal educational practices begin. The potential for allowing modification of teaching style or learning environment to match individual MBTI types or even group MBTI types is enormous. For example, it has been found that most professors at universities teach in an MBTI type I (introverted) manner while students generally prefer an MBTI type S manner of teaching (Cooper & Miller, 1991), yet when professors deliberately teach in the manner matching their students' MBTI scores, student satisfaction ratings and overall grade performance are significantly enhanced (Provost, 1987; Cooper & Miller, 1991; McCutcheon et al., 1991; Fisher et al., 1998).

Currently, participants in IDEELS simulations are encouraged to complete an online MBTI questionnaire to become more aware of their own learning styles and needs. With our work investigating the links between personality types and student performance and attitudes in the IDEELS project we hope to be able to provide future educators using computer-supported learning environments with concrete data on the preferences they are likely to find amongst students with particular MBTI types.

Not Teaching, but Facilitating Learning

One of most important factors in making technology-enhanced learning environments successful is the presence of an adequately trained and resourced human facilitator. In other words, the most successful application of computer- and Internet-supported learning is as a complement to face-to-face classroom learning, not as a less expensive substitute. Project IDEELS resources for new group facilitators include manuals on facilitating and debriefing, facilitator training workshops, a facilitators' community in OPUSi, teaching suggestions and answer keys for many of the preparatory activities, one-on-one mentoring by experienced facilitators in the area, and a facilitator-training CD.

Issues for Distance Education

A short-term study of the use of DLE for the teaching of negotiation theory (McKersie & Fonstad, 1997) reported that there were major differences between the pedagogical methods that are suitable for normal teaching and those suitable for computer-based distance education. The major advantage noted for DLE was that it gives students access to educational resources that they might otherwise be unable to use because of time limitations or geographical location. This potential for greater access to higher and more specialized learning is of great interest to a wide group of potential students, including those whose physical or mental disabilities might have otherwise prevented them from such educational opportunities (Gay, 1996).

However these same factors also place a great responsibility on the designers and facilitators of DLE systems. The systems of strict deadlines for assignments or exercises becomes very problematic for students who may be pursuing distance education because they have insufficient time to devote themselves to traditional full-time education or because of some other factor in their lives. Another issue that is closely linked to this deadline problem is that of providing support in the course for students who fall behind in the course progression because of some legitimate reason. Many distance based instruction systems simply rely on the student working through the course modules more quickly on their own. When many students fall behind it is because other external factors have introduced considerable additional stresses into their schedules. It may be inappropriate to expect these students to adapt by increasing their academic work load, instead a more student centered approach may be to provide alternative credit accumulation schedules, with delayed examinations and class graduations away from a fixed academic calendar.

Meeting research, evaluation and validation needs without compromising the quality of the simulation experience

In Project Ideels we have implemented what we feel constitute ***unobtrusive measures*** of the participants' backgrounds and attitudes and of the effects of the simulation, in part through an on-line survey administered before and after the simulation period[1]. The on-line survey consists of web-based questionnaires (HTML documents) that the participants can respond to at their convenience, either at the university / college or at home.

The pre- and post-simulation questionnaires measure the following (Fig. 2):

Pre-simulation questionnaire http://www.hint.no/~kne/ideels/pre_sim.htm	**Post-simulation questionnaire** http://www.hint.no/~kne/ideels/post_sim.htm
Background variables (gender, age, attitudes,experience etc.)	
Language related skills, attitudes	Effect on language development[2]
Cross-cultural / cross-disciplinary experience, perceptions, attitudes	Evaluation of cross-cultural experience
Collaboration experience/experience with team-work	Evaluation of team work
Expectations towards the simulation	Experience with the simulation
Human rights issues (November 2000 & March 2001)	Human rights issues – revisited – - allows for an evaluation of attitude change
	User Interface Satisfaction: evaluation of OPUSi software for teleconference within Project IDEELS

Figure 2: Comparison of Pre- and Post-Simulation Surveys

Since 1998 Project IDEELS have utilized this design of a pre- and post-simulation on-line survey of participants in four different simulations where the focus has been:

1998: Designing the Eutropolis Education System
1999: Tertiary Education and Training in Eutropolis and Eutropia
2000: Human Rights in Eutropia
2001: Immigration Policy in the Eutropian Federation

The questionnaires used across these four points in time have a common core of questions (both pre- and post-simulation questions), which allows for an analysis of effects across different scenarios.

Results from the Project IDEELS pre- and post-simulation surveys may be found at:

http://www.hint.no/~kne/ideels/results/

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KnixSOM Method for Information Resource Management

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KnixSOM is an alternative method for information resource management. KnixSOM is a method for organizing metadata based documents into a meaningful maps for exploration and search. KnixSOM is based on the SOM (Self-Organizing Map) algorithm that is used to automatically organize the documents onto a plane so that contently related documents appear close to each other.

Document maps are constructed by using SOM_PAK, a non-commercial software package developed at Helsinki University of Technology in Laboratory of Computer and Information Science. An interface written in JAVA2 applets is used to control the programs in the SOM_PAK. Document map is automatically created and converted into generic XML format and into SVG for visual presentation.

KnixSOM is connected to a Knixmas database (part of Knixmas project, EU-Inco N 977113), which is a relational model database implemented in Oracle SQL server. The database contains metadata instances about research documents, so that each document is processed as an independent entity that has no relation to other document metadata instances. The document metadata is organized into groups and elements according to the Dublin Core document metadata specification.

Development and Evaluation of Introductory IT Self-training System for Life-long Learners

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As a contract research trusted by Digital Communities Promotion Office (DCs), a set of self-instructional materials for beginning users of computers and network has been designed, developed, and pilot-tested. The materials cover such basics as Introduction to PC, the Internet (Web browsing), E-mail, Word, Excel, and Power Point, all of which are introduced using clear and useful examples from everyday life. Clear checkpoints are given so that the beginners can proceed their training by themselves at their speed. A three-day training program was designed and carried out with those interested in involving in local community activities to be a licensed IT teacher. Characteristics of both instructional materials and training program will be summarized as to how this new set of life-long educational opportunity is different from traditional learning materials which can be seen in Japan. The process of material development and the results from field studies will also be reported.

A Navigation Path Planning Assistant for Web-based Learning

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Abstract: The main topic addressed in this paper is how to help learners navigate in existing web-based learning resources. In order to resolve this issue, we propose a learner-centered navigation path planning. The key idea is to provide learners with a path planning space, in which they can see through hyperspace to plan a navigation path. This paper describes an assistant system called Planning Assistant (PA for short), which is composed of the resource map, page previewer, and path previewer. The page previewer generates an overview of each web page in the map by extracting representative information from the html file. The path previewer helps learners make a sequence of the pages previewed as navigation path plan. These facilities help learners decide which pages to visit and plan a navigation path without visiting web pages. This paper also describes an evaluation of leaner-centered navigation path planning with PA. The results indicate that PA facilitates learners' navigation in hyperspace, particularly in more complicated hyperspace.

Introduction

An increasing number of hypermedia-based resources on the web have been available, which are designed from an educational point of view, or which are worth learning (Brusilovsky, 1996). Learning with such existing web-based learning resources has accordingly become important, particularly as the realization of lifelong and distance learning (Kashihara, 1998).

Web-based learning resources provide learners with hyperspace where they can explore domain concepts in a self-directed way by following the links among web pages to achieve a learning goal. Such self-directed learning (Fischer, 1998, Dee-Lucas, 1996) could produce good results. On the other hand, learners often fail in making the navigation path since they do not know which link to follow for achieving their learning goal due to the complexity of hyperspace. They may alternatively make diverse cognitive efforts at comprehending the contents of pages, setting up global or local learning goals, making a path called navigation path attaining their goals etc., in the exploratory learning. How to facilitate learners' navigation and learning has been consequently a major issue in educational hypermedia systems (Conklin, 1987).

The main topic addressed here is how to help learners navigate in existing web-based learning resources. Current work on educational hypermedia systems has provided a number of navigational aids such as spatial/concept maps and adaptive navigation (Domel, 1994, Heiling Huai, 1997). These representative navigational aids would generally work well in educational hypermedia whose semantic structure has given or analyzed. However, it is doubtful whether they apply to web-based learning resources. Existing web-based learning resources mostly have no concept maps. It is also hard to identify semantic structure of domain concepts embedded in the learning resources. Although there exist web-based learning resources with site maps, the information included in the maps do not always allow learners to foresee the contents of the web pages. In addition, adaptive navigational aids are not always applicable since existing web-based learning resources generally have no clear description of semantic relationships among web pages, which is indispensable for executing the adaptation.

Towards this issue, we introduce a learner-centered navigation path planning. The key idea is to provide learners with a planning space, in which they can see through web-based learning resources to make a navigation path plan, apart from hyperspace. Such planning space is also expected to facilitate their learning since they can focus mainly on comprehending the contents of the learning resources in hyperspace. We have accordingly developed an assistant system for the navigation path planning, which is called Planning Assistant or PA for short. PA provides learners with some facilities that help learners decide which page to visit and plan a navigation path without visiting hyperspace.

This paper also describes an evaluation of learner-centered navigation path planning with PA. The results indicate that PA facilitates learners' navigation particularly in more complicated hyperspace.

Navigation Path Planning

Problems of Navigation in Hyperspace

In hyperspace, learners can explore the web pages in a self-directed way by following links among the pages to learn domain concepts embedded in the explored pages. The self-directed learning involves making a navigation path, which consists of pages that the learners decide to explore. However, they often fail in making the navigation path and reach an impasse. There are two main causes as follows.

- The learners cannot foresee what they should explore next from the current page for achieving their learning goal due to the complexity of hyperspace.
- The learners need to concurrently make diverse cognitive efforts not only at making a navigation path but also at setting up global/local learning goals, comprehending the contents explored, and so on.

Framework of Navigation Path Planning

Let us now introduce a framework for learner-centered navigation path planning in order to resolve the above navigation problems. There are two key points of the learner-centered navigation path planning. The first one is to divide learning process into navigation path planning and exploration (plan execution) phases as shown in Figure 1. In the planning phase, learners decide which page to visit and the sequence of pages visited. In the exploration phase, on the other hand, they are expected to explore hyperspace according to their navigation path plan. These phases are repeated during learning in hyperspace.

The second key point is to provide learners with planning and exploration spaces. In the planning space, learners can see through hyperspace provided by a learning resource to plan a navigation path. In the exploration space, on the other hand, they are expected to execute their navigation path plan. Such distinction allows the learners to focus mainly on cognitive efforts that are related to each phase.

We next discuss how to support learner-centered navigation path planning with some essential facilities for each phase.

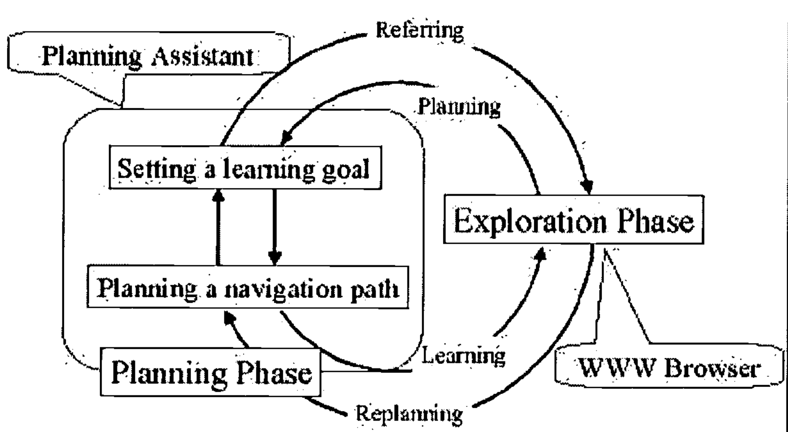

Figure 1: Learning process

Support for Planning Phase

In order to plan a navigation path successfully, it is first important to get information for setting up global/local learning goals. Some existing educational hypermedia systems have provided the resource map, which represents hyperspace as network of nodes corresponding to web pages. Although the resource map provides learners with information for considering navigation path, the map alone may not always allow them to sufficiently foresee the contents of the web pages. Therefore, some additional information is required. However, planning with the full contents of the web pages causes the same navigation problem as hyperspace usually produces. This suggests the necessity to give learners an informative overview of the contents. In this paper, we introduce page previewer that tries to extract keywords, sentences, or images to be considered representative from a web page to display them as the preview of the page. The resource map with the page previewer enables learners to grasp not only the whole structure of web-based learning resource but also an overview of each web page. Referring to this information, the learners can consequently set up learning goals easily.

In addition, the navigation path planning involves considering the relationships among web pages explored, changing the plan, and replanning over again. We accordingly introduce the path previewer, which makes a sequence of the previewed pages that are put in order by learners. The path previewer enables learners to compare neighboring pages and to plan a navigation path for achieving their learning goal without visiting hyperspace. Since the navigation path also gives learners an overview of the contents to be learned as advanced organizer before exploring hyperspace, their learning in hyperspace can be improved (Ausubel, 1961).

Support for Exploration Phase

After the planning phase, learners are expected to follow their navigation path plans during the exploration phase. We accordingly introduce the navigation controller that enables them to explore along their navigation path plan in a simply way. However, the learners do not always need to follow the navigation path. They can explore pages that are not included in the navigation path with web browser. When they want to change or cancel the navigation path during the exploration, they can return to the planning phase.

Planning Assistant

Let us next demonstrate PA. Figure 2 shows the user interface of PA, which consists of the resource map, the page previewer, the path previewer and the navigation controller. PA has been implemented with Microsoft Visual Basic 6.0 as plug-in tool for Microsoft Internet Explorer 4.0 (IE for short) or higher.

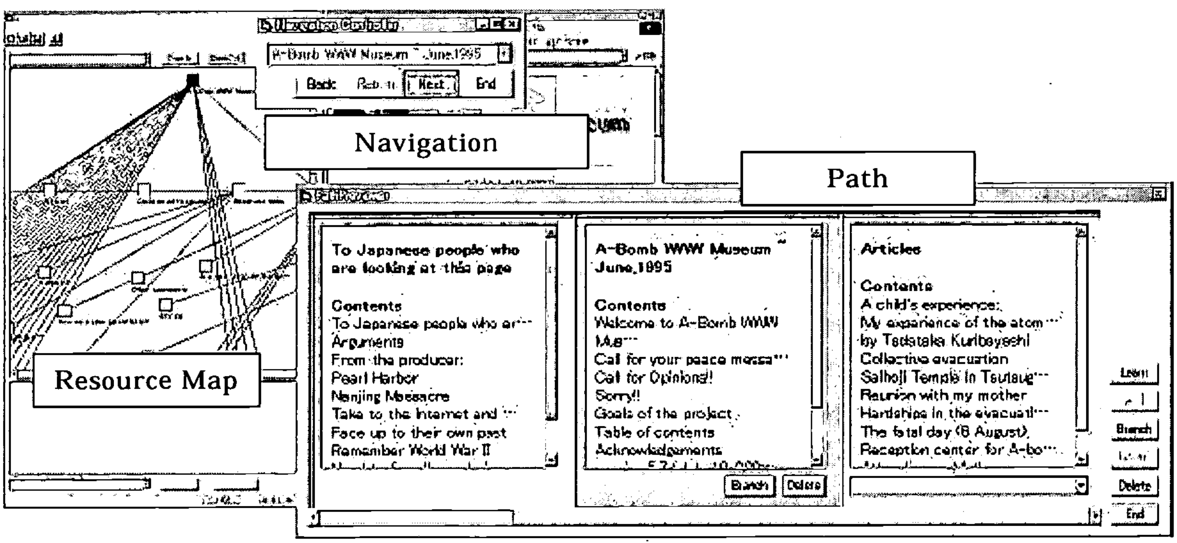

Figure 2: User Interface

Resource Map

The resource map represents hyperspace of a web-based learning resource selected by learners as network of nodes corresponding to the web pages. It is automatically generated and displayed in the map window when they select the learning resource. The resource map represents the web pages only within the same web site where the homepage selected by the learners is located. The links from the site to others are omitted. Nodes in the resource map are tagged with page titles indicated by title tags in the html files. In addition, we added a title list of all pages in the web site. These facilities enable learners to decide from which page to start their navigation path planning. In selecting a node or title, they can have an overview of the web page with the page previewer.

Page Previewer

The page previewer extracts key information such as words, sentences of images attached to some html tags in a page selected and displays it as an overview of the page. Table 1 shows the html tags that can be considered representative of the page, and Figure 3 shows an example of the page previewer. The right window displays the preview of a web page shown in the left window. As for the links out of the page, the page previewer searches for <A href> tags in the html file, and displays all titles of the linked pages in the drop-down menu as link list at the lower part of the page previewer. In planning a navigation path, the learners can start the path previewer by pushing the 'Path' button in the page previewer.

Table 1: Html tags

[illegible]	[illegible]
[illegible]	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	
[illegible]	[illegible]
[illegible]	
[illegible]	[illegible]

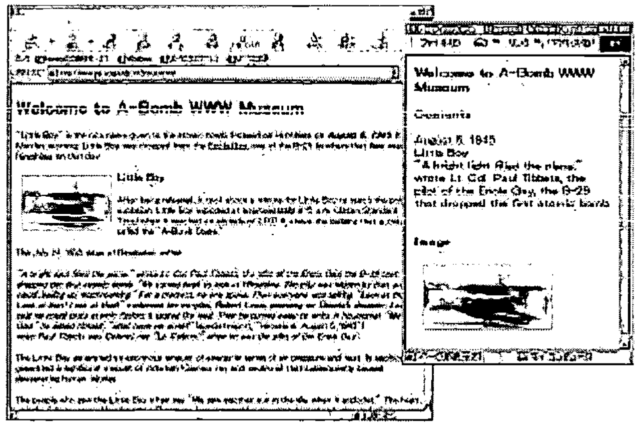

Figure 3: An example of the page previewed

Path Previewer

The path previewer makes a sequence of pages learners have previewed, which pages are put in order by learners. The order of the previewed pages accordingly represents a navigation path plan. How to plan a navigation path is as follow, (i) learners select a next page from the link list which displays titles of the pages directly linked to the current page, (ii) the path previewer displays an overview of the page selected next to the current page, (iii) if they want to add the page into the sequence, push the "Add" button it and return to (i), and (iv) if they do not want to add the page selected, return to (i) and select a next page again. In this way, the path previewer helps them plan (add, delete and branch), change, and replan their navigation path.

Navigation Controller

The navigation controller enables learners to explore along their navigation path plan in a simple way. Pushing ' Next ' button, the learners can explore the next page on their navigation path plan. They can also explore pages that are not along their navigation path plan. When the page explored by them is not along their plan, the navigation controller puts a warning icon and shows 'Return' button in order to come back on their navigation path plan. When they also want to change or cancel the navigation path during the exploration, they can return to the page previewer and the path previewer from the node corresponding to the current page on web browser.

In this way, learners are expected to repeat the planning and exploration to accomplish their learning in a self-directed way.

Evaluation

Purpose

In order to evaluate the effectiveness of PA, we conducted an experiment. The main purpose of this experiment was to ascertain if PA facilitates navigation in hyperspace compared to navigation without PA. We prepared two learning resources, which had comparatively simple and complicated hyperspace, and ascertained for which resource PA supports navigation more effectively.

Domain and Subjects

Table 2 shows the two learning resources ([1], [2]). It describes the number of pages, the number of links per page, which was calculated except for navigation links such as Next, Back, and Top, and the longest distance from the homepage to terminal page that has no link. These can be viewed as the indicator of the complexity of hyperspace each learning resource provides. The learning resource 1 accordingly had a more complicated hyperspace. Subjects were 32 graduate and undergraduate students in science and technology who were not familiar with the domain of the learning resources.

Table 2: Learning Resources

	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

We set four conditions, which were (1) planning and execution with PA in learning resource 1 (Complicated-With), (2) exploration in learning resource 1 without PA (Complicated-Without), (3) planning and execution with PA in learning resource 2 (Simple-With), (4) exploration in the learning resource 2 without PA (Simple-Without). Subjects were provided with IE as web browser under each condition. In this experiment, each subject learned one learning resource without PA and learned the other with PA. Moreover, we assigned the subjects into four groups in order to counterbalance these conditions.

Procedure

The procedure of the experiment with each subject was as follows:

(1) He/she was given the explanation about how to use PA.
(2) He/she was given several problems as learning goals for learning resource 1 (or resource 2). The problems were classified into (a) single problem whose answer could be found within one web page, and (b) compound problem whose answers could be found in the relationships among two or three pages.
(3) He/she was required to explore answers to the single problems and compound problems within 15 minutes each with PA (or without PA), and to copy and paste the URLs of the web pages considered as the answer.
(4) When he/she finished finding out the answers or 30 minutes passed, he/she was given several problems for another resource and was required to repeat the same way with another condition.
(5) Comparing the scores and the behavior of subjects under Simple-With and Simple-Without or under Complicated-With and Complicated-Without, we evaluated the effectiveness of PA.

We measured three criteria that were 'achievement', 'accuracy', and 'efficiency' of navigation, which were calculated from the scores. 'Achievement' was calculated from the number of questions they answered within time limit (15 minutes for each condition). 'Accuracy' was the percentage of correct answers per the answered questions. 'Efficiency' was calculated by multiplying 'achievement' and 'accuracy'.

We also measured the influence on navigation in hyperspace by the number of revisited pages and a number of visited pages per all pages included in the learning resources, which were indicated from the behavior of subjects.

Results and Discussion

Table 3 shows the average of the 'achievement', the 'accuracy', and the 'efficiency' on each condition. As for the compound problems, the average of the 'accuracy' on Complicated-With was significantly higher than that on Complicated-Without ($F=11.14$, $p<0.01$). The average of the 'efficiency' on Complicated-With was also higher than that on Complicated-Without ($F=21.34$, $p<0.01$). From these results, it was ascertained that PA enabled learners to plan a good navigation path for achieving their learning goals especially such as

Table 3: Experimental Result

[illegible]						
	[illegible]			[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]						
	[illegible]			[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

relating web pages each other in more complicated hyperspace. In a simpler hyperspace, on the other hand, PA could not be so effective since it was able to easily see through the learning resource even without PA.

Table 4 shows the average number of revisit per page explored on each condition. The results indicate that there is a significant difference between the average number of Simple-With and Simple-Without ($F=29.10$, $P<0.01$). There is also a significant difference between Complicated-With and Complicated-Without ($F=63.83$, $P<0.01$). These results indicate that PA reduces learners' behavior of revisiting the pages that have been visited both in simple and complicated hyperspace. In other words, PA enables learners to see through learning resources.

Table 5 shows the average number of visited pages per all pages on each condition. There was a significant difference between Simple-With and Simple-Without ($F=46.19$, $P<0.01$). There is also a significant difference between Complicated-With and Complicated-Without ($F=183.18$, $P<0.01$). These results indicate that PA makes exploration in hyperspace intensive. In addition, the average of 'efficiency' on Complicated-With was very high as shown in Table 3. These results indicate that PA enables learners to more efficiently direct their attention to pages, which fulfill their learning goals, particularly in a complicated hyperspace. From the above results, we can say that PA has a potential for facilitating navigation in a more complicated hyperspace.

Table 4: The average number of revisit pages

	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Table 5: The average number of visited pages per all pages

	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Conclusion

This paper has proposed a learner-centered navigation path planning for learning with existing web-based resources. The important point is to provide learners with a planning space where they can see through the web pages to plan a navigation path. As the advantages, learning in hyperspace can be improved since the distinction between planning phase and exploration phase allows learners to focus mainly on comprehending the contents of the learning resources in hyperspace. The navigation path can also give learners an overview of the contents to be learned before exploring hyperspace.

This paper has also demonstrated a support system called PA including the resource map, the page previewer, the path previewer, and the navigation controller. These facilities allow learners to plan and explore a navigation path plan in a simple way. In addition, this paper has described an evaluation of PA. The results indicate that the system produces good effects on navigation in a complicated hyperspace.

In the future, we need a more detailed evaluation of the learner-centered navigation path planning. We would also like to provide more adaptive aids in the page and the path previewer.

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Development of a CD-ROM based In-service teacher training program for ICT instruction

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Abstract: A CD-ROM based In-service ICT Training Program for schoolteachers was planned, developed, and delivered to all of 40,000 schools throughout Japan. The training program was designed to guide self-regulated workshops within an elementary or secondary school with little experience of using ICT in their instruction. The design and development was carried out by a group of researchers and teachers leading ICT application in school education, organized by the Center of Educational Computing and sponsored by the Information-technology Promotion Agency foundation (IPA). The pilot studies were carried out while the training program was being developed. Observations and questionnaire revealed that this new approach of self-regulated training package was welcomed by the participants. Characteristics of In-service training programs in Japan and importance of this study for preparing Japanese teachers for ICT utilization in everyday classes are discussed.

Introduction

A CD-ROM based In-service Training Program for schoolteachers to obtain practical skills in designing lessons with ICT was planned and developed, which has been delivered to all of 40,000 schools throughout Japan. The training program was designed to guide self-regulated workshops by school teachers within an elementary or secondary school who have little experience of using ICT in their instruction. The design and development was carried out by a group of researchers and school teachers leading ICT application in school education, organized by the Center of Educational Computing and sponsored by the Information-technology Promotion Agency foundation (IPA).

The Training Program

The training program consists of a CD-ROM, two Video programs, and a workshop text (See Fig.1). The contents of the training program include the followings:

(1) How to overcome fear of ICT
(2) ICT workshop beyond skill training
(3) Procedures for Self-regulated workshop
(4) Forms for planning ICT instruction
(5) Introductory excises for ICT instruction, and
(6) Sample workshop outcomes from pilot studies

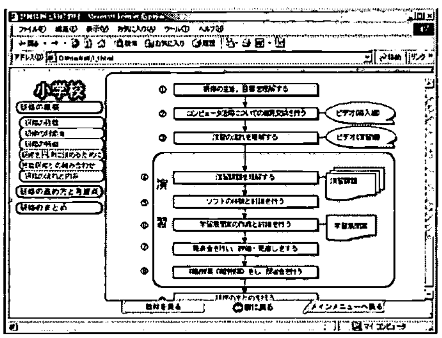

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Fig.1 Sample screens

Evaluation of the Program

The pilot studies were carried out while the training program was being developed. Observations and questionnaire revealed that the participants welcomed this new approach of self-regulated training package. Further studies are needed to verify how this program are in fact utilized at each of school sites and how much it has been effective to create more ICT applications in classroom, as well as more positive thinking toward ICT in teachers mind.

Contributions of the Program

Integration of ICT technology into everyday classes requires reconsideration of instructor-led lecture style chalk-and-talk approach that has been the main methodology found in Japanese classrooms. This can be an opportunity to make school lessons more student-centered and self-directed learning. In order this change to take place, teachers need to be trained for a major change of their roles.

Contrary, typical teacher training programs in Japan have been instructor-led chalk-and-talk style. Teachers themselves need to experience how to learn in a self-regulatory manner, when they are learning something new, such as ICT and its application to classroom. In this respect, this program should give the teachers an opportunity to learn new skills in a suitable learning style.

The Information Revolution and The Future Role of Educators

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Abstract: The purpose of this paper is to identify trends which are likely to come to fruition in the near term future and generate implications for the educational professional. The trends focus upon the information communications revolution and one subset, the coming Instructional Technology (IT) revolution. Ideas have been abstracted from a forthcoming chapter in the International Handbook on Information Systems. (In Press). H. Adelsberger, Collis, B., & Pawlowski, J. (Eds.). Berlin: Springer-Verlag.

The Scenario Approach

Predicting the future beyond lunch can be at once frustrating and unrealistic. An alternative is to consider different plausible scenarios of what might happen, develop a plan for each scenario and monitor events to decide which plan to implement. This scenario strategy has been used extensively in various business-futures planning (e.g., Schwartz, 1996).

The first scenario, at one extreme, is that nothing will change significantly from the current state of affairs. A teacher from the early 1900s who was magically transported to a current classroom would feel quite at home. The appropriate strategy might be to maintain a low profile in the trenches, keep your helmet pressed down around your ears and keep your head low. It is regularly practiced by many who are either within a few years of retirement or view their role as stewards of the institution who will turn it over to their successors in the same fine shape they received it. Some have suggested the lack of wisdom of this approach.

> Universities won't survive...higher education is in deep crisis. Already we are beginning to deliver more lectures and classes off-campus via satellite or two-way video at a fraction of the cost [of traditional courses]. Today's [campus] buildings are hopelessly unsuited and totally unneeded. (Drucker, quoted in Green, 1999, p 15).

In a series of studies of campus computing in the USA, Green paints a somewhat dismal picture of the preparedness for this change when he says "the evidence suggests that as an "enterprise," higher education remains mostly unprepared for the consequences of this coming convergence." (1999, p. 11).

The other extreme end of the scenario spectrum is that the ICT revolution will dramatically effect how instruction is delivered in a major and revolutionary fashion. A teacher of today, transported into this new future, would be bewildered, out of place, and find difficulty determining what to do or say. The viability of this scenario of the future of education is based on machine and intellectual technologies which have been promised and are being tested at this time, plus successful experiences on smaller or non-educational scales than proposed in the following scenario.

Below are some guidelines to prepare educators for the IT society based on a review of current and projected technological and sociological developments.

Specialize in Change and Reform

If IT is not "rocket science" and can be implemented by any educator with proper support, particularly that which is provided in the context of the interdisciplinary team (see below), why has it been so little used? One answer whose credibility is growing is that IT represents a major innovation and the diffusion of innovation involves change. Bates has argued that

> New technologies are associated with postindustrial forms of organization based on highly skilled and flexible workers with a good degree of autonomy organized into relatively small and flexible operational units. In contrast, universities and colleges have been characterized by a mixture of agrarian and industrial forms of organization, with hierarchical, bureaucratic, and relatively inflexible organizational structures and procedures...the introduction of new technologies for teaching will require a major shift toward postindustrial forms of organization for universities and colleges." (Bates, 2000, pp. 1, 2).

It behooves us to learn all we can about the process of diffusion of innovation (change), whether it comes from a managerial, administrative higher education framework (e.g., Bates, 2000), a business leadership framework (Kotter, 1996; Senge & Roth, 1999), a sociological, psychological framework (Rogers, 1995), or an educational technology framework (Fullan, 1991, 1992, Szabo et al, 1999). This leads directly to the second role.

Understand Innovation Rules and How They Apply to IT

IT must be respected as an innovation and its diffusion (Rogers, 1995: Szabo, 1996; Szabo & Anderson, 1997; Szabo, Anderson & Fuchs, 1999). This approach begins with an examination of those factors which characterize successful and unsuccessful innovation diffusion, from a variety of fields of human endeavor. It then constructs a system to optimize the effects of those factors. This paper looks at eleven characteristics of innovation and implications for the IT educator.

Focus on the Intellectual Technology, as Well as the Machine Technology

It is often stated that IT is too expensive. Exploring this notion further results in the conclusion that in education, machine technology costs are quantifiable and add-on, while the supposed benefits (increased achievement, effectiveness, attitude and access) are neither 1) easily quantified nor 2) valued in a practical, applied sense in education (which faculty member's increments or other rewards are based on how much their students achieve or how quickly)?

While it may be true that it is a zero-sum game for machine technology (money spent on IT must come from some other part of the budget), the intellectual technology represented in the employees of the university or college is a rich, renewable and expandable resource. And it is this technology which creates the programs which drive the learning process which is presented by the machine technology.

Predict Directions Computing is Going and the Implications for Education
Networking

The global network of interconnected servers and clients will enable every educator (and student) to not only obtain resources from any location in the world, it will also enable every educator to contribute resources where they have expertise.

Broadband Transmission

The first infrastructure technology element is broadband communication which will enable the transmission of interactive and multimedia computer files significantly larger than anything we have today outside the research laboratory. At the time of this writing, governments are selling expensive licenses (average cost in

Britain of $7B per licens) for third generation (3G) broadband frequencies which will significantly increase the ability to transmit large (e.g., full motion, full color video) files using wireless technology.

Wireless Communication

Wireless communication will permit full access to all educational services we now have and more, from any place in the world without a physical connection. On the day everyone has a single access number and full multimedia capability on a portable wireless device, we will have to rethink how, when and why we communicate with students, colleagues, administrators, suppliers, and experts.

Internet Appliances

Internet appliances are consumer electronics which incorporate elements of wireless phones, audio-visual entertainment devices and traditional PCs into useful devices. One such device resembles a 20 by 29 cm notepad with a digital screen, pencil-like pointing device and wireless connectivity. This prototype hand-held device and presumably its successors (1) are made possible by microchips with high power but low power consumption, (2) will enable complete, interactive, multimedia-based courses of instruction to be received anywhere, and (3) will become relatively inexpensive if the forecast high volume consumer demand drives down prices. One implication is that the costs of distance education compared with conventional learning will become exceedingly attractive, especially when one considers the tradeoffs of the time and inconvenience and lost opportunity costs of relocating to an institution of higher education.

Databases

The third technology is also currently available as exemplified by the VISA credit card phenomenon which operates with vast interconnected server-driven databases which collect, store, quickly analyze and regurgitate on demand, information requested by authorized users, clients, and administrators in report format which they specify and control. Imagine the existence of master, world wide educational databases which contain detailed information about every conceivable aspect of educational life everywhere on the globe. Educators will have to create, maintain, and use these databases for the benefit of their students.

New Models of Operation Infrastructure

The fourth infrastructure component is a function of the human rather than technological concepts. This involves a major reconstruction of the educational systems of the world.

> The advent of the Internet is a massive, even unprecedented exercise in managing change...Success requires changing the model for how to organise the work and lead the organisation. It requires challenging traditional assumptions about organization, communication, decision-making, operating style, managerial behavior -- and then defining a new way. *That is a human problem, not a technological one.*" [emphasis added].

Indeed it will require a major cultural change (Bates, 2000; Szabo, 1996).

CMC may result in a major leap forward in the development of the global brain, discussed elsewhere in this paper. It certainly seems to be playing a role in the development of the operating system called Linux. Anyone can change the code to improve or extend its functionality, but the changes must be made available to other users. Theories of learning which place high value on knowledge construction through dialogue with others and reflection may benefit from enhanced CMC in the forms of computer conferencing, e-mail, list servs an other facilities which have yet to be developed.

Preserve conditions of intellectual freedom and open political institutions

The Post Industrial Society and its current incarnation, informationalism, promise men and women greater control of their social destinies. "But this is only possible under conditions of intellectual freedom and open political institutions, the freedom to pursue truth against those who wish to restrict it. This is the alpha and omega of the alphabet of knowledge." (Bell, 1999, lxxxiv). But this requires action and reflective thinking. "In times of rapid technological change, reflective practice is virtually an occupational necessity for everyone (Guiton, 1999, p. 52).

Respond to Changes in Educational and Social Goals

Increased demand for intellectual education and training for service, professional and managerial employment, coupled with decreased but nevertheless existing demands for skilled and semi-skilled workers. These latter will be reduced by such technologies as performance support systems and expert systems, which in turn will require building. There will also be a growing need to retrain and re-orient workers displaced by informationalism and provide entry into the market.

Another area of concern to educators is a somewhat uncomfortable concept--market share and competition with other educational institutions, commercial firms, and international alliances. Does your institution want a market share of the education and training industry, and if so how much? In the early days of the Internet, it will be easy for institutions to capture a nice share of the student market, but there are signs that will change as competition heats up.

Develop and Use Technology to Communicate

Computers aren't just for number-crunching anymore. They have become powerful but limited tools to support a wide range of communications. Consider the role of reflection and expertise among members of a class and how those elements can be used to enhance and enrich the educational experience of the whole class.

Break Free From Conventional Bonds, Thinking

The term horseless carriage was used to define the first automobiles-a blend of the old and new. But retaining the old, while providing some level of comfort, may have hindered the appearance of the new. Perhaps the term distance education will conjure up images of the classroom in different regions and have a stifling effect on the culture change necessary.

One way to break from conventional bonds is the look at things from a different perspective. It has been said that a chicken can be defined as a device which an egg uses to reproduce itself.

There are myriad details of how this could or should take shape; too many to include here. An extensive review of immersive instruction through virtual reality technology may be found in McLellan (1996). The outcome, however, is that any student can access the best education in the world from any location in the world in any time zone. The global brain will be strengthened. Now if we could just make similar progress and expand results like these into the arena of ethics, morals, and the realm of spirituality.

Change is guaranteed but what that future will look like must wait until it happens. It is likely however that change will continue at a rapid, even accelerating pace. Several other conjectures come to mind. First, unlike most of the rest of our economic, social and cultural environment, education has to date been largely untouched by the sweeping changes arising from the ICT revolution. It seems likely that this will change; that ICT will ultimately have a transforming effect upon the way we conceive of and deliver educational services.

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An Evaluation of TIES (Training, Infrastructure & Empowerment System): Evaluating Learning Technology Initiatives in Continuing Professional Development

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TIES is a system of professional development for educators in the process of change through instructional technology. It is built on the twin assumptions that instructional technology is an innovation, and educators fail to recognize the implications in terms of innovation diffusion. The TIES foundation is derived from a distillation of characterteristics of successful and unsuccessful innovations. The outcome is a multi-faceted approach in which senior academics are encouraged to set a vision for the institution, and strategically-located and constructed leadership teams work to interpret and make that vision become a reality. This session describes TIES, its implementation in a research university, and results of interview-based research of a cross-section of TIES participants.

Constructivist Approach Towards Designing IT-based Constructivist Learning Activities

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Abstract: A nation-wide Masterplan for IT in education was implemented in Singapore since 1997. To help overcome the shortage of instructional programs, an innovate approach, called microLESSONS™,was devised to help teachers develop their own IT based instructional materials using MS Powerpoint ™. In addition, it is also a way to help teachers to adopt a more constructivist approach by engaging them in designing constructivist learning activities.

Background

To meet the challenges of the 21st century, the Ministry of Education in Singapore has launched the Master Plan for Information Technology (IT) in Education in 1997. IT based teaching and learning was identified as one of the key strategies to equip our young with skills to think, to learn independently and to communicate effectively. Teacher training plays a vital role in the successful implementation of the IT Master Plan. However, there remained a few thorny issues that could present great barrier to the successful implementation of IT Masterplan. These problems could undermine the effects of integration IT in instruction, rendering the multimillion-dollar investment to waste.

Problems

One of the problems we faced was the availability of instructional software. While there are commercially produced pre-packaged materials, many of these software were not relevant for the local curriculum. Though the Ministry of Education and some local software developers are producing materials tailored to our local needs, it takes time to produce quality materials. In addition, such effort is hampered by the limited market in this island nation with a population of only 3.9 millions people.

Many of the existing instructional software were designed based on traditional didactic approach in which the instructor assume the role of the fountain of knowledge. Instruction is focused on what information the learner needs to know or must know and then take the actions to provide the learner with the necessary information. While such didactic approach can be very efficient in disseminating information, the students are often not engaged in higher order thinking. The problem is aggravated in the learning of ill-structured knowledge domains, in which acquisition of simplified and compartmentalized knowledge often occurs (Spiro et al., 1992); students cannot handle complex, ill-structured problems in real-life situation.

The above problems might lead to another problem – perpetuation of the traditional instructional paradigm. Teachers using the available software, which are designed based on didactic pedagogy, might regard them as the model of IT-based instruction and such approach becomes more deeply entrenched in classroom practices. This is evident from the difficulty student teachers have in designing constructivist learning activities in our courses. Even after some discussion and feedback, some student teachers still revert to the show-and-tell method of instruction that they are familiar with.

Introduction to microLESSONS™

The microLESSONS™ project started in 1998 by Philip Wong, the head of Instructional Science academic group, as an research project funded by the National Institute of Education. In Jan 2000, Ednovation, a software company in Singapore, joined in to provide further financial and technical support for the development of microLESSONS™ . MicroLESSONS™ as the name implies, are small units of learning activities with specific learning objectives as opposed to most commercial learning materials that cover a complete topic or curriculum. They are student-centered materials that incorporate various hypermedia features (e.g. hyperlinks, animation, graphics, sound, interactivity) to enhance the learning process. To facilitate the process, a user-friendly hypermedia tool should be chosen so as to facilitate rather than hamper the production process. MS Powerpoint™ is chosen as the multimedia tool for this reason.

Potential Benefits of microLESSONS™

Creating a microLESSONS™ is an active learning of constructivist approach of instruction: the MS Powerpoint™ is used as a Mindtool (Jonassen, 2000) to engage the teachers in active construction of their knowledge about constructivist learning through design and development of something concrete and sharable. From our experience in conducting microLESSONS™ course, even after the initial exposure to microLESSONS™, many student teachers still start with traditional didactic approach. But through discussions and feedback, these student teachers could better understand the constructivist approach and become more receptive towards this alternative approach of instruction.

Once the teachers have mastered the skills of creating microLESSONS™, they have in fact been empowered to create their own IT-based learning materials. They are able to create materials customized to their needs instead of being totally dependent on commercially available software. The time needed to identify, evaluate, purchase and adapt existing materials is salvaged for more productive designing activities.

While the process of creating microLESSONS™ can benefit the teachers, the products, i.e. the microLESSONS™ will benefit the students. They are designed to engage the students with learning activities that emphasize active, intentional learning. These activities often encourage higher order thinking
-based cognitive tools like
simulations can also be included to enhance thinking skills.

One of the advantages of microLESSONS™ is the adaptability and transportability of the products. Each microLESSONS™ is a small unit of instruction that is easily adapted by the instructor. A teacher may use one or a few microLESSONS™ units in complement to non-IT based instruction to cover a topic. A teacher may also customize a microLESSONS™ unit by modifying the hyperlinks to other websites or programs. The small file size of microLESSONS™ facilitates transportability and they can be easily exchanged through floppy diskettes, CD-ROMs or the Internet.

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Image Analysis and Teaching the Concept of Function

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Abstract: The concept of function is key for understanding algebra and all higher mathematics. Using digital images and image processing, it is possible to introduce the concept of function in new ways which has the potential to be more compelling and effective for some students and which can better reflect the spirit in which functions can be applied in contemporary technology. We describe how two programs for PCs and Macintoshes, called the Pixel Calculator and the Image Warper, can support the exploration of function from a variety of viewpoints. While a digital image itself can be considered as a function, the many other kinds of functions which arise in image analysis support discussions of invertibility, composition, and design of functions for specific purposes. This approach encompasses an important aspect of functions: that they are objects to be *designed* and *applied* as well as objects to be contemplated and manipulated with formalisms. The materials and suggestions reported here represent one aspect of an ongoing project that explores applications of image processing in mathematics education.

Introduction

This paper presents an aspect of applying image analysis in education. Some issues related to teaching the concept of function are discussed. Particular materials developed by the project, "Mathematics Experiences Through Image Processing" at the University of Washington are described and their applicability to the teaching of functions described along with possible additional activities using image-analysis algorithm design.

As part of an effort to improve mathematics education in the United States and in other countries (NCTM, 1989), our project has been developing materials that permit mathematical ideas to be learned in a context of connections to the real world, relevance to students, use of computer technology, and rich visual representations (Tanimoto, 1994). This project focuses on middle-school and high-school students (ages 10-18); the age of 14 is a critical one in that more students leak out of the mathematics pipeline at that age than any other.

A key mathematics concept in the middle-school/high-school curriculum is the concept of function. This concept is crucial for understanding algebra, the differential calculus, and most higher mathematics Eisenberg, 1991). While the notion of function is extremely simple, the representations, terminology, and diverse examples of functions often lead to confusion for students. Functions are typically introduced using set theory, formal descriptions of numerical domains or other notation which may complicate the teaching of the basic concept itself. The use of graphs helps some students but may confuse others (Goldenberg, 1988).

An advantage of using computer-based image processing to teach about functions is that functions can be seen as *operational*. When a function is applied to an image, the function "comes alive" in a certain sense. This can have a positive motivational effect on students. At the same time, the computational context provides additional richness for the study of functions. The distinction between mathematical functions and computational functions is typically not made in grades K-12, and students who begin their formal study of computing in college must overcome this confusion at the same time that they are learning a programming language.

Images as Functions

Let's begin by considering images themselves as functions. One often thinks of a function as a rule for answering questions. The function $f(x) = x + 1$ can thus be considered as a scheme for answering questions such as "If you give me the number 2, what number will I give you back?" Another representation of such a rule is a table of values such as that shown below.

x	f(x)
0	1
1	2
2	3
3	0

In this way a function may be viewed as a type of correspondence between questions and answers.

Mapping to and from Coordinate Pairs

By considering a digital image as a slightly more elaborate table, which provides a way to give answers to questions of the form "What value is at x = 153, y = 39?" students can come to understand that a digital image may be used as a function and that it actually is a function. A consequence of this is that an image can be used as the key to a code. Provided that the image contains pixels with enough distinct values, a pair of coordinates can be used to represent a character of an alphabet. A student decodes a pair of coordinates by looking up the pixel value for that pair of coordinates in the image, and taking the k^{th} character of the alphabet, where k is the value of the pixel. The use of codes is a standard approach to involving students in mathematical activities in an informal way.

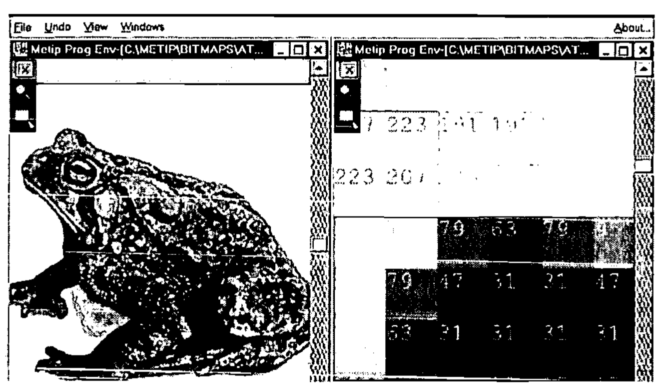
The Application of a Function

Once the student understands the concept of function as a rule for answering questions, it is important to distinguish the *application* of a function from the function itself. Where the function provides a *way* to answer questions, the application of the function is the actual *answering* of such a question. This point can be confusing, as the answer to a question could itself be an image and thus a function. An example of such a question is this: "What image results if we subtract each pixel value from 255?" (answer: a photographic negative of the original).

Pixel Calculator Operations as Functions

The Pixel Calculator

The Pixel Calculator is a program for displaying and manipulating digital images on personal computers. While its principal intended use is to introduce students to the digital representation of images, it may also be used to support discussions and exercises about the mathematical concept of function. The Pixel Calculator is first of all a display tool. As the user zooms into the image using the magnifier tool, the pixels of the image appear as gray squares, and when the squares are large enough, the numerical pixel values are overlaid upon them. In this way, the display shows both the visual and numerical aspects of digital images, and therefore it portrays a digital image as both a visual object and a mathematical object. Figure 1 shows two displays of a toad image to illustrate the combination of visual and numerical views afforded by the Pixel Calculator.



An illustration of visual and numerical displays of an image with the Pixel Calculator program.

In addition to the magnifier tool, the Pixel Calculator provides a rectangle-selection tool. With it, the user may select a rectangular region of pixels. When such a selection is made, a calculator object appears on the screen. The user may then modify the values of the selected pixels by entering values and operations on the calculator.

Operations on Single Pixels and on Multiple Pixels

One possibility when using the rectangle-selection tool is that the user clicks once without dragging and thereby selects only a single pixel. Performing calculator operations then affects only this one pixel. For example, entering # + 50 would cause the selected pixel to take on the value 50 plus its current value or 255, whichever is smaller. In this mode of use, the user is specifying a function and applying it to a single argument at the same time.

When the user has selected a rectangle containing more than one pixel, the operations entered into the calculator are applied to *all* the selected pixels. If the selection rectangle includes all the pixels of the image, then the user is causing the function to be applied to the entire image. One may consider this to be a multiple application of a pixel-oriented function or to be a single application of a different kind of function --- one that takes as its input argument an entire image rather than a single pixel value.

The Concept of Variable

A concept that is closely associated with functions and with algebra more generally is that of "variable." Mathematicians use variables for a variety of different purposes, and when variables are introduced to students for the first time, it is important to be clear on which purpose is intended. A variable may be an *independent* variable in a function definition. It may represent an *unknown* quantity to be established (in an algebra problem). A free variable may also indicate implicit universal quantification as in F(x,y) = 0. It has been pointed out (Kline, 1972), (Philipp, 1992) that the concepts of function and variable have been linked ever since they were introduced by Leibniz.

> Related numbers that change together, like x and y in the above equation, are called variables.
> When one variable depends on another for its value, we say that it is a function of the other.
> (Upton 1936, in Philipp, 1992, p.239)

The most important interpretation of variable is "varying quantity." This concept is specifically designed into the Pixel Calculator. The Pixel Calculator uses the symbol "#" to mean "the current value of the pixel." The operation "# + 50" corresponds to the function $f(x) = x + 50$. Thus # represents a quantity that generally varies from one pixel to another, and it plays the role of independent variable in formulating functions with the Pixel Calculator. The symbol #, which looks like a pixel, is preferable in this context to the symbol x, which not only has nothing obvious to do with the value of a pixel, but which can easily be confused with the x-coordinate of the pixel.

The same symbol can represent an unknown in an algebra problem without difficulty. Consider the following question: "If the user applied the function # + 10 to a pixel and the result was 25, what was the pixel value?" Expressed with the equation # + 10 = 25, the problem can be solved in the conventional way by subtracting 10 from each side to yield # = 15. The Pixel Calculator implements an arithmetic calculus that we have named "pixel arithmetic." Among other properties, pixel arithmetic obeys truncation semantics. Thus 255 + 1 produces 255 and 0 - 1 produces 0. Therefore, the next algebra problem has a multiplicity of solutions: "If the user applied the function # + 10 to a pixel and the result was 255, what was the pixel value?" The answer is "one of the values 245, 246, ..., 255." This sort of algebra problem, where the function as well as the result are given, and where it is required to find the starting pixel value, can be called "doing Pixel Calculator operations backwards."

Geometric Transformations with the Image Warper

While the Pixel Calculator supports the exploration of functions as operations on pixel values, another sort of function takes entire images as input values and produces transformed images as outputs where each output pixel may depend on the values of one or more input pixels in different locations.

The Image Warper is a program for personal computers which permits the user to specify geometric transformations on images using sets of line segments called "control lines." The program uses an algorithm reported in the SIGGRAPH'92 conference (Beier and Neely, 1992) which is part of a "
functions on images effected by the Pixel Calculator are specified in terms of operations on individual pixels. The pixel-wise function operates on each pixel independently and independent of the pixel's x and y coordinates. The Image Warper, on the other hand, transforms an image according to geometry—that is, according to the x and y coordinates of the pixels. After a student has warped an image by defining a set of control lines and their displacements, one may ask her/him the question, "Where is the function?" A student unfamiliar with functions as methods for transforming images may be tempted to say that the resulting image is the function, or that the pair consisting of the source and destination images represents the function. Once it is clear that the function is something that can be applied to any image of given dimensions, they may be able to realize that the function is

represented by the set of control lines and their displacements. In order to save the function, one saves the control lines (together with their displacements). The lines (and displacements), together with the algorithm implemented in the program, provide a specification of the function.

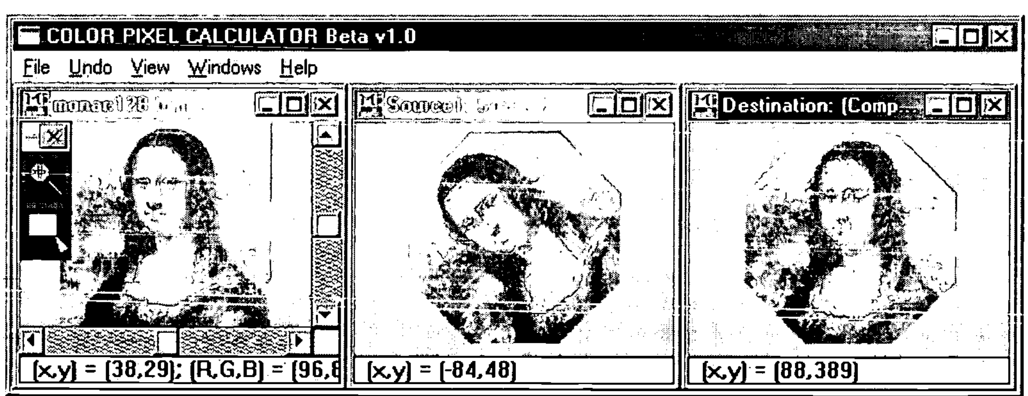
Invertibility of Functions

A useful property of functions that can be easily introduced through the image-processing context is invertibility. As mentioned above, doing Pixel Calculator operations backwards provides a simple way to pose algebra problems using the variable symbol #. The multiplicity of answers to the second problem above indicates, that it is not always possible to get back to precisely the value one started with when applying a function and then trying to go backwards. Such a discussion leads naturally into the concept of *invertibility* of functions.

While the concept of undoing the effect of a function is a natural one, the concept of *inverse* of a function is more subtle. The inverse of a function is also a function, and it must undo what the original function did to any element of the domain (e.g., any image, in the case of an image transformation). Strictly speaking, the inverse of a function must always produce the original element from the transformed element exactly.

When one considers an image itself to be a function $F{:}X \times Y \rightarrow \{0, 1, \ldots, 255\}$, the question arises whether such an image can have an inverse. If the image were a bijection (which would imply that the image has precisely 256 pixels), then the image would have an actual inverse, a mapping that assigns to each pixel value in the range a unique coordinate pair where that value occurs in the image. Since such images that might have inverses are so restricted and unlikely to occur if one were to use a commercial digital camera or scanner in the normal fashion, it is natural to ask whether there is some other way in which an image can have an inverse. The answer is "yes." It is common in image analysis algorithms to require answers to questions such as "Where in the image does the value *set* of coordinate pairs. If the number 73 is not the value of any pixel in the image, then the answer set is the empty set. Otherwise, it is a set consisting of all the (x,y) locations where the pixel value is 73. This kind of inverse is sometimes called the "relational inverse" of the image. Traditional lessons on invertibility of geometric transformations such as rotation, reflection, and scaling are implicitly based on a pure notion of invertibility. Applying a transformation to an image and then applying the inverse transformation to the image must reproduce the original image exactly.

In the discrete world of digital image processing, we can also identify different kinds of *partial invertibility*. For example, a translation of an image to the left by k pixels causes data to "fall off the edge" of the image and brings in potentially undefined at the right border of the image. The subsequent translation of the image to the right by k pixels is a partial inverse for the left translation, because some of the pixels are restored to their exact original values, but values in the leftmost k columns of the image are either undefined or set to a "padding" value. In the case of rotation around the center of the image by $\pi / 4$ followed by rotation by $-\pi / 4$, there is a similar loss of data due to pixels at the corners again "falling off" the image. However, there is an additional source of information loss. The resampling that must be performed in computing the rotated image in the discrete space of pixel samples causes a loss of detail. If the original image happened to be extremely detailed, this loss might not be noticeable. However, close inspection of the pixel values is likely to indicate that the pixels are not always brought precisely back to their original values. Therefore, this illustrates a second kind of partial invertibility.



An original image, its rotation by $\pi/4$, and the result of rotating it back.
The rotation transformation has a "partial inverse."

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These transformations which are at least partially invertible can be contrasted with image mappings that contain singularities. Such a mapping is easily specified with the Image Warper by drawing two line segments in the shape of a cross, and then rotating one of the segments by π in the destination window. The resulting transformation has a drastic effect on the images it warps.

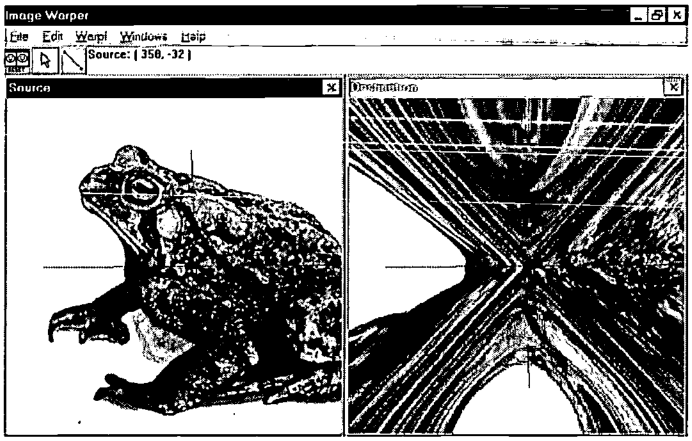

Illustration of warping with the "cross" transformation (non-invertible).

Functions as Processes

In presenting functions as process, one must note that unlike purely mathematical functions, computational functions have additional aspects such as temporal behavior and consumption of memory resources. The temporal behavior may depend upon not only the way in which the function is programmed, but the presence and behavior of other processes running on the same computer, the particular input values given, and the particular hardware that the program is running on. Computational functions are also different in that their domains and ranges are generally not the same as those of purely mathematical functions. Whereas mathematical functions often take as their domain the real numbers or vectors of real numbers, computational functions must usually limit themselves to finite representations such as double-precision floating-point values. Integers are often restricted to 32 or fewer bits.

Construction of Functions (or Functions as Designable Objects)

Mathematical functions are often conceived of as Platonic, pre-existing ideas that we may discover but not create. While it is indeed likely that any function that we can describe very simply (such as $f(x) = 2 \sin x$) has been "created" before and therefore is not "original," there is no reason not to consider functions as objects to be designed or created, and in image analysis and other areas of applied mathematics this is commonplace.

In order that students develop a sense that functions are objects to be designed, they need a means of expressing those designs. The basic building blocks of complicated functions are themselves functions, though they are simpler. Transformations on images may be built out of simpler transformations. Simple ones include translations, rotations, scale changes, and arithmetic operations on pixel values. Geometric distortions can be expressed in terms of mathematical functions applied to the coordinates of pixels.

Students can explore the design of functions from either the bottom-up or the top-down approach. Bottom-up creation of functions begins with some available functions and involves combining them in various ways, exploring the effects of the resulting composite functions. Top-down design is encouraged when a student is given a precise goal and asked to create a function that achieves that goal. The goal may be to correctly classify some objects or images.

In a traditional image understanding framework, the recognition process begins with the sensing of an image, its preprocessing, segmentation, feature extraction, and classification or description. If students are provided with a suitably rich vocabulary of functional building blocks, it should be possible for them to construct working image analysis systems. Two good activites in this realm are segmentation and measuring faces. The process of separating the pixels of an object (such as a person) from those of the background provides a suitable challenge for students to design a function. Working with primitives such as a thresholder, a mean-pixel-value function, a central region selector, and various parameters, a student can develop a segmentation function that will extract the shape of the person from the background, at least under appropriate conditions.

Another challenge for the student is to design a function that takes an outline of a person's face, expressed as a binary image, and comes up with a value that can be used to discriminate correctly among the faces in a given set. The aspect ratio of the face is one straightforward possibility.

Pedagogical Issues

The approach to teaching about functions outlined here may have the following benefits: an apparent relevance to students, because they can understand how functions are needed for generating special effects and for automatic pattern recognition; an aura of excitement because the functions often have striking visual effects; and an authenticity in terms of design and construction of functions, which is something very real in the engineering community. While functions have been traditionally taught in terms of correspondences and other recent approaches that have considered co-variational approaches and rates of change (Confrey and Smith, 1994), the teaching of functions as designable objects and/or as process objects with computational properties is a new approach that fits well in the context of image analysis techniques.

Software Availability

The Pixel Calculator and the Image Warper are available for download free of charge for educational purposes. For more information, see `http://www.cs.washington.edu/research/metip/`.

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Participation and Motivation in Computer-Supported Collaborative Learning

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Abstract: Previous research has demonstrated that the uneven nature of students' participation is one notable challenge of Computer-Supported Learning. In this study we analyzed the relations between elementary school students' motivational orientation and their engagement in computer-supported inquiry learning within a networked learning environment. The investigation was a case study in nature; one classroom's study project was examined across two terms. The participants were the teacher and 30 students of one fifth-grade class. The technical infrastructure was provided by Virtual Web School (VWS) developed by Helsinki City Department of Education. A self-report questionnaire was used to assess students' motivational orientation. Students' discourse interaction in the database was investigated through social network analysis. The results of the study indicated that mainly the high learning-oriented students actively engaged in CSCL. It was encouraging, however, that there was moderate reciprocal interaction across gender and motivational orientation groups. Implications for educational practices are discussed.

Introduction

The emergence of a knowledge society is transforming educational practices in many ways. In international assessments, innovative learning technology, based on the new information and communication technology (ICT), is seen to lead to a new decade of the learning revolution (Pea et al. 1999). Computer-supported Collaborative Learning (CSCL) is expected to increase the quality of education by engaging students and teachers in coordinated efforts to build new knowledge and to solve problems together (Dillenbourg, Baker, Blaye & O'Malley 1996).

One of the starting points of the present study is the progressive inquiry model of learning developed by Hakkarainen (1998) and his colleagues in the context of CSCL. Characteristic of progressive inquiry is to go beyond conventional learning by pursuing students' own questions and problems of understanding; generating and discussing their own conceptions and explanations for the problems being addressed. The model implies that students themselves should develop functions of monitoring and controlling learning (e.g., Bereiter & Scardamalia 1987).

It can be stated that the above-presented elements of progressive inquiry impose rather demanding challenges for an individual student's cognitive capacity. In addition, any learning or performance situation can, from a student's point of view, be seen as a 'coping situation' with many other, e.g. socioemotional and motivational, demands (Boekaerts 1993). The goals students pursue in a given learning situation depend partly on each student's interpretation of these demands. Learning may not be seen by the student as the most crucial (or even

-worth (Covington 1992) or some other issues present in the learning environment engage students' attention (e.g. chatting with friends).

From a motivational point of view students' personal goals represent the energizing and directing force of activity (Pintrich & Schunk 1996). In classroom studies it has been found that the learning-oriented students (those who seek to increase their knowledge and skills) show more active cognitive engagement in learning activities (Meece, Blumenfeld & Hoyle 1988; Lehtinen et al. 1995) and tend to choose more challenging tasks than other students (Dweck 1999). Moreover there is evidence that when working with computer supported learning environments, learning-oriented students are more active, creating new knowledge and commenting on other students' inquiries in the database (Järvelä et al. 1999). These findings are also in accordance with investigations of students' preferences regarding different instructional practices. It has been reported that while learning-oriented students prefer autonomy and possibilities for challenging work, there seem to be students who are not so willing to participate and 'be active' during learning situations (Niemivirta, 1998; Peltonen & Niemivirta 1999).

Further, there are certain indications that rather than helping to overcome motivational, cultural or knowledge-related differences between students, computer-supported learning leads to increasing learning difficulties and performance differences - without strong teacher guidance (Venezky 1999). Therefore, the uneven nature of students' participation can be considered to be one of the current problems of Computer-Supported Learning.

On the other hand, the promise of the new computer supported learning environments has been partly based on the pedagogical assumption that they include elements, which can be regarded as *inherently* motivating (e.g. possibilities to solve complex, authentic tasks) despite students' individual differences and prior experiences (CTGV, 1992; Lin et al., 1995; Savery & Duffy 1995). A few studies have even demonstrated promising results: that, in some cases, students who have problems in adapting to an ordinary school tasks, may find CSCL very motivating and intriguing (Hakkarainen, Lipponen, Järvelä & Niemivirta 1999). Consequently, there seems to be a need for a more detailed analysis of the patterns and intensity of students' participation and of the individual differences behind these phenomena.

The present study focused on uncovering the patterns of students' participation by applying methods of social network analysis, which provides statistical tools for examining networking relations among students (Wasserman & Faust, 1995; Scott 1991). The problem we addressed was whether high learning-oriented students who are engaged in conventional educational practices would also be most active in the context of CSCL. Palonen and Hakkarainen (2000) found out that there may be substantial gender differences involved in participation in CSCL. Thus, gender was included in the study design to test for similar differences on this data.

The questions addressed were a) how intensively do elementary school students representing both genders and different levels of learning orientation participate in discourse interaction within a networked learning environment; b) is the students' discourse interaction dominated by some student groups.

Methods

Participants

The study was conducted in a fifth-grade classroom in an ordinary urban elementary school. Altogether, 30 students and one teacher participated in the study, which focused on analyzing the students' activities in two study projects in history. To support collaborative building of knowledge, the students used collaborative software called Virtual Web School (VWS) designed by the Media Center of the Helsinki City Department of Education. The VWS was designed to help students share information and construct learners' joint knowledge. There were four networked computers within the classroom that were used for conducting the project.

Data analysis

The students were administered a self-report questionnaire to identify their motivational orientation at the beginning of the learning project (Niemivirta 1996). The self-report questionnaire included several subscales, but only the scale for learning orientation was used in this study. The scale contained five items for assessing a student's focus on learning new things and gaining knowledge (e.g. "*The most important goal for me in school is to acquire new knowledge*"). Items of this scale were used to create a composite score (Cronbach's alpha coefficient for this scale was .87). In order to make comparisons between students representing different levels of learning orientation, students were divided into two groups on the basis of a median split on this scale. Students with above-median scores were classified in 'high learning orientation', and remaining students in 'low learning orientation' groups. Both genders were equally distributed across the two groups.

Patterns of students' participation within the VWS were examined by applying social network analysis for written discourse interactions between the students (Wasserman & Faust, 1995; Scott 1991). Characteristics of the students' social network were analyzed by examining the amount of direct connections among members of a learning community (density), patterns of interaction in the community as a whole (centralization), and the extent of each student group's participation (centrality).

Measuring the density is a simple way to assess characteristics of a network: the more actors have connections with one another, the denser will be the network. The density of a (binary) network is the number of observed ties divided by the number of all possible ties (Borgatti, Everett & Freeman 1996b, p. 78; Scott 1991, p. 74). Density of a binary matrix varies between 0 and 1, and it is 1 in cases where everyone is directly interacting with everyone else. Centralization describes how tightly interaction within a network is organized around particular focal points. A centrality value is calculated for each student in order to find the most active and visible persons in the community, and it was assessed using Freeman's degree (i.e., number of sent and received comments).

The data consisted of the links between students' notes: who interacted with whom by constructing VWS comments. The information was examined as a weighted and directed graph representing the structure of communication, in which the teacher and the pupils were viewed as nodes and the comments as vertices. The dataset was dichotomized in the analyses (cut-off point = 0). All analyses were performed by using the Ucinet program (Borgatti, Everett & Freeman 1999).

Results

Density of Participation

The analysis indicated that the students' network of interaction was not very dense; the density was 0.26 (SD =0.44) for symmetrized data (direction of commenting ignored). In the case of the asymmetric graph based both on sent and received comments, the measure was 0.16 (SD =0.37) of the possible ties. From the relatively high standard deviations, we may infer that there were subgroups of students that engaged in denser interaction than their fellow students. Therefore, we examined density of students' interaction as a function of gender and levels of learning orientation. The network was partitioned into blocks the density of which was examined separately on the basis of gender and motivational orientation (low vs. high learning orientation) (see Tab. 1). In addition, the teacher of the classroom formed her own blocks. However, the densities of blocks with varying sizes are not directly comparable; i.e., larger graphs have lower densities than smaller graphs because only so many ties can, in reality, be maintained by an individual (Scott 1991, p. 77).

An examination of Table 1 reveals that there were differences between the students' participation patterns as a function of their gender and motivational orientation. Density of between-student interaction in the case of low learning-oriented students appeared to be lower than that of high learning-oriented students. There were not, however, the same kind of drastic gender-related differences in intensity of participation found in some other studies (Palonen & Hakkarainen 2000). Table 1 indicates, further, that a substantial part of the discourse interaction took place between the high learning-oriented students. It is encouraging, though, that there was also interaction across the borders of gender groups as well as across students representing different levels of learning orientation. In many cases low learning-oriented students' were in connection with the high learning-oriented students although interaction between the low learning-oriented students themselves was not very dense.

Table 1.
Density of Interaction across levels of Learning Orientation (LO) and Gender

Receiver / Sender	N	Boy low LO	Boy high LO	Girl low LO	Girl high LO	Teacher
Boy low LO	7	0.10	0.10	0.02	0.11	0.29
Boy high LO	7	0.10	0.29	0.09	0.16	0.71
Girl low LO	8	0.04	0.11	0.07	0.22	0.13
Girl high LO	8	0.11	0.30	0.19	0.45	0.63
Teacher	1	0.57	0.14	0.00	0.38	-

Finally, it can be seen that the teacher, who sent 9 messages and received 21 messages from 13 students, interacted with the both gender groups with an equal intensity. It is particularly noticeable, that she engaged in rather intensive interaction with low learning-oriented boys apparently trying to get them involved in CSCL. She was also interacting with high learning-oriented boys and girls. This is to be expected because active participation of these groups provides many opportunities for her to respond and provide support. An open question is why she did not make a corresponding effort in the case of low learning-oriented girls. It is also to be noticed that interaction between the students and the teacher was bi-directional. In many cases teachers are only commenting on students' productions, but there is no any real dialogue involved.

The Centralization and Centrality of Participation

We also examined the extent to which a whole graph representing VWS students' interaction had a centralized structure (Scott 1991, pp. 92-93). The results of the analysis indicated that students' interaction was not very centralized (0.24 and 0.35 in the case of sent and received comments, respectively). It follows that the students' communicative efforts were distributed among a relatively large number of persons.

The participating students, taken together, produced 280 written notes. On average, they sent 8.9 (SD = 7.9) comments. All students either sent or received a comment but two students did not send any comments and two did not receive even a single comment. Table 2 reveals, however, that there were between-student differences in the intensity of engagement in VWS-mediated peer interaction. The most active students could be found among the high learning-oriented girls in the cases of both sent and received comments. Also high learning-oriented boys participated actively, but high learning-oriented girls produced approximately twice as many comments as the corresponding boys. The girls contacted a much larger group of fellow students through their comments than any group of boys. However, where the number of actual dialogue partners is concerned (i.e., number of students that one was interacting bi-directionally), learning orientation appeared to be a more important factor than gender.

Table 2.
The Centrality of Participation across levels of Learning Orientation (LO) and Gender

Group*		Sent comments		Received comments		Partners contacted		Dialogy partners[1]	
	N	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Boys									
Low-LO[a]	7	5.7	(6.8)	4.0	(5.0)	2.6	(1.6)	0.9	(1.1)
High-LO[b]	7	10.6	(7.4)	7.9	(5.3)	3.4	(1.9)	2.1	(2.0)
Girls									
Low-LO[bc]	8	4.3	(2.5)	4.0	(7.7)	5.1	(2.6)	1.0	(1.3)
High-LO[ac]	8	15.0	(9.2)	18.0	(17.8)	8.1	(3.1)	3.3	(1.8)
TOTAL	30	8.9	(7.9)	8.6	(11.7)	4.9	(3.2)	1.8	(1.8)

*Groups with same letters differ from each other at $p<.05$ (Nonparametric, MW-test for comparing two groups of cases on one variable). [1] Dialogy partners refer to number of fellow students that a student both sent and received comments so that the interaction was bi-directional.

Because of the small sample size and abnormal distribution of measures, the statistical significance of these differences was examined using nonparametric versions of the t-test and analysis of variance. The findings revealed significant differences ($p<.01$) on all measures between high learning-oriented and low learning-oriented students (Mann-Whitney test). There were no significant differences between boys and girls at the general level. However, several differences were found *across* the four groups. Both low learning-oriented boys and girls differed significantly ($p<.05$) from the high learning-oriented girls' group on all measures. Low learning-oriented girls differed also from high learning-oriented boys ($p<.05$), while there were no significant differences between boys' groups.

Discussion

The results of the study indicate that the level of students' learning orientation was closely associated with the intensity of their participation in CSCL. In other words, the high learning-oriented students, and most girls, engaged in a rather intensive process of inquiry within the VWS. The low learning-oriented students, in contrast, produced fewer comments or pieces of knowledge during the projects examined. These phenomena revealed by the study might appear to be expected or trivial because, in a sense, a disposition to engage in active learning is what we expect from learning-oriented students. However, it is important to remember that the motivational orientation was assessed by using a self-report questionnaire that addressed the students' general motivational tendencies notwithstanding CSCL.

Moreover, it is not self-evident that students who are learning-oriented would also be the ones who engage in CSCL with the highest intensity. Our earlier studies indicate that for pupils with performance or avoidance orientation in relation to traditional school tasks, CSCL may open up an alternative way of participating in schoolwork (Lipponen & Hakkarainen 1997; Hakkarainen et al. 1999).

The results of this study indicate that the students' participation was not equal. It was, however, encouraging that students representing both genders were involved in CSCL inquiry. Students' participation was not centralized to the extent that only a few students produced most of the knowledge. Further, the results indicate that interaction across boundaries of gender or motivational orientation was rather active. This appears to be a very valuable and encouraging aspect of networked learning that would not have been revealed without the methods of social network analysis.

However, these results point out the importance of acknowledging students' individual differences in the context prevailing motivational basis and gender do 'make a difference' as far as their participation is concerned. One possible explanation might be students' different skills in regulating their goal directed activity. Further, it is possible that, on the basis of their goal preferences, students interpret the characteristics of the learning environment differently. For students with strong learning orientation, the new learning environment may seem to provide possibilities to challenge one's cognitive capacities and promise new knowledge. Instead, some students may experience these elements as new obstacles and demands that they have no interest in or prerequisites to encounter. In both cases, the importance of teacher guidance and support is highlighted. It seems evident that students with motivational problems need more structured instruction and encouragement during computer supported study projects. On the other hand, students with strong learning orientation may also need guidance in their inquiry practices. In-depth learning is demanding for everyone facing the new challenges of CSCL, regardless of students' enthusiasm or personal goals.

Certain limitations of the study are important to note. First, because of the small sample size, the findings of the study need further testing with larger populations. Second, the methods used covered only a part of the actual interaction during the projects. Observational data are needed to supplement the results obtained through database analysis.

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SOME "DO'S And DON'TS" In The DELIVERY Of DISTANCE/ON-LINE EDUCATION

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Abstract: The current American education system is vastly different from the institutions of twenty years ago. The pervasive influence of technology is changing the way we teach, the way we conduct research, and the way we seek to provide increased educational opportunities to students from all walks of life. Many departments of Information Technology are beginning to develop programs to offer courses using on-line or web-based delivery, i.e. via the "virtual classroom". In this paper, we offer a list of "do's and don'ts" that provide background and insight into the decisions involved with creating a virtual classroom and the activities associated with the development of an online Information Technology course. In conclusion, we present some of our observations concerning the impact of the online paradigm based on our own experience.

INTRODUCTION

In the past, students who were unable to attend college in the traditional way used correspondence courses to earn a degree. Now the trend in higher education is to offer courses, and in many cases, entire degree programs via distance education, the most notable being Internet or web-based instruction. One result of this trend is an increase in the number of adults attending college for the first time, returning to finish a degree, or to get additional training in a specific area. Institutions of higher learning are scrambling to take advantage of this new development. A recent survey by the U.S. Department of Education's National Center for Education Statistics (NCES) shows that the number of distance education programs increased by 72 percent from 1995 to 1997-98. Moreover, an additional 20 percent of the institutions surveyed planned to implement distance education programs within the next three years. Those institutions also reported that they planned to start using or increase the use of Internet-based technology and two-way interactive video technology more than any other type of technology. (3) These results suggest that on-line course delivery is dramatically on the rise. Although the effectiveness of distance education is under current debate (4), institutions are rushing to jump on the "e-learning" bandwagon. In turn, faculties are being asked to develop web-based enhancements for traditional courses or an entire course to be delivered online. In this paper, we propose practical suggestions (do's and don'ts) for a faculty member who is considering or facing that challenge.

OUR ON-LINE CURRICULUM

Northwestern State University (NSU) is a 4-year public university of about 9,000 students that serves a mostly rural population in northwest Louisiana. Given the large geographical service area, NSU has become a leader in the state in online education. It was one of the first institutions to have courses included in the Southern Regional Electronic Campus of the Southern Regional Education Board (7). Our institution currently offers approximately 60 online courses to over 2000 students. Others are being developed and plans are underway for the development of complete online associate degrees in Computer Information Systems (CIS) and Business Administration (BUAD).

We have been involved with the development and delivering of online courses for approximately three years. We have organized our suggestions into two broad categories: (1) course *development*, i.e. that which takes place from initiation of the project up to actual course delivery, and (2) *course facilitation*, i.e. that which takes place while the course is underway.

DO'S AND DON'TS OF COURSE DEVELOPMENT

DO...

- Allow more time to develop materials for an online class.
- Work with your administrators as much as possible. (8)
- State instructions and other information about the class as explicitly as possible.
- Keep *course integrity* in mind at all times.

DON'T...

- Use existing course materials just because they are readily available and worked in a traditional classroom environment. (5)
- Try to re-invent the wheel.
- Think all courses can be delivered effectively online.

DO'S AND DON'TS OF COURSE FACILITATION

DO...

- Provide some type of orientation so that students can practice using the technology.
- Make your first quiz over the orientation. This forces the student to take a close look at the course documents.
- Provide each student with timely feedback. Student surveys show that prompt response from the instructor is very important to student satisfaction with the online experience. (2)
- Treat students courteously and with respect. The written word can appear harsher than the spoken word.
- Be prepared to handle technical questions and problems. Know where to refer the student.
- Evaluate and revise.
- Maintain a course portfolio to help organize your course, remember what you did, and provide a source of information when it comes to teaching evaluations. (6)

DON'T...

- Isolate your students or yourself. If anyone feels *over your head*, then ask for help.
- Allow your class size to become too large.

CONCLUSION

The trend in higher education is to develop electronic delivery of individual courses or entire degree programs. The successful development of any distance education program rests squarely on the shoulders of the institution's faculty. Therefore, faculty members must break away from old paradigms and adopt new techniques for teaching and learning. We have presented a list of suggestions, "*do's and don'ts*" for an educator who is interested in or facing the challenge of developing an online course or enhancing a traditional course with an online component.

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Case Study: The Translation of Archive Materials into an Interactive Medium

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Abstract: This paper documents and explores the methodology employed by the developers of the Euro.Network.Hats project - a CD-ROM and web site exploring the hatting and millinery industry in Europe, particularly the development and decline of European felt hat manufacture. It will provide an insight into an approach to the translation of diverse archive materials into an interactive digital format. The paper will illustrate the process of content development: from the elicitation of content knowledge to the developer's response in terms of information, visual and interaction design.

Introduction

Stockport Hat Museum initially approached the Learning Methods Unit (now a core element of the International Centre for Digital Content) in 1998 with regard to the development of multimedia materials for their new museum site. The success of this relationship led the Museum to approach the ICDC for support on a bid for transnational funding under the European Community's Raphael programme.

> *The aim of this programme is to encourage co-operation between the Member States in the area of cultural heritage with a European dimension. It is intended to support and complement Member States' action aimed at representing national culture, highlighting the shared cultural heritage while respecting national and regional diversity. This action seeks to encourage operations to promote European cultural heritage, especially through new information technology and multilingualism.*

The bid was successful and funding amounting to 144.328 EUR was awarded in September 1999, the project being scheduled to run from September 1999 to September 2001. The ICDC acts as technology partner for the project, which will explore the hatting and millinery industry in Europe and maximise public access to a significant aspect of social and industrial heritage. The final product will be an interactive CD-ROM, available in English, French, Dutch and German, exploring the hatting and millinery industry in at least three European countries.

The Project

The Museum came to the ICDC with certain key pre-requisites. The product was to explore the hatting and millinery industry in Europe using content supplied by the European partners. The content had to be equally accessible in four languages (English, French, Dutch and German) and to three distinct user groups (researcher, school child and casual browser).

The Players

There are three major stakeholders in this production: the content specialist (the Museum), the developer (ICDC) and the user.

The lead partner in this project is the Stockport Hat Museum; they represent the bid partners: Museé du Chapeau, France and Historisch Museum, Netherlands. Together they are the content specialists. They hold a wealth of information about the hatting and millinery industry. However they lack knowledge of the creative technology they wish to be developed. They are unlikely to be aware of the potential of specific content.

The ICDC developers have a good understanding of the management of rich information and its presentation in an interactive fashion but nothing beyond surface knowledge of the subject matter to be presented.

In any multimedia production it is the user who is the ultimate arbiter of quality, not the developer or the content specialist. Therefore an awareness of the needs of the user are crucial to the development of coherent and usable content. We anticipate that each type of user will have a variety of different needs.

The researcher has prior knowledge of the subject - we assume that they will approach the product searching for particular information rather than casual browsing. The child will have a range of needs too. Activities within the CD-ROM may need to be classroom focused (whether teacher guided or self-directed study or just fun). It is understood that the gatekeepers (teachers, parents) needs must be acknowledged in responding to the child's needs. We anticipate that the general browser has a level of curiosity about the content and therefore needs an environment that is easy to explore.

The Process of Content Development

In attempting to present complex information it is crucial that the presenter is knowledgeable in their field. When the medium is written this shouldn't be a problem - here the author has complete control over the means of communicating their ideas. The intent of the author is only impeded by their ability to express their ideas. Interactive forms however demand a different process. Two distinct roles emerge: content specialist and multimedia producer. Here, author and means of communication are divorced. If the information to be conveyed is to retain its original quality and meaning, great care must be taken. The content specialist and multimedia producer must work together to share their knowledge. Either working alone will dilute their skills and therefore the end product.

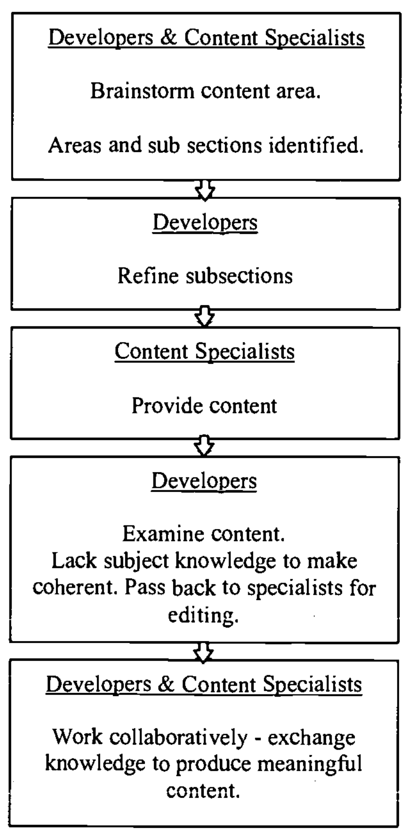

Figure 1. Content Development Process

Knowledge Elicitation

The model above (figure 1) represents the content development process. This process is iterative and continues throughout the development of the project. The content specialists hold the knowledge within their own context; this knowledge needs to be extracted. Here the need is to break down the knowledge accumulated by the content specialist into distinct areas to aid understanding first for the developer and then for the user.

To start this process several brainstorms were needed to break down the large content area into definite themes. It became clear that the content area to be included was extensive and the relationship between themes was complex.

There seemed no natural order or hierarchy of information. Sub sections of the six areas identified overlapped resulting in potentially confusing or unnecessarily duplicated information.

Having a greater understanding of navigational structures and the structure/editing of content for a multimedia context, the developers independently refined and removed sections to make the content more coherent and manageable.

Even with further refinement it was difficult to find a clear organisation of information that would not artificially compartmentalise the content. However, we recognise that a fragmented body of information need not be a divided one. There is a balance between chunking information for easy explanation and retaining the mosaic of information. We came to understand that the structure of the information was largely arbitrary. The way in which we made the content accessible would be crucial.

Information Design

Any structuring of information is artificial - information has no natural underlying order. But by categorising content we transform data to information - by supplying a context within which the content can be accessed we give the user a greater chance of assimilating the information into knowledge.

After establishing the content areas we went on to develop a metaphor to represent the content. It was clear that the holistic nature of the information couldn't and shouldn't be avoided - it should instead be embraced. The metaphor provides a map of the interactive environment. Information exists within the information space of the model - altering the position of a point on any axis allows a meaningful movement between content areas. Using this metaphor allows you to see the development of certain processes over several hundred years. It allows you to see these processes as they differ between country and also allows you experience other categories of information from the same time and place.

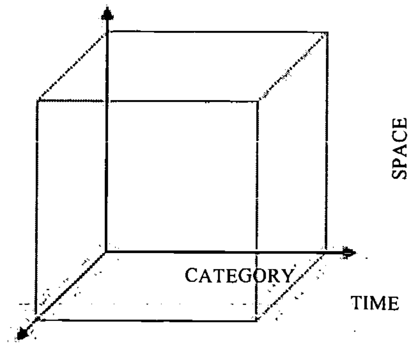

Figure 2. Content Metaphor

Structuring information by time, location and category allows us to separate the information into bite size chunks. As we are dealing with historical information largely provided by a museum, each photo, artifact etc. already has a date and geographical location associated with it. In addition, the categories defined in collaboration with the Museum staff provide the final element of the metaphor. This model allows for an easily understood and accessible division of content areas i.e. 1850, France, Architecture. It should be noted that all content is to be available in four languages (English, French, Dutch and German). This adds a fourth dimension to the model where any content can instantly be viewed in another language.

The model was developed before we had access to the content. It was an abstract approach to content about to be delivered. Resources were provided as a mass of information (text, image, and video) and it soon became apparent that the materials supplied were much too dense for easy assimilation by the developers. The developers had a basic understanding of the content, which was insufficient to develop the rich, coherent content required for the CD-ROM. At this point the developers decided upon the range of content to be covered in the CD-ROM. This made it clear that the content specialists had to edit the content to match these requirements. The developers and content specialists later met to collaborate in the gathering and formulation of resources. This enabled the developer to identify material that had potential for development in multimedia context that may have been overlooked by museum staff as their knowledge of multimedia was limited.

For instance, this simple line drawing had been discounted by museum staff as being of no value to the development. By chance the developers became aware of this and knew immediately that this resource was ripe for inclusion in the CD-ROM.

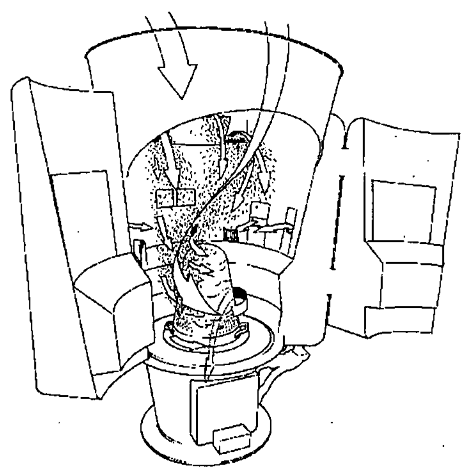

Figure 3. Technical drawing of fur-former

The developer's lack of specific knowledge was useful in this instance. Previous video selected for inclusion in the CD-ROM included footage of the process illustrated above. However the age and quality of the film reduced the clarity of the footage. The footage would have offered an incomplete view of the process to a layperson whereas a content specialist would tap in to their content knowledge to fill in the gaps. Our role as layperson allowed us to see through the eyes of the user. We therefore knew we had to provide a more comprehensive breakdown of the fur-forming process.

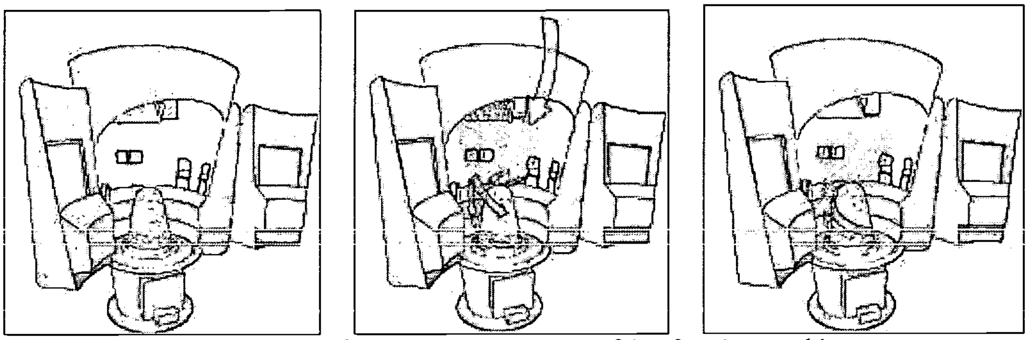

Figure 4. Stills from animated sequence of Fur-forming machine

This example shows the importance of collaboration between client and designer to exchange individual subject knowledge thus providing a richer more comprehensive set of content for the user. The ideal situation would be to work together in the same location to develop content. Ideas the designer has trigger 'hidden' information from the client and vice versa.

Visual and Interaction Design

The visual and interaction design is an expression of the information design. Once the metaphor had been developed a 2D representation of this was designed for screen use. All the elements from the metaphor had to be included: category, time, space and language. This enabled the content specialist to visualise the development and the way in which the content they were to provide would be accessed. This early treatment is flexible and evolves through consultation with the client. Our primary consideration was to create an environment where a diverse range of content could be presented with the focus upon the content rather than the interface. The generous use of space and muted colour scheme were intended to draw the user to the content.

Please visit http://www.icdc.org.uk to link to the project web site to view examples of the interface design.

The central element of the screen was devoted to content allowing us to use the top and bottom of the screen as areas for interface/navigation control. This wide screen layout gives an uncluttered and consistent feel to whatever content is presented. The interface design gives a crucial sense of orientation to the user. When the user selects a different area of content to visit the desired effect is that of the content coming to the user rather than vice versa. The user feels safe/comfortable and ensures the design meets their needs rather than the user fitting to the system's needs.
We build upon the sense of orientation by the use of perspective within the screen. Multimedia does not have to be a 2-dimensional form and the screen design used should express that. The distinction between the content itself and the icons used to control or navigate are clearly separated by the use of perspective. Incorporating perspective into the design was intended to aid the understanding of the content and acts as a visual representation of the layering of information.

The process of content editing and processing is time consuming and continues throughout the development period. As a result the developers aren't always aware of the nature of the content for inclusion. Therefore the interface had to be readily adaptable to new content to prevent costly redesigns every time new content was received. In addition, all content can be viewed in four languages. This has an immediate knock-on effect to screen design. A passage written in one language will not be the same size in another language. The flexibility of the interface was key. The use of layers of information allow the developers to build screens using a basic tool set without knowing the content in advance.

Types of Interaction

The interface has four types of interaction available - content navigation, interface control, context and the content itself.

Content Navigation

The means by which the user navigates through the content is crucial to their creation of a mental model of the content available. Successful navigation involves actively using the metaphor used by the developers to map the content. Time, space, category and language are all equally accessible from any point within the content. Changing any one will present the user with different content.

Interface Control

The user must be given support in using the developed product and have control over the underlying system.

Context

We anticipate that the environment created is easy to use and to explore. However we appreciate from are own experience that frustration can occur when the user feels confined to the metaphor in place. As the needs of the user are diverse we allow the user to step outside of the metaphor. Rather than following prescribed routes, users can jump to different points in the interactive environments according to their needs.
The researcher can search for a particular keyword and/or media type and move straight to that point rather than intuiting where certain content will occur within the model. Children will have access to interactive worksheets. Here users will be prompted to answer questions relating to the content in the CD-ROM. This is anticipated to be used by school children where use of the CD-ROM may need to be teacher guided. As the questions may be curriculum based the user will be guided to specific areas of content - again this allows immediate direction to content without explicit use of the metaphor. Not all activities will be curriculum based. Users will be able to reorganise content to meet their own needs by capturing media and storing it for their own purpose i.e. school projects.

Content

Within the framework supplied by the consistent interface rules there is room for flexible content. The interaction within each content area will be developed using the interface tool set developed.

Conclusion

This paper has sought to illustrate the methodology employed in a particular CD-ROM production and to indicate the value of that approach. At the time of this conference the production phase will be complete and the CD-ROM will be undergoing testing prior to release. The developers will be preparing to demonstrate this to the transnational partners and testing will begin. We will soon to discover whether the approach taken has been successful.

When the project began the content seemed extensive and complex. The development of a metaphor to understand the organisation of this information has been key. Though the scale and complexity of the information has not changed, the means by which we can understand it has. The metaphor began as a model for the developers to map the information to be addressed. It evolved into a means of navigation and a way of looking at content development.

Creating a set of parameters for the information to be incorporated into the production will, we anticipate, prove invaluable. Giving the user the opportunity to choose a context for the information they access, and to follow the links between strands of information, will improve their understanding and appreciation of the holistic nature of any body of knowledge. However, giving the opportunity for users to create their own paths, to step outside our rules and to create their own order will, we hope, prove equally invaluable.

On Paper or Hypermedia? the Effect of Procedural Information in Digital Video Format in the Learning of a Music Score Editor Program by Novice Users

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Abstract

In this study, and by means of an experimental contrast design, we have tried to determine whether the use of an electronic manual is more effective and efficient than a print manual for the training of novice users with a score editor program. We also looked for differences in access to the two types and for information on users' perceptions regarding the materials they used. Were developed a minimalist print manual, an hypermedia manual and two questionnaires. The most prominent difference between the two manuals was the use of digital video to present procedural information in the electronic version. The rest of the information remained the same for the two manuals, as did the training strategy based on guided exploration. The research findings show an effect of the hypermedia manual in learning outcomes, access to manuals and users' perceptions. This effect might have been due to the confluence of several factors differentiating the manuals: the procedural information in the video format and the design of the interface - with limited control elements, fast access to information and a low complementary interaction between presentation modalities- minimized the potential cognitive overload and allowed the user to start working rapidly.

Keywords: novice user training, training materials, hypermedia, minimalism, music technology.

1. Introduction

Research related to technical documentation, understood as an instructional resource, investigates design and elaboration strategies that are especially important because of their impact on learning. Educational research is deficient on empirical studies comparing novice users' learning outcomes in working with different types of documentation. This deficiency extends to a lack of contrasting on presentation modalities. It is widely expected that computers will increasingly play an important role as normal working tools in different knowledge domains, musical disciplines included (Tejada, 1998). At least in academic environments, a considerable amount of time will certainly be devoted to learning computer programs and controlling machines. Educators will need to expand their knowledge of methodologies and materials to include this type of learning.

2. Literature and hypothesis

2.1 Minimalist training materials

Carroll et al. (1987) observed the novice users' behavior and they found problems on the program documentation: it was extensive and exhaustive and did not have either a task-based approach or a system for error detection and correction. In their empirical studies, the model was a learner focused to act, interested principally in doing real tasks, trying to make sense of all, he/she sees, hears, reads and does; someone that uses their own hypothesis even when the evidence contradicts them; a learner with a tendency to access technical documentation in a non-linear way (Carroll, 1990). Conventional manuals do not address this novice user's needs. This explains why only a small percentage of users read technical documentation (Lazonder & van der Meij, 1993). Novice users, focused on their goals, generally explore program functions by means of a trial-and-error strategy, which technical writers try to avoid in the manuals. Furthermore, while users explore, they make many errors, which explain the high amount of time devoted to correct them -about 25% to 50% of training time (Lazonder & van der Meij, 1994, 1995). The minimalism, a model of training heavily user centered, takes on two key principles from cognitive psychology: active learning and constructivism. Users can learn more and better if they are actively involved; when they are doing something. Users do not learn so much if they follow instructions like a script. Secondly, the user builds up their own mental models combining their past experiences with new information; hence, their mental models, already constructed, are modified. It makes explicit the user's goals and involves them in real tasks. It reduces the need for extended training materials and supports error recognition and correction. Its aims are to maintain motivation, promote active learning and make the learning environment user-friendly, that is, it enables exploration that users can do without feeling frustrated by their errors. Several authors define principles for the minimalist model (Carroll 1990, 1998; Van der Meij & Carroll, 1995).[1] These share some characteristics with cognitive psychology: focus on real tasks; active learning; documentation structure based on users' real needs; brevity of materials; error recognition and correction; modularity; screen-documentation coordination system; iterative documentation design. Empirical research contrasting minimal materials and conventional ones has shown the superiority of the minimalist approach in developing training materials.[1]

2.2 Problems of non-linear information access

Interacting with information in a hypermedia structure is a complex cognitive activity. Total freedom in the choice of the pathway into a hypermedia system may mean that the user's orientation abilities decrease (Dede, 1992) and a cognitive overload can arise. The term cognitive overload refers to the additional cognitive effort and concentration needed to simultaneously perform certain tasks. This demand for additional effort is due not only to the user taking decisions about what path to follow, but also to being forced to remember his/her situation in the net and the nodes that he/she has visited. Sciarone and Meijer (1993) have shown that the freedom provided in navigating through a hypertext system provoked users' inability to do the tasks required of them and that they preferred finding the responses through the system's help rather than learning the system itself. Several authors have tried to overcome this problem by providing navigational help, such as maps, indexes or pathway restrictions (Gay, Trumbull, & Mazur, 1991). Some useful techniques in facilitating navigation and avoiding disorientation are guided tours, maps, backtracks, bookmarks, overview diagrams, search engines and *fisheye* views (see Nielsen, 1995).

2.3 Contrast of print and electronic materials

Empirical contrast studies of educative print and electronic materials have shown contradictory results, due to the heterogeneity of research goals, subjects and type of materials used. Some studies show positive results for print materials.[2] There are two studies on comparing still and dynamic images in hypermedia materials. The video information included in both was declarative. Christel (1994) compared two courseware versions. A software engineering course included several records of meetings and other methodological aspects in which students could interact with simulated participants. One version included video at 30 fps and the other version presented the same contents (V) with slides which were replaced every 4 seconds (S). In test sessions, group V

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[1] A review of minimalism research can be found in McCreary & Carroll (1998). Is essential the work of Carroll et al. (1987) and his replication in Lazonder & Van der Meij (1993). For concrete aspects of minimalism, see Nowaczyk & James (1993), Lazonder (1994), Wiedenbeck, Zila & McConell (1995) and Van der Grijspaarde (1995). A multiple perspective on minimalism can be found in Carroll (1998).

[2] See Horton (1994), Brockmann (1990), Nielsen (1995) and Van der Geest (1994) for a review of contrast studies.

recalled 89% of the required information while group S recalled 71%. Pane (1994) assessed a multimedia-learning environment in the biology domain. The study measured the summative effect on students' performance and their satisfaction with the material. Instructional material containing video and simulations (V) was compared with other material containing static graphics (G); the results showed that group V spent more time working through it and scored better than group G. The author speculates that the time difference was probably due to group V projecting the video and simulations more often. These studies suggest that video information can enhance learning in a computer-based environment.

2.4 Hypothesis

Expressed in negative form, the hypothesis are (dependent variables between parenthesis):

Hypothesis 1 (H1): When carrying out tasks, there are no significant differences between users of the hypermedia manual and users of the print manual (voluntary exercises -time and number- near transfer tasks -time and accuracy-, and far transfer tasks-time and accuracy-).
Hypothesis 2 (H2): There are no significant differences in manual access between users of the hypermedia manual and users of the print manual (frequency of access, number of jumps, access time).
Hypothesis 3 (H3): There are no significant differences of opinion about the materials between users of hypermedia manual and users of print manual (ease of use, usefulness, satisfaction, structure and organization, speed of information search and the preference for the other manual).

3 Methodology

3.1 Previous work

We gathered data from users over two academic years through verbal protocols, which showed the most frequent problems users had with the music score editor, the "impasses" or errors they made, methodologies they used to solve problems and whether they needed external help to resolve the impasses. These data allowed us to make a task analysis, task selection and an error-recognizing and correction system to include in the manuals.

Our model of user was one with the following profile: low skills in computer use, a moderate level of motivation in learning with computers, high motivation in learning music programs and a low-moderate level of previous music knowledge. On the basis of this profile and the type of learning intended, we adopted the features of the minimalist model.

3.2 Materials

Before building the two manuals, we translated the music score editor into Spanish in order to: a) make the user's work environment more accessible; and b) eliminate a potential nuisance variable during the experiment.
A task analysis was carried out to determine the tasks to include. In the print manual, the procedural information was presented in text, while in the hypermedia manual it was presented in a digital video format. The hypermedia manual did not display video with other complementary information (textual or graphic) in order to avoid both dividing attention and the appearance of cognitive overload (Sweller, 1994). The manuals consisted mainly of procedural information, except for the first unit, which was devoted to the conceptual, specific terminology used. This unit was a still graphic without text. The structure of both manual contents was logical, sequential and chronological with respect to the task. Contents were split up into twenty units; the unit titles made up the Table of Contents and were used as organizers. The interface was quite straightforward, with a reduced number of control elements that allowed users to run a complete navigation. The hypermedia manual included a help system in order to facilitate operations and minimize the potential cognitive overload Ebersole, 1997).

According to minimalist model, a section called "Posibles Errores" (Possible Errors) for diagnosing and correcting errors was included in eleven units of both manuals, which were most susceptible to syntactic and semantic errors (Carroll, 1990; Lazonder & Van der Meij, 1995). The system consisted of a description of most frequent error and its general or specific corrections. Also, other section termed "Por ti mismo" (On Your Own) was included in order to stimulate user guided exploration and production. With this section, we expected users to do voluntary tasks (see Carroll et al., 1987; Van der Meij, 1993).

Usability tests were carried out with novice users that allowed us to gather data for redesigning the manuals. A pilot test was carried out in order to: a) assess the time necessary to accomplish near and far transfer tasks in experiment; and b) modify the observers' score card. The final version of the print manual was a fifteen-page booklet, whereas the original manual was a 256-page book. The final version of the hypermedia manual was an auto executable (4 Mb.) made using Macromedia's Director with links to 6.4 Mb. of video clips.

3.2 Subjects

To test the fifteen sub hypotheses, we used inter-subject contrast design with volunteer undergraduates on the Music Education Teacher course at the University of La Rioja -Spain. An initial questionnaire about previous experience of use of computers filtered out thirty subjects (11 males and 19 females) with an age range between 17-26 years. This sample was regrouped in sub samples corresponding to nuisance variables (age, course and sex) and assigned randomly to each of the experimental conditions to balance the groups. The subjects were provided with a consent form for participation and received one extra credit.

3.3 Control of variables

The documentation to train with a music score editor program (Encore) was the independent variable; it had two levels: hypermedia manual (HM) and print manual (PM). To balance the experimental conditions, the subjects were grouped in sex, age and course sub samples. They were then randomly assigned to each experimental condition. The program that subjects were to learn was translated into Spanish. The researcher was neither an observer nor an evaluator. The experimental environment was constant: place, hour and computers.

Each of the fifteen observers recorded measurements on two subjects, one of each experimental condition: study time for each instructional unit, time of voluntary exercises and time of transfer tasks in the test stage. Observers also recorded the current unit number and problems expressed by subjects "thinking aloud". Variables related to the users' perceptions were measured with a questionnaire working on a seven-point scale. An external evaluator scored the test files by an evaluation form provided by the experimenter, which indicated scores based on the absence/presence of items required for transfer tasks.

3.4 Experimental environment and procedures

The experiment was carried out in a computer classroom at the University of La Rioja with fifteen Macintosh PowerMac 6230; it took three training sessions of ninety minutes and one test session (one week between each). The print manual was a booklet with fifteen pages of text and graphics.

All the subjects in each experimental condition were told that the research aim was to study how a user learns a music score editor program. They were not informed about the other manual. Based on the data obtained in the pilot test, subjects were assigned thirty minutes to do nine near transfer tasks. These included fifteen different operations to be undertaken out of context. Subjects were assigned fifteen minutes to do one far transfer task. This consisted of replicating a music score and involved the application of knowledge to novel situations and the application of non-explicit information from the manuals. Subjects were not allowed to consult their manual while performing the transfer tasks (test session). When finished with the test session, subjects were provided with a final questionnaire, model A or B depending on the experimental condition, to test the dependent variables on users' perceptions.

4. Results

4.1 Training and learning

Three PM subjects and four HM subjects did not finish all the near transfer tasks. This difference was not significant (means: HM=8,66; PM=8,46).
Analysis of the data related to learning outcomes with the U-Mann-Whitney test showed significant variance (Table 1). A T test for non-related samples was run, which confirmed the significance. According to these results, the HM group scored better in near and far transfer tasks than the PM group.

Table 1
Results of variables related to learning outcomes and their statistical significance
(standard deviation between parenthesis. HM=hypermedia manual. PM= print manual)

	number of voluntary exercises	mean time for voluntary exercises (in sec)	mean time for near transfer tasks (in sec)	mean time for far transfer task (in sec.)	mean score of near transfer tasks (max. 21)	mean score of far transfer tasks (max. 20)
HM	18,46 (6,50)	246,59 (92,89)	1477,46 (370,09)	878,86 (57,13)	19,96 (1,74)	19,01 (0,77)
PM	21,06 (7,45)	245,58 (95,26)	1431,60 (390,0)	879,60 (78,96)	16,90 (3,47)	13,83 (2,20)
Significance	U=100; p>0,05	U=90; p>0,05	U=106; p>0,05	U=101; p>0,05	U=43,5; p<0,05 t= 3,05; df=28; p<0,05	U=4; p<0,001 t =8,60; df=17,43 p<0,001

4.2 Access to documentation

This variable was operationalized as a) number of accesses; b) jumps between non-consecutive units; and c) time of access. The results for number and time of accesses showed statistical significance with the U-Mann-Whitney test (Table 2). A T test for non-related samples confirmed the significance. Group HM consulted the manual less and consumed 33% less time than their counterpart.

Table 2
Results of variables related to access to documentation and their statistical significance (standard deviation between parenthesis)

	Mean number of accesses	Mean number of jumps between units	Total time consulting documentation (in sec.)
HM	49,06 (38,74)	3,53	3213,20 (1465,63)
PM	282,46 (170,81)	2,60	4751,53 (2113,93)
Significance	U=6; p<0,0001 t= -5,16; df=15,44 p<0,001	U=99; p>0,05	U=65; p<0,05 t= -2,32; df=28 p<0,05

4.3 Users' perceptions

The item 13 of the final questionnaire asked subjects to evaluate their preferences for the prominent information modality included in the other manual, the one they don't used (Table 3). The users of print manual would have preferred to use the hypermedia manual to a greater extent than the HM users the print manual.

Table 3 Results of variables related to users' perceptions and their significance (max. 7) (HM=hypermedia manual. PM= print manual)						
	Ease of use	Usefulness	Satisfaction	Organization and structure	speed of searching information	Preferences for the other manual
HM	3,06	6,53	5,86	6,00	2,53	2,00
PM	2,40	6,33	5,86	5,60	2,33	3,93
Significance	U=93; p>0,05	U=98; p>0,05	U=112; p>0,05	U=99; p>0,05	U=100; p>0,05	U=47; p<0,005 t= -3,37; df=20,7; p<0,01

5. Conclusions

The research findings show an effect of the hypermedia manual in learning outcomes; access to manuals and users' perceptions. This effect might have been due to the confluence of several factors that differentiate the manuals. First, the procedural information in the hypermedia manual was exclusively video. The hypermedia manual approached a modeling of the student using a presentation modality that fitted better with the type of learning sought; it produced extra time during training and a better assimilation of task procedures by users. Secondly, the design of the interface -with limited control elements, fast access to information and a low complementary interaction between presentation modalities- minimized the potential cognitive overload and allowed the user to start working rapidly. Designers of educational software materials for novice users should cover users' information needs -focus on user- rather than follow a systemic approach, for example by making a list of what the software is capable of doing. With the incorporation of novice users to learning situations, electronic training materials should be conceived so that the user can quickly build a suitable mental model of the software by explicit wordings from domain knowledge, program features and capabilities, through a real task approach and the presentation of procedural information in the video format.

Further investigations could offer users the freedom to access both types of documentation in order to study the relationships between use frequency and the variables measured. This will help in understanding the reasons why a particular user (expert, intermediate, novice) chooses one or another type of documentation and therefore knowing more on the user's information search strategies. Two variables not studied in this work are the type and number of errors during training. These ones might be important to explain the effect of materials. Though this would require highly trained observers, these two variables and error correction time should be studied to relate them to access to materials and learning outcomes.

This study made a moderate attempt to measure the effectiveness and efficiency of two types of auto instructive learning software materials through a guided exploration by novice users. It left at the margins important matters like learning style influences, degree of learning directivity, training strategies or type of users, which deserve to be investigated.

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Learning on the Move: Vocabulary Study via Email and Mobile Phone SMS

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Abstract: Vocabulary acquisition is an important element of foreign language learning. Research on memory suggests that vocabulary can be learned most efficiently by elaboratively rehearsing each word at spaced intervals. We propose that *push* media – such as short email and text messages sent to student's mobile phones - can encourage study at regular intervals. We developed a series of concise, informal *mini lessons* and sent students three each day. Students reported that the push media and friendly writing style were enjoyable and promoted regular study.

Introduction

Cognitive science provides educators with insights into learning, challenging us to help students learn more efficiently. In foreign language acquisition, one challenge is memorizing a large vocabulary. Effective vocabulary study includes practice at *spaced intervals* (Bjork 1979; Dempster 1996) employing *elaborative rehearsal* leading to deeper mental processing (Craik & Lockhart 1972). However, Japanese university classes meet once a week, making spaced practice difficult. Students need to be unusually self-disciplined to space their studies. Instead of relying on discipline, we help students study outside the classroom by sending email to their mobile phones.

Vocabulary Study

Acquiring a large foreign language vocabulary daunts adult learners. They need 5,000 words to read non-specialized English texts (Nation 1990). Applying research on learning, they should review words at spaced intervals; their review should incorporate elaborative rehearsal in various contexts rather than simple repetitions.

Foreign language students acquire vocabulary both by intentional learning through explicit instruction (Nation 1990) and by incidental learning through reading (Nagy et al. 1987). Experts recommend combining these methods (Wood 2001) but existing teaching materials provide inadequate exposure to many of the 5000 essential words (Groot 2000). Thus, students need a program facilitating long-term memory storage of vocabulary.

Push Media

The educational materials normally used outside of class - texts, web pages, even homework assignments - are *pull* media, in that students must willfully pick them up to use them. But imagine if students used *push* media - email or SMS (mobile phone email, so-called Short Message Service) - media that prompted them to immediately study. Push media seem ideal for the repeated exposures needed to efficiently learn foreign-language vocabulary. Compared to students only occasionally admonished to study in intervals, students receiving spaced email vocabulary lessons would be more likely to do so.

Although many articles advocate email in teaching foreign languages, most describe student-generated email exchanges or written assignments submitted via email (Warschauer 1995). We found no *research* using email as educational push media. But some *websites* offer push learning. EnglishTown.com, a web-based commercial language school, emails English lessons containing readings, vocabulary lists, practice sentences, and review quizzes. They also promise English lessons for WAP phones. Another site, EigoTown.com, provides daily idiom lessons and monthly hypertext fiction. However, no research describes the effectiveness of any of these programs.

We propose facilitating learning by emailing new vocabulary in spaced intervals to mobile phones. We present vocabulary in several contexts to encourage elaborative rehearsal. We investigate the use of SMS as a tool for learning, specifically the learning of foreign language vocabulary.

We chose mobile phones because of their popularity in Japan. Nearly 60 million Japanese (half the population) *constantly* carry mobile phones (Mobile Media 2001). In contrast, only 20% have *occasional* access to desktop PCs. Ubiquitous internet-capable mobile phones can encourage structured practice outside of class.

Experiment

We introduced five words each week, sending students short *mini lessons* three times a day. Individual lessons defined a single word, taught some facet of a word, gave new contexts and examples, or reviewed words previously introduced. This variety of messages provided students with elaborative rehearsal, likely leading to deeper processing than that provided by methods such as bilingual word lists.

In the spirit of email, and accommodating the limitations of SMS, we wrote concise lessons (under 100 words) in an informal, friendly style. We also devoted the last lesson of each day to a *story episode*. We hoped that students would anticipate our lessons as they anticipated personal messages from their friends.

Hypotheses

In this first phase of our study, we investigated usability issues, considering these hypotheses:

H1. Push media will prompt students to study vocabulary.

H2. The story episodes, and concise, informal writing style will appeal to students.

H3. Push will be sufficient: students will be content to read their lessons without interaction (just as they've read their texts and studied their paper vocabulary lists without interaction).

H4. Students will read our short appealing messages soon after they arrive. (If students read lessons when they arrive, we could control their study intervals simply by controlling the time we send messages.)

Procedure

To test these hypotheses we gathered eight volunteer students of English as a foreign language (EFL) and Japanese as a foreign language (JFL). Pre-tests determined sets of words unknown to all the volunteers. We wrote the fifteen mini lessons required for each week of study, and then constructed a computer program that would automatically send lessons at 9:00, 12:30, and 16:00 each day. For example, here are the second day's EFL lessons:

```
   Hello. Hi everyone. I hope you are enjoying learning English words. Learning is
lifelong, not temporary. Today's word is reluctant. If you're reluctant to do
something, you're unwilling to do it. You might do it slowly and without enthusiasm
because you're afraid or shy about doing it. Many people are reluctant to speak to
large groups. They feel afraid or shy about talking in front of many people. How
about you? Is there something that you are reluctant to do?
   Hello again. Do you remember the words we studied yesterday and this morning?
Ignorant? Temporary? Reluctant? Sometimes people who live deep in the mountains of
North America are called ignorant. Many of those people do not go to high school.
They stop going to school after 6th grade. The government hopes this is a temporary
problem. But parents are reluctant to let their children go to high school because
they need them to work.
   Maggie was tall, almost as tall as Tom. (Tom was the young man's name.) Maggie had
purple hair. Tom had never seen anyone with purple hair. He thought it was strange
but beautiful. It made him want to talk to her to ask why she had purple hair. But
Tom was very shy and he was reluctant to begin a conversation with her. He kept
hoping that she would talk to him. Finally, one day...
```

One student read the lessons using SMS on a mobile phone; the other students read their lessons using email on their PCs. At the conclusion of the experiment, the students took post-tests and responded to a questionnaire.

Results

H1 was supported: 88% of our volunteers studied the lessons every day. 75% mentally reviewed.

H2 was supported: Students found the lessons "very enjoyable" and 88% desired to continue studying using this method. Most praised the brevity and informal writing style. All enjoyed the stories most.

H3 was partially supported: 75% of the students were content to merely read their lessons. But one student desired quizzes; another wished to ask questions.

H4 was supported *only by the student reading the lessons via SMS on her mobile phone.* The students reading email on their PCs were often unable to soon read incoming lessons; many could read only once or twice a day. Only for the student using a mobile phone were we able to evenly distribute our three lessons throughout the day.

Future Work

Our informal, bite-sized lessons were well received, but our experiments have only just begun. We plan to

- Add interaction (quizzes and hypertext).
- Compare mobile phones to PC email (for convenience, coolness, and disruption).
- Prepare even terser (100 character) micro lessons (for use on less endowed mobile phones).
- Study learning effects (finding optimal review intervals and number of words studied per week).

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Middleware to Support an Asynchronous Internet Course

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Abstract: Changing demographics at many colleges has led to an increasing demand for distance education programs based on emerging network and multi-media workstation technologies. This paper describes middleware that personalizes asynchronous Internet courses featuring 1) Use of a database of related material, which differs in difficulty, assumed background and delivery modes.2) Use of knowledge base in which the instructional material is organized as a dependency graph between the instructional topics 3) Management of the student's progress through the material based on demonstrated preparation in the prerequisite material 4) Uses of Artificial Intelligence techniques to assist in the creative process of learning concepts in discrete mathematics. We report on status of this project and plans to utilize this system for teaching two leveling courses in discrete mathematics and programming for transfer student into our computer science program. (This work supported by NSF DUE-9981039)

1. Introduction

The changing mission of institutes of higher education has led to increased interest in the use of emerging network technologies to support distance education programs. These changes have been brought about by the need for life long education in fast moving industries, desire for second career choices [Thomas91], and the spiraling costs of higher education. Aside from perceived cost advantages of utilizing computer and communications technologies for education and training, distance education claims to offer self-paced just-in-time learning which provides the efficient delivery of information to the students as they need that information. However to realize its potential, distance education requires new learning models and new methods of organizing, delivering and managing instructional material [Benyon 1997]. These models should support efficient learning (in terms of the amount of effort expended to realize goal) and they should be compatible with the life styles of prospective students, many of whom will continue to work while furthering their education. This paper describes a middleware infrastructure for asynchronous internet-based course delivery that features personalization to student progress and background.

The organization of this paper is as follows. The background section describes the motivation for this work as well as related work in the area. The next section covers the overall system architecture. This is followed by discussion of the state of the prototyping efforts. The final section gives conclusions and directions for future work.

2. Background

Of specific interest to Old Dominion University is the critical need for information technologists. One study done by the Virginia Business Higher Education Council in Virginia First 2000 (released October 1997) identifies a critical shortage of information technologists for an ever-increasing job market. Part of this need will be met by retraining non-traditional students who may already be working in a related field. These students tend to be more mature and better motivated than traditional college students. In many cases they are impatient with unnecessary obstacles that are often placed in the way of an education by traditional approaches (one size fits all lecture for instance).

Because of convenience and cost, many students choose to start their (re-) education in community colleges and then transfer to a four-year program. Recently the Department of Computer Science has initiated the TechEd program which will provide transfer students or those with an Associates Degree from a Community College with the ability to finish a four year degree through a variety of distance education media including broadcast TV, synchronous interactive instruction delivered over an INTRANET to the desktop, and asynchronous Web-based delivery of course material. In order for this program to be a success, it will be necessary for these students to make the (sometimes difficult) transition into our program. Because of rapid advances in information technology and a lack of uniform requirements in the introductory courses, students are not always adequately prepared for our upper level courses. Based on our experience with transfer students, we anticipate that the students enrolling in this program will have a wide variety of backgrounds, from professional programmers to students fresh out of community college. In particular their backgrounds in programming, problem solving and theoretical computer science will vary widely. In order to deal with any deficiencies; we believe it will be necessary to provide certain "leveling" courses that address any weaknesses in the student's background. Furthermore these "leveling" course will need to be personalized to the student background, learning media preferences and life styles (e.g. adapt to the student's work schedule). This will in turn require a course structure, technological infrastructure and sophisticated evaluation services that support an any-time, any-place personalized education.

One of the earlier computer based instruction systems is LISP Tutor [Anderson 1985], It helps students to learn LISP programming by detecting and analyzing mistakes. There are also systems which tailor their responses to user questions, such as UNIX Consultant (UC)[Wilensky 1988], [So 1994], Eurohelp [Breuker 1990][Winkels 1992], E-Help [Ohyama 1993], and Intelligent Help for IPS [Mallen 1996]. UC and So and Travis's system are for helping UNIX operating system users, Eurohelp deals with an e-mail system, E-Help is concerned with a text editor, and Mallen's system provides assistance to information processing system users using the designer's description of the system. Today there are a number of Web based adaptive educational systems such as ELM-ART [Brusilovsky 1996], PAT-InterBook [Brusilovsky 1997] and WITS [Okazaki 1996] to name a few. These systems except WITS have adaptive sequencing capability of knowledge units and they all do intelligent solution analysis. There is a comprehensive review paper by Brusilovsky [Brusilovsky 1998]. There is also a system CIRCSIM-Tutor [Evens] that uses natural language dialog to communicate with students.

Another application of artificial intelligence research comes from the work on automatic theorem provers. There are numerous automatic theorem-proving systems today such as HOL [Gordon 1987], Otter [McCune 1994], and TPS [Nesmith 1998] just to name a few. Of these TPS is an automatic theorem prover for high order logic. Since it is relatively easy to install and use, we have adapted it to diagnose student's answers to exercise questions in logic.

Needless to say appropriate and timely feedback through an analysis of the students' answers is very desirable. But there are many problems for which it is not trivial to even verify the correctness of the student's answers. For example when translating English into a formula of predicate logic, there are infinitely many correct answers. Even simple properties of logic, such as commutativity and associativity of *and* and *or* operators, create many variations. It is therefore necessary to have some kind of intelligence in checking the correctness of students' answers. In this project existing artificial intelligence technologies are investigated for possible use in providing solution checking and analysis. Currently TPS automatic theorem proving system [Nesmith 1998] and symbolic computation of MAPLE are used in providing solution checking.

3. Architecture

The work described in this paper is focused on providing the technological infrastructure to support two cornerstone courses for the TechEd program. These cornerstone courses will be taken for credit and are intended to provide the necessary theoretical (CS381) and practical programming (CS333) background for students entering the TechEd program. Because of the diversity in student backgrounds and the varying time commitment to complete the material, these courses will be self-paced using web technology for instructional delivery and monitoring.

The main objective of the proposed courses is to adapt to the diversity of backgrounds of entering students. Their key features are: a) Use of a database of related material, which differs in difficulty, assumed background and delivery modes. b) Use of knowledge base in which the instructional material is organized as a dependency graph between the instructional topics. c) Control by students to explore any material for which they have the prerequisites. At each stage, the student can be evaluated to determine their preparation for more advanced material. d) Management of the student's progress through the material based on demonstrated preparation in the prerequisite material. e) Uses of Artificial Intelligence techniques to assist in the creative process of learning concepts in discrete mathematics.

In this section, we describe the architecture to support the proposed adaptive tutoring system. We describe the course description and students profile structure followed by the overall architecture.

3.2 Course Description

The course description including the prerequisite information and requirements is represented using XML, and is similar to the proposed IEEE course description markup language

3.3 Profile Description

The student profile consists of two parts: static and dynamic. The static profile is set up at the registration time, and the dynamic profile tracks the students progress in the course.

3.4 Software Architecture

The proposed architecture is partitioned into three tiers as shown in Figure 1. The first tier consists of student and instructor interfaces, which are realized using Java applets. The second tier consists of HTTP server along with other major components for handling student and instructor requests. The third tier consists of AI system to support automatic evaluation and databases for storing course content, structure, and student profile.

4. Status of Prototype

We have built a prototype system that implements most of the major components of our architecture and have tested the functionality of the system with the CS 381 course. The prototype system is implemented using Java and servlet technology to maintain the portability of the code. We have implemented the basic Navigation and Evaluation applets. In the second tier we have implemented all the components except the Instructor related components. For testing purposes, we have created the course description and entered into the system manually. In the third tier, we are using Unix based file system for the content repository. The Oracle database is being used to store the course description and student profile.

This prototype is the result of several previous prototyping efforts that have been used in the past three years to teach various aspects of CS333 and CS381.

Utilizing AI techniques

Learning by doing is an important strategy in developing and reinforcing the student's understanding of the material. An ideal web course would provide students with opportunities to work on exercise questions and to get feedback on their work just as they do from their human instructors or tutors. With the current technology, however, it is not possible even to accept and evaluate students' answers unless they are in multiple-choice or other restricted forms. Diagnosing student performance and giving appropriate feedback is also difficult. The discrete math exercise analyzer utilizes theorem proving techniques and symbolic mathematics to takes a first step toward achieving the goal.

At this time our system is capable of doing the following automatically on Web through the use of an automatic theorem prover TPS and a symbolic computation system MAPLE:

1. *Answer checking for English to logic translation*
   Given an English sentence, a universe and predicates to use, students are asked to type in a logical formula that represents the sentence. The system accepts any answer as correct if it is equivalent to the stored correct answer. This equivalence is checked by an automatic theorem prover TPS.
2. *Checking simple inferences*
   Students type in logical formulas representing premises and a conclusion. The system then checks whether or not the conclusion can be deduced from the premises. The inference is checked by TPS.
3. *Checking correctness of simple set theory theorems*

Students can type in a simple theorem of set theory. The system then checks whether or not it is correct. TPS is used for proving theorems.

4. *Checking proofs by mathematical induction*
   For example, a proof by mathematical induction of $1+2+\ldots + n = n(n+1)/2$ is checked automatically by this system. Statements involving equalities and inequalities can be proven. Symbolic computation of MAPLE through MATLAB has been extended to provide this capability.
5. *Checking converse, contrapositive and negation of statements in English*
   Students are asked to type in English the converse, contrapositive and negation of simple English sentences. Their answers are checked and the result is displayed.
   Here simple natural language processing is used.

Currently work is under way on a system which accepts a simple English sentence and its translation into logical formula and which checks the correctness of the translation. This involves the automatic translation of English into logic and checking of equivalence between student's translation and system generated translation by TPS. Our goal is to handle the range of exercises found in a typical book on discrete mathematics.

5. Conclusions and Future Work

This architecture and the current prototype described in this paper is the result of previous systems that have been built over the past several years to support CS333 (which has been offered three times) and CS381 (which has been offered twice). Both these courses are successful and attract an increasing number of non-traditional students each offering. The development of an appropriate middleware infrastructure to support personalized progress through asynchronous Internet courses will provide a firm foundation for developing new approaches to learning. Providing alternate content presentations and utilizing the information in the dynamic profile will allow the system to adapt to the learning style, interests and background of the student. Providing sophisticated analysis of student answers using AI techniques will broaden the range of material that can be adapted to Internet presentation and evaluation.

Once completed, the new system will allow the exploration of several new areas of research. For instance, the protocol between a browser and a web server is essentially episodic. Each access to the web site is a separate episode with limited state information kept between episodes. The current implementation attempts to inject a degree of continuity by recording and reporting progress. However more sophisticated methods of dialog management would be desirable. We plan to investigate how current research in dialog management can be adapted to a web-based course.

Another area in which we have begun investigation is the use of user input capture during a problem solving session and the subsequent replay of this input by the instructor who can analyze the problem solving strategies of the student by virtually "looking over the shoulder" of the student (this may be computer assisted).

We believe that the proposed middleware infrastructure will provide the basis for a truly adaptive self-paced Internet course delivery system.

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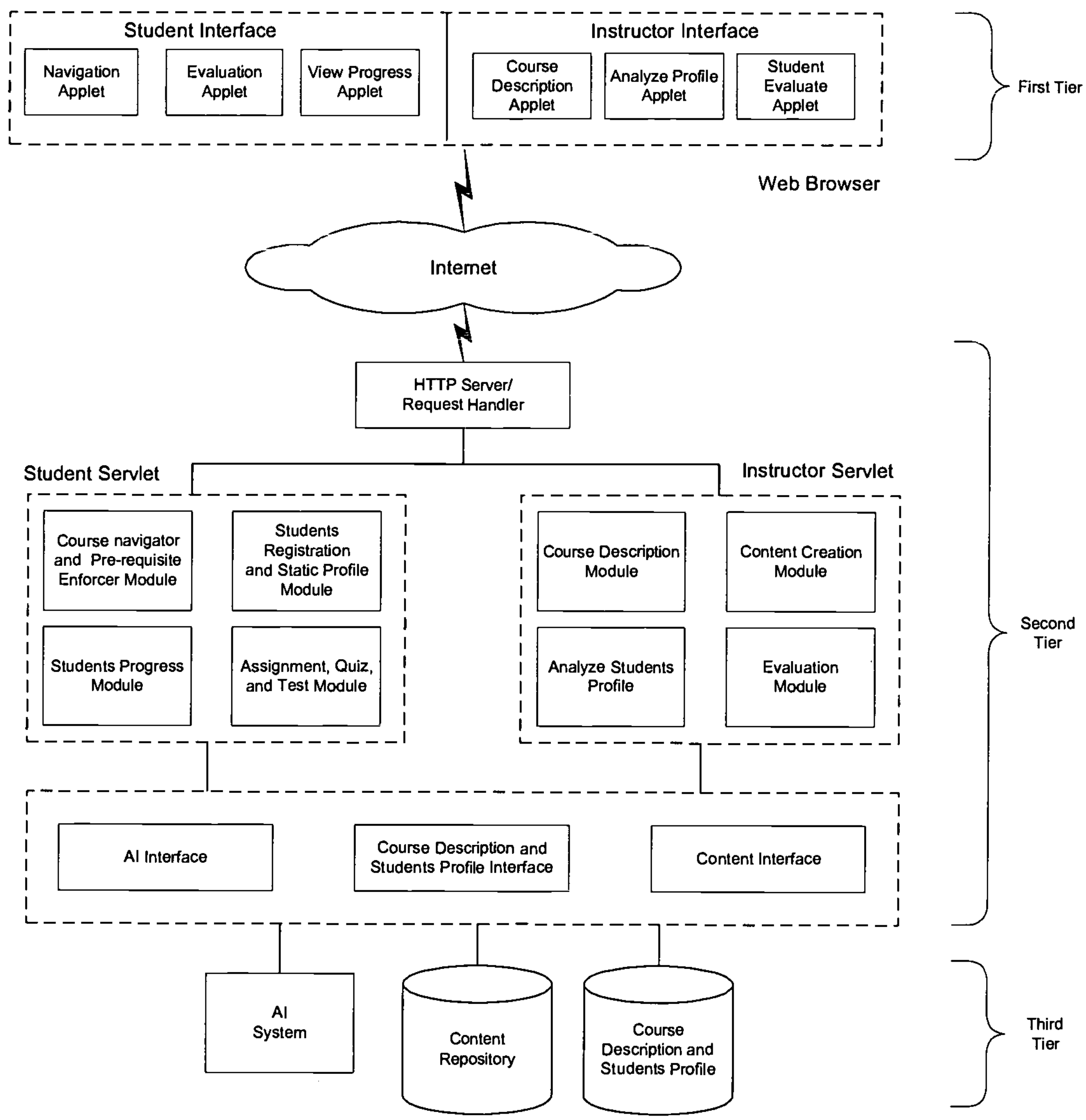

Student Interface
Navigation Applet
Evaluation Applet
View Progress Applet
Instructor Interface
Course Description Applet
Analyze Profile Applet
Student Evaluate Applet
First Tier
Web Browser
Internet
HTTP Server/ Request Handler
Student Servlet
Instructor Servlet
Course navigator and Pre-requisite Enforcer Module
Students Registration and Static Profile Module
Students Progress Module
Assignment, Quiz, and Test Module
Course Description Module
Content Creation Module
Analyze Students Profile
Evaluation Module
Second Tier
AI Interface
Course Description and Students Profile Interface
Content Interface
AI System
Content Repository
Course Description and Students Profile
Third Tier

1953

Do Gender Differences in Computer Efficacy Affect Course Grade Performance in Interactive Technology Courses?

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Previous research has shown that self-efficacy is related to task performance. The purpose of this research was to examine the effect of gender differences in efficacy beliefs (general, computer, and confidence) on expected course grade performance in interactive technology courses. As expected, males reported higher computer efficacy beliefs and greater confidence to do well in the course than did females. However, the interactions between gender and efficacy beliefs were unrelated to expected course grade. In other words, even though males and females reported different efficacy beliefs, males and females reported similar expected grades at the end of the semester.

Student individual differences, reactions, and learning in a molecular biochemistry course using web technology

Holly Traver, Rensselaer Polytechnic Inst., USA; Joyce Diwan, Rensselaer Polytechnic Inst., USA

Student individual differences, reactions, and learning were examined in a course that incorporates student collaboration and web technology. As expected, attitudes toward interactive technology positively impacted learning, and males reported higher levels of computer efficacy than did females. Gender differences in computer efficacy were unrelated to differences in learning gain. In addition, self-monitoring interacted with gender to influence learning gain, such that male learning gain tended to decrease as levels of self-monitoring increased; female learning gain was unrelated to self-monitoring.

Cognitive Learning Analysis for Strategic Educational Media Development Planning

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Abstract: Recent cognition research has provided new tools for analyzing priority allocation for revisions and innovations in teaching, such as the development of educational multimedia. This paper introduces a methodology for seeking information about the learning difficulty (element interactivity), the students' level of expertise and schema development, and the students' engagement with the content (germane cognitive load) which can then be used to guide the revision and innovation. An example is provided showing how a relative cognitive demand estimates obtained from staff and students may be used as a guide to prioritizing multimedia development. The method is shown to be very easy to use, providing all educators a new method, based on recent cognition research, for systematically organizing educational innovations.

Relative Cognitive Demand

After taking over from Gil Amelio as an interim Apple CEO, Steve Jobs faced some tough questions at a public presentation about why Apple had killed off some projects, such as the Newton. His answer was that in order for Apple to do some things well the company had to focus on those things by cutting out other activities. The argument of this paper is that in order to produce the strategic innovation benefits expected in educational development and revision projects, such as multimedia or online projects, the most pressing student learning needs have to be identified and prioritized for action. Then the effort, time and funds invested to address the greatest needs will produce the best improvements for educational programs.

How might we identify the priority areas for action in the current subjects? The usual answer is to carry out a needs analysis (Reigeluth, 1999), learner analysis (Heinich, Molenda, Russell, & Smaldino, 1999), context analysis (Tessmer & Richey, 1997) or task analysis (Jonassen, Tessmer, & Hannum, 1999; Tennyson & Schott, 1997). Although some existing analysis methods already provide useful information helping to prioritize the development of learning materials for new courses or existing ones during revision (Jonassen et al., 1999, p. 17-22) it is argued in this paper that results derived in the Cognitive Load Theory framework (Sweller, van Merriënboer, & Paas, 1998) can be used to produce a cognitive demand based guide for priority allocation. A number of sources of information are incorporated and can be used to set priorities. Three major interacting factors have been identified in the Cognitive Load Theory framework, which may be used as the basis for focusing improvement efforts in innovation programs. These are: (a) element interactivity of learning content, (b) expertise level of the learner, and (c) germane cognitive load of the content.

Element Interactivity

A major finding in Cognitive Load Theory has been to recognize that the characteristics of the learning content significantly affect the mental processing demand during learning. This is an important consideration since the human working memory, the portion of our minds used for conscious problem solving and mental processing, can only deal with very few items, or chunks, simultaneously (Miller, 1956; Richardson, 1996). Thus an important consideration is how many elements does a learning task present to be processed and related to each other simultaneously, i.e. its element interactivity? For example, learning individual reserved words in a computer programming language is a lower element interactivity task than learning the procedure for a recursive process.

Each of the reserved words can be learned independently, but to create a recursive procedure the programmer needs to take into account its place in the program, the variables involved, the scope of the recursion, mechanisms for detecting the end conditions for the recursion, appropriate syntax for writing the recursion end operation, etc. Thus to create an effective recursion procedure many elements need to be identified, and their interactions considered, resulting in a large number of individual items to be processed in working memory.

The element interactivity of a given task may be analyzed by examining the number of sub-tasks and their relationships to each other (Tuovinen, 1999). For example, Sweller and Chandler (1994) analyzed the elements of locating a point on coordinate axis and identified seven items or steps in the process.

Expertise and Schema Development

This is exactly the difficulty level a new learner trying to find a point on x-y axis has to face. If the element interactivity is too great, the learner will not be able to cope with the processing demands and the learning is faulty. However, we also know that once people have located many points on coordinate axis they will be able to combine, or chunk, many of these steps together and their working memories treat these seven distinct items as smaller groups. Eventually the whole process may be treated as a single item in the working memory. The chunking of basic items for more effective processing is called schema development, and it takes place as the learners become more expert in the field. Thus a task with many interacting elements, identified as discussed above, may not pose a very large demand on learners' working memories, and would be considered appropriate for them.

This argues for the identification of the learners' level of prior knowledge and capability in a given area, so that appropriate instruction may be provided to them. This may be achieved by surveying students about their prior experience with content, e.g. databases (Tuovinen & Sweller, 1999). Alternatively the students' prior schema or mental model may be evaluated, as shown by (Marshall, 1995) and (Cosgrove, 1994).

These approaches have a similar flavor to the task analysis stage in instructional design (Redding, 1995; Taylor, 1994). The earlier approaches to task analysis were based on the behaviorism, but the later approaches described in the above sources, are grounded in cognitive science. In these instructional design approaches the function of task analysis is to identify what the learner needs to be able to do after an educational or training program.

The differences between the conventional task analysis and the approach advocated in this paper are that the current approach is closely related to a robust theoretical structure which integrates human information processing, learning and instructional implications. The approach of this paper also systematically links task element interactivity and expertise, which is often vaguely, if at all, connected in conventional task analysis. This new approach incorporates analysis approaches which have been developed and tested in empirical research over more than a decade (Sweller, 1999; Sweller et al., 1998).

Germane Cognitive Load

Van Merriënboer (1999, personal communication) (Sweller et al., 1998) found that some students were not able to make the most effective use of their learning materials, not because the tasks posed too high processing demands on their working memories, but rather the opposite. The students did not adequately engage with the learning material. Thus a number of ways have been identified to ensure the students engage adequately with the material they need to understand, e.g. completion exercises (Tuovinen & Ross, 1997; Van Merrienboer, 1990), or employing a system for generalized encoding of information learned by analogy (Pirolli & Anderson, 1985).

Thus the processing demand of the learning content for students with a given level of prior knowledge must not be too high, or learning is impaired, and the students must engage sufficiently with the material for it to be beneficial. How then do we identify the relative cognitive demand in a given subject and how do we relate it to the students' prior learning? It is the hypothesis of this paper that it is possible to obtain useful estimates of the relative cognitive demand for particular subject content.

Estimation of Relative Cognitive Demand
Expert Estimates

Many people have a good knowledge of a given course content. If these people were asked to rank the relative effort or cognitive processing demands of the various content components, a composite ranking from the most to the least demanding content can be derived by computing the medians of their rankings for each subject component (Argyrous, 1996, p. 41). If some people are judged to have a better understanding of student learning in this subject, their estimates may be appropriately weighed. Some of the possible people who could be consulted to give these rankings are: subject designers, i.e. lecturers, responsible for designing current or previous versions of the subject, educational and instructional designers involved in the subject design, authors of relevant textbooks, authors of relevant educational software, and tutors/lecturers who have previously taught the course. The data may be sought using a very simple survey form, which lists the subject components and asks the informants to rank or rate the components according to their relative cognitive demand.

Novice Estimates

Despite the best efforts of the teachers or lecturers, they are often not very good judges of the learning requirements of students. This was borne out in experimental studies on software evaluation where teachers were asked to judge the educational value of software and then their judgments were examined in light of the students' performance (Reiser & Kegelmann, 1994). Thus it is important to obtain information from the students themselves. The students are a vital source of information about the relative cognitive demand of their subject's components. Students who have recently studied a subject can rank the relative cognitive demand and give estimates of their prior knowledge of the subject parts. Their consolidated reports can form the second major category for determining the innovation priorities. A survey form, such as shown in Appendix 1, can be used.

Unfortunately the students often forget the earlier difficulties where they had to expend considerable mental energies in comparison to problems they face currently, or have met most recently. Thus their end-of-subject ratings are not as valuable as data sought immediately after they have worked on particular content components. For this reason in the evaluation of the strategic innovations student data on cognitive effort/demand should be gathered throughout their engagement with the subject.

Once these two sets of rankings of the cognitive demand of the subject have been developed they may be compared to gain estimates of the cognitive demand as shown in the following example. The cognitive demand estimates may then be used to establish priorities for educational innovation and development.

Example

The following learning analysis was carried out to find out what aspects of a current first-year university subject most urgently needed additional multimedia resources. Both staff and student data was obtained from a small number of people. Thus this is a simplified example dealing only with a small number of data sources. However, even this limited analysis helps to illustrate the process. 2 staff and 22 students in an on-campus class were surveyed (student survey instrument attached as an Appendix 1) and the following results were obtained.

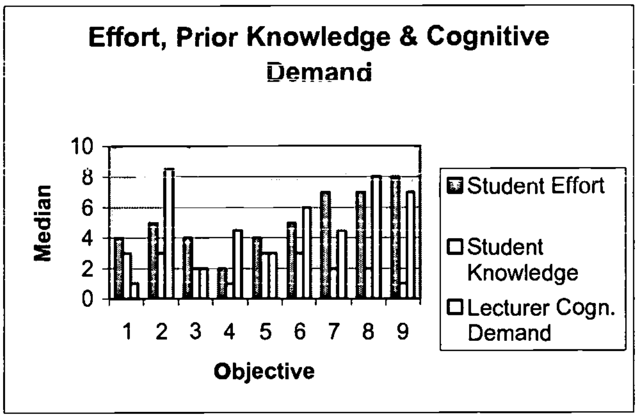
Cognitive Effort and Prior Learning Estimates

The lecturers were asked to rank the relative cognitive demand of the subject objectives (see list in Appendix 1) from 1 (least demanding) to 9 (most demanding) using a simple table. Using a similar ranking scale the survey instrument shown in Appendix 1 was used to gain estimates of the cognitive effort in student learning in this subject.

The medians of the staff relative cognitive demand estimates were obtained (see 'Lecturer Cogn. Demand' values on Graph 1). The medians of the mental effort estimates provided by the students were computed for each objective category (see 'Student Effort' on Graph 1). Estimates of the students' relevant prior knowledge were also obtained.

The medians for the prior learning survey results for each objective category were computed. These medians are shown on Graph 1.

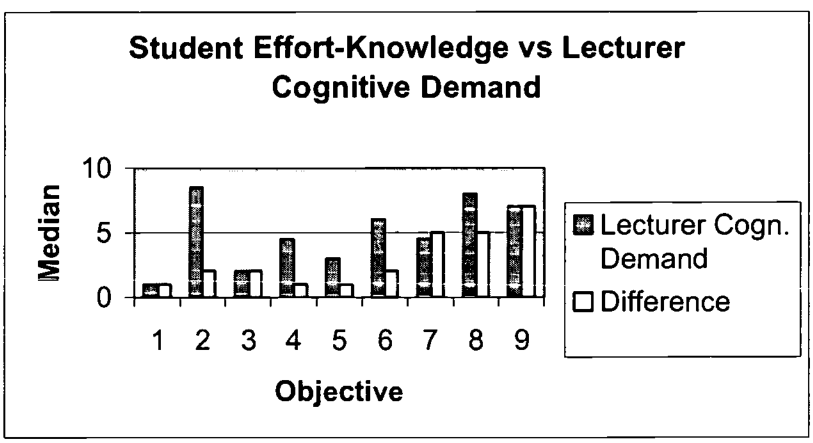
Graph 1: Student Estimates of Cognitive Effort and Prior Knowledge, and Lecturer Estimates of Cognitive Demand



The greatest learning needs occur in the areas where the students have the least prior knowledge and require the greatest effort to process the new learning material. In contrast areas where students already possess good knowledge and require minimal effort to master the work comprise the lowest learning needs, in terms of further learning process improvement. In fact, the student effort and prior knowledge graphs suggest that the greatest learning difficulties are indicated by the greatest differences between effort and prior knowledge. Alternatively, when the knowledge and effort estimates are close, the learning difficulties are reduced.

To help to identify the greatest group differences between the mental effort and prior knowledge required by the subject objectives, the median differences were computed. These were then graphed (Graph 2). The greatest differences indicate the areas that need the most educational design attention.

Graph 2: Median Differences: Student Mental Effort – Prior Knowledge, and Lecturer Estimates of Cognitive Demand



Priority

The median differences between the student estimates of the mental effort and the prior knowledge and the median lecturer cognitive demand estimates may be used as a basis for arranging a priority order for development effort in this subject. As noted previously, the lecturers and students do not necessarily agree in their learning difficulty estimates. For example, the lecturers rated objectives 2, 4, 5 and 6 as more cognitively demanding than the students. However, where they do agree, such as in rating objectives 7, 8 and 9 as highly demanding or difficult, we can be reasonably confident that we have found high priority areas for further educational development.

Conclusion

It is possible to gain significant information about students' prior knowledge and cognitive effort during a course of study. This information may be used to set priorities for subject revision. The technique used is relatively simple and speedy, in contrast to the more comprehensive conventional learning needs and task analysis methods and may be profitably employed by educators alongside other needs and task analysis methods.

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Appendix 1

Evaluation of GCO1812, Computer programming 2. Date:________.

Student Number: ____________ Sex: Male/Female (Please circle one) Age: ______ years

OBJECTIVE	**Mental Effort Rank** 1=least effort 9=most effort	**Prior knowedge** 1 … 5	**Specific difficulties** (Briefly note any particular problems in learning this material)
1. understand the concept of recursion			
2. be able to make effective use of recursion to solve new problems			
3. understand the concept of an abstract data structure			
4. be able to implement data structures appropriately in Java			
5. be familiar with some common existing data structures, including stacks, queues, lists, tables and priority queues			
6. be able to implement data structures using any of the common data representations, including arrays, linked lists and binary trees			
7. be able to make effective use of existing data structures to solve higher level problems			
8. be able to design a new data structure to solve a new problem			
9. be able to perform order-of-magnitude complexity analyses on simple algorithms			

Mental Effort:
Estimate the relative mental effort of the 9 sections of work. Number the objectives from 1 (least effort, easiest) to 9 (most effort, hardest).

Prior Knowledge:
I have experienced this concept
1 = never
2 = seldom
3 = sometimes
4 = often
5 = frequently

MeduLearning

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Abstract: MeduLearning studies essential multimedia learning skills against the background of new 'literacies'. literacy is increasingly evolving into a plural concept comprising not only traditional and visual literacy, but also general media and digital literacy on the one hand and more specific electronic and multimedia literacy on the other hand. MeduLearning envisages to trace specific skills that account for successful interaction with a multimedia programme. Two empirical studies were carried out with a multimedia strip story ('Operation Teddy Bear') about World War II. The first study (OT 1) with last-grade primary school pupils forwarded evidence for a competition of cognitive load build up by multimedia layers in the story with the linear succession of pictures in accessing historical background information. The results of a second study (OT 2) with pupils suffering from learning difficulties are now being analysed. An assumption of OT 2 is that disadvantaged children will cling on to visual cues in the strip story. The implications of this assumption for curriculum development are mentioned.

Introduction

MeduLearning is a line of thought explicitly stressing the insufficiency of the traditional classroom in meeting the need of children for skills to learn and work with educational multimedia. Therefore, essential multimedia learning skills have to be studied and a strategy for implementing the outcome of research in school curricula has to be developed. A useful starting point of research in this domain is the study of literacy, both in its traditional and new forms. Literacy is a powerful theoretical background for research into the interaction of learners with educational multimedia.

Traditional literacy and visual literacy

The skill to comprehend and handle printed course materials is essential, both in school and in broader society. The International Adult Literacy Survey (IALS) describes literacy as a broad range of information processing skills in relation to written or printed language and defines traditional literacy as follows (Van Damme et al., 1997):

"Using printed and written information to function in society, to achieve one's goal and to develop one's knowledge and potential."

However, literacy is increasingly evolving into a plural literacy (Erstad, 1998) due to the growing importance of images in communication. Visual literacy complements traditional literacy and claims a unique position in today's school curriculum. Children should acquire skills to work effectively and efficiently with educational multimedia. Undoubtedly, it is indispensable to analyse the nature of the skills children need to take full advantage of today's new learning opportunities.

Still more 'literacies'

Debes (1969) first mentioned 'visual literacy'. Like traditional 'verbal' language, a specific 'image' language supports communication. Visual literacy may not only be a means of communication, but also a way of thinking (Hortin, 1983). Thinking visually, then, means the ability to think and learn in terms of images.

During the last decade, a panoply of 'literacies' related to new technologies surfaced: media literacy (Hobbs, 1998; Potter, 1998), electronic literacy (Maylath, 1993), multimedia literacy (Kellner, 1998), computer literacy (Guthrie & Richardson, 1995; Peha, 1995), and digital literacy (Gilster, 1997). Media literacy pertains to communication through printed media; digital literacy is the ability to navigate both effectively and efficiently and to keep track of position in electronic media, while 'criss-crossing the landscape' (Spiro, et al., 1991). Computer literacy is the ability to integrate information and build an own knowledge base, subsuming both electronic literacy (e-mail reading skills) and multimedia literacy (technical multimedia skills). Reading hypertext is cared for by both electronic and multimedia literacy. When comparing the different 'literacies', two observations are important. First, critical analysis, interpretation, and processing of information are attributed to media literacy and digital literacy. The processing and integration of information (computer literacy) and technical skills (electronic and multimedia literacy) have to be critically evaluated by tutees. Secondly, without the notion of traditional and visual literacy, none of the newer forms of literacy can be understood.

MeduLearning: research questions

Departing from the 'literacies' debate, MeduLearning envisaged to trace specific skills that account for successful interaction with a multimedia programme. These skills have to be integrated in the school curriculum and treated as abilities underlying new 'literacies'. The primary research question concerns the relationship between 'operational skills' (searching, clicking, and dragging objects) and content comprehension in a multimedia programme. Is retrieval of information influenced by the mastery of operational skills?

Information can be presented textually, visually, or spoken. Does the integration of different types of information in a multimedia software package breaks the typical linearity of user's interaction with the interface? This research question addresses conditions that facilitate 'switching subjects' in a multimedia programme fitted out with 'clickable' hotspots and hyperlinks. Different subjects in a single multimedia package can range for instance from an adventure game with hyperlinks to an illustrated and spoken encyclopaedia supporting the game with relevant background information. A related question points to the relationship between switching subjects and retrieving or remembering information afterwards. Is switching subjects detrimental to retrieval of information or does it on the contrary support memory?

Research studies

Platform and method

Two research studies into MeduLearning were conducted. In both studies, the platform used was an educational CD-ROM, called 'Operatie Teddybeer' ('Operation Teddy Bear' or OT). The CD-ROM presents a multimedia strip about the adventures of a 12 years old boy, Paul, during the invasion of France by allied troops in June 1944. Paul smuggles important documents stolen from the Germans and hidden in his teddy bear to Paris, where his mother waits for him. The strip story is 73 pages long. The story is animated by the addition of sounds, motion, and more. The conversations within the different pictures making up the whole strip are textual: speech bubbles flash on and off according to actions undertaken by the user. Typical actions to be performed include searching, clicking, and dragging objects. Apart from the strip story, a huge amount of background information concerning World War II is included in the CD-ROM. This multimedia encyclopaedia is accessible through so-called hotspots in the story; a fighter aircraft for instance, highlighted in the strip story, leads into background information about allied air superiority in the second half of World War II.

Both in research study 1 (OT 1) and research study 2 (OT 2) children are observed while working through the CD-ROM's content materials. Observation data were recorded in a log-book. Afterwards, children were asked to reconstruct the story line of OT in an essay and to recall as much of the story as they still remembered. Finally, they were interviewed and attended on specific episodes in the strip where a decision to search, to click, or to drag was requested. We were interested if some sort of strategy hides behind searching for objects in the strip's pictures, clicking them, and/or dragging them to other pictures.

The observation of children and the recording of data were executed by master students taking a course in educational technology. They were credited for their involvement. Each student observed and interviewed a primary school pupil aged 11 or 12. This age group was chosen for the first research study, OT 1, since its more explorative nature demanded pupils who were good readers with sufficient computer expertise. It could not be allowed that the exploration of operational skills would be hampered by insufficient traditional and/or multimedia literacy. In all, 63 last-graders of Flemish primary schools participated in OT 1.

Results and discussion OT 1

The primary research question that addressed the influence of mastering and executing operational skills on the reconstruction of the story-line suggested a negative relationship. While pupils' essays were insufficient, even weak, the operational skills searching, clicking, and dragging were acquired effortlessly. Additionally, it turned out that an essay representing a story-line of a strip is a too demanding assignment for last-grade pupils after several hours in front of the computer.

The qualitative data analysis software package 'Etnograph' supported the analysis of data gathered. Essays and interview excerpts are coded and searched for utterances that support raw logbook data. The logbook recorded the fluency of searching, clicking, and dragging in OT, the accessing of background information, and the thoroughness of reading conversation bubbles.

Multimedia effects such as the combination of pictures, text, motion, and sound do not contribute to breaking the linearity of pictures' succession in the multimedia OT strip. Accessing background information through hotspots and hyperlinks is limited.

An explanation for pupils' clinging on to operational skills in a semi-linear adventure game quite like the OT story-line may reside in the 'cognitive load' phenomenon (Kalyuga, Chandler, & Sweller, 1999). The integration of pictures, text, motion, and sound heightens cognitive load. Meanwhile, task tension pertaining to the involvement in the rousing OT story successfully competes with the attractiveness of hotspots, opening a way to background information.

A last research question pertained to mutual support of the story-line and the background information in OT. Generally, the pupils' essays do not contain any reference to background topics at all. Strenuous effort to keep up with the speed of the story line's evolutions throughout OT seems to dissociate the story line and background information in the experience of children.

Finally, OT 1 produced 4 navigation patterns: (1) apathetic navigators, (2) selective readers, (3) information meeters, and (4) information explorers. Apathetic navigators pass through OT in a linear way and fully concentrate on the story-line. They ignore all hotspots giving access to background information.

Selective readers are rightly interested in background information, but often due to time pressures, they prefer first to work through the OT story line. They access background information that appeals them most.

A third group of pupils are 'information meeters': hotspots that are exceptionally striking are selected for further exploration. However, hotspots that are hidden in the background of the strip's pictures are ignored and there is no active soliciting of additional information.

'Information explorers' learn most of the CD-ROM's content. They consult all possible additional information and make good use of hotspots and hyperlinks, both in the actual OT story and the background information encyclopaedia.

Testing new insights

The results of OT 1 suggest that children pre-eminently view OT as a strip story. This view does not alter substantially while reading OT. Initially, the presence of sounds, speech excerpts, music, and motion in the story adds 'movie' features to OT. As the story progresses, children more readily anticipate story events: they look for objects in pictures that most probably will play a role in the next few pictures. Mere reactions to audio-visual events in pictures lessen. Searching, clicking, and dragging objects become increasingly well-considered. Throughout OT, visual literacy progressively changes from visual reagibility to ideational comprehension. Visual literacy is an essential condition for meeting OT's requirements. Multimedia literacy skills are effortlessly acquired on the spot: clicking and dragging objects are no problem. Originally, visual literacy is narrowed to multimedia skills like clicking and dragging, but gradually visual literacy opens up again to more thoughtful, content driven interaction with OT.

Working with OT proved to be a strenuous activity demanding high levels of persistent concentration. Since there are some good reasons to question the essay as a criterion to measure story line recall, recall should be orally in new studies, giving more spontaneous and exhaustive output of what remains stuck in memory.

Taking into account OT 1 results a new research study was set up featuring oral recall of the story line. At this moment, we are analysing data gathered by students, credited for their participation in observing and interviewing pupils. OT 2 was designed to be less explorative and explicitly investigates the added value of OT in opening up media skills to first grade pupils of polytechnic schools, aged 12 and 13. All of the pupils selected, 27 in number, follow a special preparatory year that copes with learning deficits incurred in primary school. Main interest are performances of children with learning difficulties in OT. OT 2 questions the evolution of cognitive activity in first graders with learning difficulties. Is the assumption that children with learning difficulties will cling on to visual cues in the OT story justified? A profound analysis of log-books has to yield conditions that trigger access of background information in disadvantaged pupils.

Implications of the studies

Both research studies provide input for implementing MeduLearning in school curriculum. OT 1 drew attention to an important shift from superficial reactions to visual stimuli toward anticipation of events in the story line. Pupils seem to encounter difficulties to cope with the different layers of multimedia information: text, pictures, motion, music, sounds. The linear nature of the story-line is hardly broken: background information is scarcely accessed. Processing and integrating information from different sources is a computer literacy skill that may acquire a place in school curriculum in due time.

OT 2 will make clear if pupils with learning difficulties perceive OT as a linear story-line that is better not broken by accessing background information via hotspots. If pupils hold on to visual cues, they should be more prone to access background information and OT may be a select platform for disadvantaged pupils. In conjunction with traditional reading and writing training, computer literate pupils may cope successfully with learning difficulties. Computer literacy in disadvantaged pupils comprises technical computer skills (searching, clicking, and dragging) and cue awareness that triggers reading and deepened understanding of information content.

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Networked Educational Management: Transforming Educational Management in a Networked Institute

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ABSTRACT: Transformation of academic, student and administrative management are key elements in the institutionalisation of Internet/intranet-based (networked) education in higher education. The distributed nature of networked education demands distributed models of academic, student and administrative management. This precept is based on the writer's doctorate research, implementation of networked education at Massey University, New Zealand as well as on consulting assignments over the last six years including a five-month consulting engagement at Cape Technikon, South Africa. Some argue that networked education is essentially an alternative delivery mode and its management is thus no different than that of other modes. Others posit that networked education is a new educational paradigm and a response to the educational needs of the emerging information society, in the same way as the traditional class was a response to the educational needs of the industrial society. Management of networked education is therefore fundamentally different from conventional educational management and correlates with new forms of private enterprise management including management of the learning organization, the information-based organisation and the networked organisation. The writer proposes a new form of higher educational management for the operations of networked education: *networked educational management.* The following dimensions of networked educational management are discussed: its distributed nature, managing convergence, its adaptability and transitory character.

Introduction

The widespread implementation of Internet and intranet-based education (networked education) in tertiary education globally necessitates a careful consideration of appropriate corresponding academic, administrative and student management approaches. Drucker (1998, p. 100) argues that "... as soon as a company takes the first tentative steps from data to information, its decision processes, management structure, and even the way it gets its work done begin to be transformed."

Networked education are being implemented on an exponential scale due to its flexibility, its links to the emerging culture of post-modernism (Hartley, 1995), potential to increase the cost-effectiveness of delivery (Romiszowski, 1993, June) and quality of learning (Uys, 1998) and its pertinence as an appropriate educational response to globalisation and in addressing the increase in the world demand for tertiary education (Daniel, 1998). Tiffin (1996, November) believes that the "...concept of the virtual class is the kernel of a new educational paradigm that matches the needs of an information society" (p. 1).

This paper presents some aspect s of the writer's doctorate research of the last four years (Uys, 2000). It is primarily based on the action research findings of the hydi Educational New Media Centre (Uys, April 1998; Uys, July 1999) in implementing networked education since September 1995 at Massey University, New Zealand. It also draws on case studies in other countries including a five-month consultancy in 2000 at the Cape Technikon, South Africa to start the wide implementation of e-Learning.

The term "*management*" is used in a broad sense to describe planning, organising, leading and control (Boone and Kurtz, 1984); Newman, Warren and McGill, 1987; Schultheis and Sumner, 1989) on all levels of a tertiary educational institute. There has been a clear and consistent call from prominent writers on management and organisational design like Drucker (1989, 1995), Senge (1990), Peters (1988), Marquard (1996), Tapscott (1996), Limerick and Cunnington (1993) that these functions of management are to be practiced in an entirely new way in the context of the emerging global information or knowledge society.

A networked institute is one in which networked education has been implemented widely and strategically. Paul (1990) posits that an institution that is dedicated to the values and practice of open learning needs to have an "open management style" (p. 72). Thomas, Carswell, Price and Petre (1998) argues for the "...transformation of practices (both teaching and administrative) to take advantage of technology in order to provide needed functions, rather than superficial translation of existing practices". Bates (1999) contends that the introduction of networked education "...will mean a thorough re-examination of the core practices of the organisation, from advertizing to registration to design and delivery of materials to student support to assessment of students, in order to analyse the most effective way of providing these services in a networked, multimedia environment."

Conventional educational management

The management structures of universities has remained largely similar through the ages as Patterson (1997, p. 7) points out "The historic continuity of the institution is unbroken, and many of the medieval university's unique features remain characteristic of ample, such as ... structures of governance, such as the division of major branches of learning into faculties, and the hierarchical positions such as deans, chancellor and rector". Over the years Higher education grew in size and complexity and "...bureaucracies became the controlling mechanism" (Garrison, 1989, p. 38). In contrast to the institutional management structures, the teaching and research functions of academic staff as professionals are typically more client oriented, less formal and less concerned with hierarchy (Paul, 1990). While institutional conventional educational management operates on a largely bureaucratic model, academic staff operate on a "collegial model" (Paul, 1990. p. 32). The anarchic model (Cohen and March, 1974) depicts the modern university as an organised anarchy which, according to Paul (1990) illustrates such ambiguities and uncertainties that it renders the traditional forms of management meaningless or inept (p. 37).

The management model on organisational level in conventional tertiary education is therefore one of tension between a centralised administrative approach and a decentralised academic approach in which the centralised, bureaucratic and hierarchical dimensions seem to be pre-eminent. The generic conventional management paradigm in tertiary education can therefore be described as being often mechanistic, formal, centralised, focussing predominantly on the local environment, insular, inflexible, rigid, bureaucratised, with strong institutional control and segmented, with a high degree of division of labour, variable participation, and often politicised.

New forms of educational management

In view of the new technologies and the emergence of the information age, education "...is experiencing a shift from formal, centralised, and segmented operations to increasingly complex, decentralised, and integrated levels of organisation" (Garrison, 1989, p. 38). Rumble (1992) refers to the operations of distance education as a "highly distributed system" which "looks very different to the residential or non-residential campus-based university" (p. 95). Peters (1993) contends that in the post-industrial society there will be in distance teaching institutions a "departure from a highly centralized organisation of the teaching-learning process and a move to small decentralized units which can be made transparent by the means of new technology" (p. 53).
use of such communication systems is seen as part of a large learning system that may well be a network of institutions" (p. 60).

Paul (1990) suggests that a value-driven leadership approach can address the different models of educational management and that in this approach, leadership is committed to ensure that people find meaning in life through their work by creating things of value (p. 68). Paul argues that an institution that is dedicated to the values and practice of open learning needs to have an "open management style" (p. 72) and that "those responsible for the leadership and management of these institutions must emulate the principles they espouse in the performance of their day-to-day activities" (p.22).

New forms of private enterprise management

Aspects like the globalisation of education, the role of private enterprise in tertiary education and pressures on the funding base impel tertiary institutes to increasingly operate in ways that closely resemble private enterprise. At the same time private enterprise is concerned with, and heavily involved in education (Drucker, 1989, p. 243; Garrision, 1989, p. 38). Organizational structures in private enterprise are becoming increasingly distributed. Drucker (1998) asserts that the "...need to organize for change also requires a high degree of decentralization" in the structure of the "new societ Beare and Slaughter (1993) contend that "... a business which operates on bureaucratic lines cannot compete in a post-industrial economy..." (p. 35). Marquardt (1996) describes the learning organisation as being "boundaryless" (p. 83). Two major transformations (or megatrends) in society are a transformation from centralisation to decentralisation (in effect distribution) and from hierarchies to networking (Naisbitt, 1982, p. 1).

Marquardt (1996) contends that in this "...faster, information-thick atmosphere of the new millennium... 'old' companies [cannot] compete with more agile and creative learning organisations" (p. xv). A learning organisation has a streamlined, flat hierarchy and is seamless and boundaryless (p. 83). It is further built on networking and "...realize the need to collaborate, share, and synergize with resources both inside and outside the company... they provide a company with a form and style that is fluid, flexible, and adaptable" (p. 84).

Networked educational management

The writer proposes a new educational management paradigm for managing the operations of networked education: *networked educational management.* Networked educational management incorporates the key elements of the new forms of private enterprise and educational management. This term is chosen since a central aspect of education in networked education and the management thereof seems to be the *connectivity* or *networking* that it facilitates often across the boundaries of space and time. This term correlates with "network management" (Limerick and Cunningham, 1993) and terms that writers like Tapscott (1996) ("internetworked organisation"), Beare and Slaughter (1993) ("network organisation"), Limerick and Cunningham (1993), ("network organisation"), and Tapscott and Caston (1993) ("open networked organisation") use when describing the organisational model for the emerging information age.

Networked educational management has twelve dimensions: networking, student focussed, globalisation, transitory, adaptability, transcending time, market orientation, computer mediation, collaboration, convergence, boundary orientation and being information based. Its distributed nature and the dimensions of convergence, its adaptability and transitory character are discussed in this paper.

<u>Distributed nature</u>

Networked educational management postulates that a distributed model of management is appropriate for networked education on both learning and institutional level. The distributed nature of networked educational management is based on the new connectivity within networked education, the distribution of learning and control, the distributed nature of the Internet and intranets, and the globalisation of education.

Networked educational management has its control, power and resources distributed throughout the organisation.

Managing the connectivity that networked education facilitates is a key difference between managing the conventional class and managing the operations of networked education. The learning control as well as on-line learning and teaching materials are distributed to both local and distance students using the same interface (ie a Web browser) because of the convergence of learning modes which traditionally have been called "distance education" -campus education" through networked education. This implies that the management of learning is no longer linked to physical locality (on-campus/off-campus) but distributed to study networks comprising local, distance, national and international students, that operate as virtual teams (Jarvenpaa and Leidner, 1998; Lipnack and Stamps, 1997).

Bates (2000) acknowledges the challenge to create a congruity between centralised and decentralised management aspirations in tertiary education: "When it comes to organisational structures, the challenge is to develop a system that encourages teaching units to be innovative and able to respond quickly to changes in subject matter, student needs, and technology. At the same time, redundancy and conflicting standards and policies across the institution must be avoided" (p. 181). A similar tension within the organisation of information systems activities and communications has been transcended in computer and communication systems using distributed approaches. Networked educational management can ensure conformity to central principles and standards as Evans and Nation (1993) contends, and simultaneously encourages diversity (Frederick, 1993; Negroponte, 1997 June).

<u>Convergence</u>

The convergence that networked educational management need to address finds expression on the institution level as well as the more detailed learning levels. On institutional level this convergence is increasingly occurring among educational institutions, enterprise, entertainment and the like (Evans and Nation, 1993).

The convergence that networked educational management needs to address is related to it being computer mediated. ICT is fundamental to the operations of networked education. Bates (1995) points to the convergence of telecommunications, television and computing as an important technology trend for the distance-teaching organisation (p. 45), while Tapscott (1996) highlights convergence of computing, communications, and content industries as one of the themes of the new economy. Networked educational management needs to manage a new integration or convergence of computing, communications, and educational content.

Networked educational management deals with a new convergence of on-campus and distance learning which has been made possible through networked education particularly with the advent of Intranets and the Internet. Garrison (1989:117) notes that this convergence is "...blurring the boundaries between conventional and distance education". This is due to an increase in the ease and feasibility of simultaneously offering a networked course to on-campus students as well as to distance students. Berge and Schrum (1998:31) contends that "it is important to recognize that on-campus programs and courses may often use the same resources and infrastructure as those delivered to students at a distance".

The convergence on macro- and micro-level does not necessarily mean conformity. Networked educational management is based on a distributed or networked model (described in 9.1 above) and can therefore couple centralised (strengthening conformity) and decentralised (encouraging divergence) management approaches.

Adaptability

The turbulent and dynamic internal and external environment calls for networked educational management to be highly adaptive. It connects to the concept of learning organisations (Marquardt, 1996) in which management needs to be highly adaptive. Networked educational management is organised along a flat hierarchy and is seamless and boundaryless like learning organisations (Marquardt, 1996).

There is also a requirement for flexibility within the software and hardware for developing on-line materials itself due to the inherent flexibility of web based materials. Management of networked education also needs to be flexible in the approach to acquiring and discarding ICT in order to grow with the continuing developments in the undergirding ICT.

An adaptive approach is also required in managing the learning environment through instructional design. Adaptive hypermedia systems achieve personalised presentation (Brusilovsky, 1996). This means that educational material is presented in an individualised and possibly unique way to students on the basis of mapping systems that are created for each individual student.

JIT teaching that is teaching that can change rapidly and immediately based on the needs of students and is available when students need it (Tiffin and Rajasingham, 1995; Marquard, 1996; Mason, 1998) calls for the management of teaching to be particularly adaptive.

Transitory

Control is an integral part of management (Newman, Warren, McGill, 1987) that is directly impacted by the transitory nature of the operations of the virtual class. Networked educational management acknowledges a decrease in control, more uncertainty and therefore an increased risk in the management of digitised education (Tapscott, 1996). The central position of the student as described above (*under* 9.2) and the changing nature of the student body contributes to an uncontrollability of huge proportions, which challenges the essence of conventional educational management and have to be addressed in networked educational management. Networked education further provides students with the flexibility of studying at their own pace and also at their choice of place. Networked education also allows students to either study independently in a more flexible mode or as part of a group in a more structured manner.

The transitory nature of networked educational management is linked to both the transitory nature of the technological environment and that of the change process. The environment in which networked education in tertiary education occurs at the beginning of the new millennium has been described as exceptionally dynamic and volatile (Tapscott, 1996). The introduction of computers in education is seen in revolutionary terms by some (Drucker, 1989). Even the nature of the change process from conventional to networked education itself is not stable (Morrison, 1995).

The global dimension of networked educational management furthermore increases the boundaries of the institutes using networked education and exposes them to be impacted by more factors and influences from a turbulent international environment.

In the emerging information or knowledge society, education has to further contend with an exponential growth of the amount of new information available for use by organisations, governments, and businesses and people (Nugent, 1996). The growth in the Internet continues to be exponential while there are furthermore sustained, revolutionary changes in the ICT that undergird networked education (Bates, 1995:45; Szabo *et al.*, 1997). In the increasingly digitised environment of networked education, networked educational management needs to allow for less control and more risk-taking (Tapscott, 1996).

Web-based materials are further especially fluid due to the ease of publication and the state of continuity of Web-based materials. In networked education the materials and teaching process is in a state of continuity which is in contrast to the state of discontinuity of materials in conventional tertiary education. Once a course is on the WWW, it remains available and no special arrangements are needed to keep it continually available - special arrangements however have to be made to discontinue its availability.

Conclusion

Transformation has become a key descriptor for the environment in which educational institutes operate. Conventional tertiary educational management has struggled with a dichotomy between its centralised administrative processes and its more fluid academic processes and has been criticised for its bureaucratic and unresponsive management structures. Institutes wishing to widely implement networked education will encounter the need to also transform its management processes. Networked educational management is proposed as an appropriate objective for this transformation.

"In a time of drastic change it is the learners who survive;
the 'learned' find themselves fully equipped
to live in a world that no longer exists"

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Challenges in Designing Communal Web-Based Learning Environments

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Abstract: In this paper we will discuss the key issues of designing communal and experiential web-based learning. When designing web-based learning we focus particularly on the community of learners and the learning situation on the users' viewpoint. We see web environments as the physical and virtual environments of action, in which learners can authentically meet and act. Our thinking is strongly based on the socio-constructivist idea of learning, on communalism in learning and studying, and on the importance of physical surroundings and context in all of our learning activities. We argue that communal learning and experientiality are meaningful didactic principles when designing web-based environments. Finally we introduce a pedagogically-potential designing model for web-based learning. Our considerations and findings have arisen from the research and development project TriO (Teaching, Studying and Learning Materials in a Network-Based Learning Environment. An Evaluation and Development Project of Network-Based Learning 1999–2000), which has been undertaken in the Media Education Centre of the Helsinki University in 1999–2000.

Keywords: Communal learning; experientiality; web-based learning; learning environments; designing model; uses of information and communication technologies (ICT).

Introduction

The work of the teacher is partly changing into designing learning environments. Information and communication technologies (ICT), especially the developments in multimedia, increased communications and web-based environments, have speeded up this change. In designing these new learning environments the challenge is to find didactically reasonable designing principles for their basis.

As a learning environment, the web clearly seems to be something that we have never experienced before (Hein 1999; Vahtivuori 1999; 2000; Vahtivuori & Masalin 2000). What do we mean by the web or a network then? These concepts themselves are quite problematic when learning and teaching are concerned. There are a number of different definitions and interpretations. The web or a net can be defined, for example, as a conceptual and cultural historical artefact or a technical platform (Lintula 1999). In this paper, the web is seen as a combination of different media, ICT tools and learning practices, which can be used for obtaining information, acting and communicating. The practices are understood as established ways of human actions. These ways of acting are created and they formulate when tools, such as e-mail, the web or a groupware are used together during the learning process. (Vahtivuori 1999; 2000; Vahtivuori & Masalin 2000)

Our idea about the concept of learning environment is based on Vahtivuori, Wager & Passi's definition (1999, 266–267) that the learning environment is formed by a physical, virtual or multimediated and telematic space (see also Tella 1998, 4–18), which is created for an active learning process and enhances and supports learners' possibilities for learning. The special needs and interests of the learners are highlighted. A functional learning environment offers practical ICT tools, different working methods, possibilities for interaction and dialogue, and guidance and support for the learners. We see the learning environment essentially as a community of learners where communal learning and communal culture may become real. This concept of a learning environment also arises from Uljens (1997) model of school didactics. In line with Uljens (1997), we emphasise the teaching–studying–learning process (TSL), in which studying in particular refers to the active process of the learner.

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According to Duffy & Jonassen (1992), the most functional learning environments are those which concentrate on the users, their needs and which emphasise a problem-based approach to learning and which take the social aspects of studying and learning into account. Our experiences and findings in different web-based learning environments strongly support Duffy & Jonassen's ideas. We see that the key issues in designing these environments and materials are: 1) paying attention to and focusing on the users; teachers and learners, as well as on the social aspects of learning, 2) creating experiential and problem-based learning on the web and, 3) understanding the characteristics of time and space in learning and studying on the web. Finally, we emphasise that, in designing and exploring web-based learning environments, the whole context of action as well as different ICT tools and the uses of these, should be considered. The web very seldom creates a catchall learning and studying environment. We would rather see the web as one tool out of a large selection of mixed media, also including conventional tools and physical space, which are a vital part of this context.

Users as Designers

One key principle in designing didactically meaningful web-based learning environments is to study and understand the user's viewpoint. By user we mean the teacher and the learner who are interacting, teaching and studying in these environments and using related materials. The producers, such as manufacturers and system designers, who design the environments and materials, always have lots of preconceptions about the user. These preconceptions may be explicit, but they may also be implicit within the producers' organisational culture. The dominant producer's preconceptions of the user become embodied in the learning environment or material. These preconceptions might not always be very relevant or reasonable in the users' viewpoint. They may even mislead the designer to create an environment which does not support the users' needs, when they are studying or teaching. That is why the social relations and discussions between the users and producers of the environment seem to be more important on the web than in conventional classroom-based learning environments. Good communicative relations and active dialogue between different participants provide a practical and also effective way of developing and creating web-based environments and materials (see e.g. Woolgar 1996). When designing these environments, the co-development of the user and the designer seems to be one of the most crucial prerequisites, when the aim is to create communal, functional and experiential learning environments in which the users willingly and effectively act and learn.

In Quest of Experiences

Hands-on sessions, experiments and learning-by-doing are often seen as important components of meaningful learning (Ackermann 1994; Jonassen 1995). Face-to-face teaching lecturers and traditional classroom-based learning are commonly supported by physical demonstrations and hands-on sessions. We argue that this should also be an objective when designing web-based learning. We see that multimedia, video, sound, animation, modelling and interactivity, especially in computer games (e.g. different edutainment software) and simulations, can create experiential and problem-based learning contexts and make virtual "hands-on" sessions possible more and more in the web-based learning environments (See Jasinski & Thiagarajan 2000). According to Gell & Cochrane (1996), the multimedia and the web, as well as other ICT innovations, can enhance learning by producing experiences. This means that, with the help of ICT, new kinds of experiential learning environments can be created. At the moment the learning materials are expanding step-by-step into a virtual "hyper- or cyberspace" in which new immersive visuality comes more and more important and documents can be flexibly cross-linked (see e.g. Aarseth 1999; Tella in preparation). The new technologies of virtual reality in interactive web-based environments will introduce in the near future the richness needed to move from the world of information to "the world of experiences" (Gell & Cochrane 1996; Vahtivuori 2000; Vahtivuori & Masalin 2000).

Understanding Time and Space

The concepts of time and space become very problematic when designing teaching and learning on the web. Learning and teaching do not necessarily have to take place in real-time, nevertheless studying and learning always take place in a physical context; in a classroom, in an office or at home. (Matikainen 2000; Vahtivuori 2000; Vahtivuori & Masalin 2000) When analysing the web as a learning environment, it should be understood as a vital part of the context used. The web cannot be detached from the physical environment and activities. We always belong to a certain time and space and culture with their limitations and opportunities. Learning and studying, like all physical and cognitive activities, are always somehow contextualised. The physical surroundings and cultural context define and change the nature and way of our activity. This relation is dialogic and exists in both ways: when the context affects us and changes our activities, our activities produce that context.

The conclusions drawn from the observations and reflections on web-based environments, clearly support the idea that the role and spesific features of the web, in a particular learning context, are important to take into account. Therefore, we see that the analysis of a physical learning environment is still a functional starting point when designing web-based environments.

In addition to the emphasised significance of physical context, the web-based learning, where the interaction and activities are primarily situated on the web, is exemplified by a lack of physical presence. This does not necessarily prove to be a barrier between learners. The feeling of presence and being on the web can sometimes be almost as real as in real life, or even more real (see e.g. Kynäslahti 1999; Welsch 2000). Slevin (2000) emphasises that this virtual rendezvous is something tangible and refers to Latour's (1998) idea of virtuality: "*... not as something which is disembodied, but something which is more material than real.*" Interaction and activities can be very rich and meaningful, even if all the learning activities are mediated. Even emotions, which are a crucial part of the communal learning process, can be delivered through media. How the community of learners will succeed in this, depends a great deal on the teacher's ability to give guidance and support for collaboration. If a comfortable and good atmosphere is created, and good ICT tools are given for communicating and acting, learners can talk and exchange their ideas the same way as in real life. New kinds of learning communities can be built in which learners can participate with people who have common learning interests. It is essential for the successful communal learning and the effective learning community on the web to aim at creating the kind of learning situation and context, which supports the dialogue, and the social dimensions of learning.

Supporting Web-Based Learning Environments through the Use of ICT

Information and communications technologies can enhance and facilitate the learning process in many different ways. We outline here some aspects of learning and technology. Our thinking is based on Goldsworthy's (1999; 2000) thoughts of how technology can support and facilitate learning. We use here the term "*technology*" to refer to information and communication technologies (ICT). Here we briefly present our model which includes four overlapping categories describing the different uses of technology facilitating learning. (See fig. 1) We also analyse how the communal modes of studying are taken into account in each of these categories. (Vahtivuori 1999; 2000)

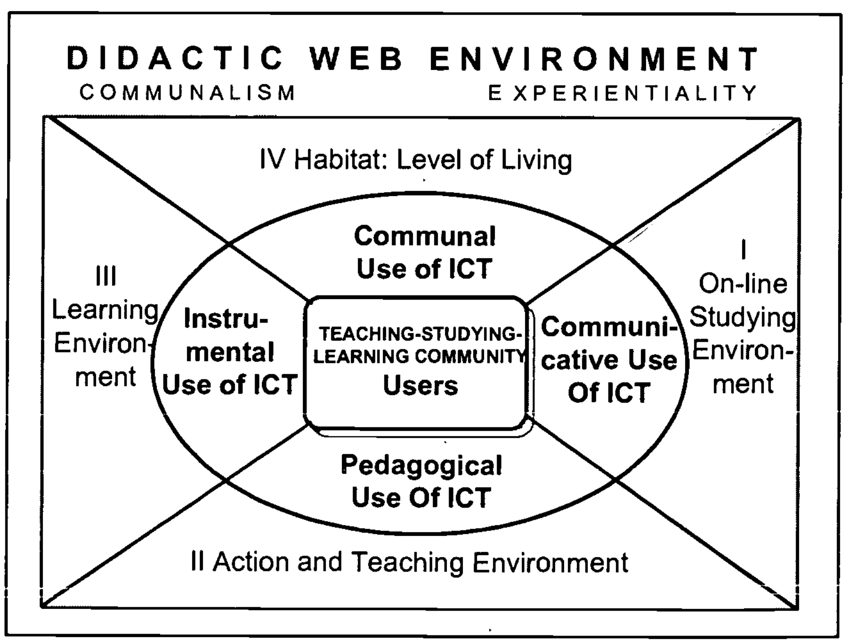

Figure 1: Different uses of ICT in Web-Based Learning Environment (Vahtivuori 2000)

Pedagogical Use of ICT

This category describes that learning can be facilitated by having content explicitly taught by a technical application or software package, with the learning material embedded in the technical appliance or software package itself (Goldsworthy 1999). Knowledge and skills are often meditated through the activities arranged in the software environment. It should be considered that this kind of use of ICT can be defined as pedagogical use merely on the condition that material or software used are didactically reasonable. This requires high professionality and pedagogical skills from the teacher. In our viewpoint, this facilitation category does not support communal learning directly, but it is an essential and commonly used part of the learning process and offers possibilities for problem-based learning with some elements of communal learning, e.g. especially when using simulations, games and edutainment software.

Instrumental Use of ICT

This use of ICT represents a common way of understanding the meaning and the use of technology in learning. It describes how technology enhances an individual's capability and efficiency when working on learning materials (Goldsworthy 1999, 59). Technology is considered a tool, in a way, as for instance a book, a leaflet or a pen in a more traditional learning environment. The instructional use of ICT can also support communal learning activities, but its *ethos* is mainly individual: one student working and interacting with the ICT tool.

Communal Use of ICT

This situation represents a more communal way of learning. Skills and content are learned through the structuring of the situation, where a group of students shares a number of computers housed in a common place. Activity and interaction are informal and improvised. Affective changes related to computer use and motivation, as well as the attributes of particular computer applications, could affect how students learn around technology. Co-operative and collaborative learning tasks are very effective and usable ways of structuring computer environments, in which students often learn as much from their interactions around the computers as they do from their interactions with them, as is described in the "pedagogical use of ICT" category (Goldsworthy 1999, 59; Vahtivuori 1999; 2000). In the communal use of ICT, students can share physical and virtual working space at the same time. Students, for instance, can solve problems; write reports and investigate together. This way of using technology supports communal modes of studying and learning and enforces the interaction and dialogue between students and teachers in a technology-generated situation.

The interaction between technology and learning may vary, depending on the way it is explored. One way is to investigate whether there is an improvement in performance on computer-based tasks, as a result of group co-operation and communal learning. The other is to investigate whether certain types of software actually facilitate the co-operative and social behaviours of learners. In all likelihood, this is a complex reciprocal relationship dependent upon the nature of the task, the attributes of the software, the physical and social surroundings, the teacher's pedagogical thinking and choices and composition and cohesion of the group. (Goldsworthy 1999, 59–62) We see that the this facilitation category is the most promising and fruitful way to organise communal learning situations in a web-based learning environment.

Communicative Use of ICT

Time learning occurs primarily through the interaction of learners at a distance, as mediated by computer technology, the learning may be considered as facilitated through technology (Goldsworthy 1999, 59–60). We called this here the communicative use of ICT. This use of ICT describes the situation in which the social organisation and interaction are mediated. This is the classical distance education (DE) situation (see e.g. Tella 1998). The key here is that participants are learning more from one another than from the computer itself; the computer is acting as a conduit for their interactions, enabling students to become separated in time and space. According to our experiences, this can easily cross over with the "communal use of ICT" facilitation category. For instance, the groupware may help the communicants through structuring the participants' interactions and other learning activities.

We find the described model and these described distinctions useful because they remind us of the complex role of ICT in communal learning. They help us to identify the different uses better and to find the key aspects and principles when designing communal web-based learning environments, and also to make reasonable choices. In these environments, it really seems to be vital to understand technologies as tools to think and act with. If we are aware of these various uses of technology as designers and teachers, we can support the students' process of learning in the best possible way and design communal web-based learning environments.

Conclusions

One of the main objectives of this article has been to understand the characteristics of the teaching–studying context of web-based learning environments and to outline the complex role and significance of the technological tools in a learning community, when designing web-based learning environments. Our reflections and findings are based on experiences on developing web-based learning environments (see TriO project http://www.edu.helsinki.fi/media/trio/english.html)

The first aspect that is important to take into account is the role of the user. We argue that the user should play an active role in the designing process for the environments and materials to be effective, to help the studying community in the learning process and to help to choose from the available tools those whose use would be most conducive to learning. The designers and users should collaborate in designing these environments. The web can give new opportunities for students and teachers to act, to teach and to learn.

The second design principle is highlighting and understanding the nature of hands-on experiences on the web. When seeking experiences, we see problem-based learning, with web-based games and role-plays and simulations as functional and promising examples. In interactive games and simulations we can regard the social and communal aspects of learning as real and authentic. Games and simulations are also immersive, so emotions are taken into account along with cognitive and intellectual aspects of learning.

One of our arguments is that the web very seldom constitutes itself a catchall learning environment. The web should always be used and understood as a part of some broader context of learning and activity. For the teacher, it is important to analyse what the role of the web is in a particular learning context and what makes it possible or not. According to our experiences, the web seems to work at its best, when it is specifically chosen for a particular task, from a larger selection of tools. So, the third designing principle in communal web-based learning environments according to our reflections is to consider not only the activities and context in the web and virtual world, but also the physical and cultural context of learning where the web is used. We argue that all the other designing principles of web-based environments can be built on physical learning environments.

Especially when designing communal web-based learning environments, it is essential to analyse the spesific features of each tool used and the different uses and strengths of the technological tools. How does each tool supports dialogue and communal activities and how can it be used in the learning community? Where and how a particular tool is used and best suited seems mostly to depend on the user, the physical context and the particular culture of the learning community. The designing models, such as the one we described, can help the teacher design and organise a learning environment in practice. They can also help to understand and to analyse the roles of the different tools and also their strengths.

When considering these points in designing web-based environments and materials, we can gain deeper understanding about web as the context of learning, studying and teaching and also get closer to environments which really support communal learning, while meeting the community needs for meaningful learning on the web.

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Experienced Teachers as Novice Knowledge Builders in Online and Face-to-Face Environments: Informing Professional Development

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Introduction

The goal of our research is to understand better how to provide professional development to teachers who are beginning to use Bereiter and Scardamalia's (1996) knowledge building theory in their classrooms. The study is a response to several calls for more attention to what the teacher must learn to be able to support an inquiry-based classroom culture (e.g., Keys & Bryan, 1999). We interviewed eight experienced teachers (experience range: 4-24 years) after they had taken a course on inquiry-based approaches to teaching and learning science (total enrollment: 18 teachers). The teachers used an online discussion environment, Web Knowledge Forum™, to discuss classroom activities and readings between class meetings. (Because the course was located in a Northern Canadian community, the class met on alternating weekends for two 4-hour classes.)

A section of the course focused on knowledge building. The teachers were first introduced to some video-based examples of knowledge building in elementary schools, and read an article (Scardamalia & Bereiter, 1996). Following this, they began to contribute their questions and theories about electricity to the online database and read an article on benchmark lessons (diSessa & Minstrell, 1998). During the following weekend, they completed a series of simple activities with batteries and bulbs, and began to develop conceptual models for the phenomena they had explored, using concept maps. In the following weeks, they discussed questions left open by this work. As the discussion evolved, the teachers had an opportunity to experience a dialectical interaction between contributions to the database and classroom activities. For example, experiments were tried in class as a result of contributions to the on-line discussion, and reading material was taken to a subsequent class in order to shed new light on one or two conceptual issues.

In the study we analyzed statistical data of online interactions, their *quality*, reflections on the course, written after each class, and verbatim transcripts of one-time interviews. This paper focuses on the interviews. Teachers were asked about their educational and professional histories, pedagogical beliefs, experiences in the course, understanding of knowledge building, and ideas about implementing it in their own classrooms. The interview questions and initial codes were informed by the knowledge building principles and a content analysis of the Knowledge Forum™ database. We report the main themes of what proved to be difficult for these teachers in relating the underpinnings of knowledge building theory to their beliefs about teaching and learning.

Results

Understanding limited to surface features of knowledge building

Although the teachers accepted that *collaboration* can enhance what an individual is able to learn, they were less open to some key aspects of knowledge building – metacognition, knowledge as improved over time, and knowledge as communal. For example, no teacher referred to the progressive nature of the knowledge building process: when a problem is understood at one level, learning resources are reinvested into understanding the problem at deeper levels (Bereiter & Scardamalia, 1993). Some teachers who understood the emergent nature of learning goals in knowledge building, were concerned about the fate of misconceptions. Such concerns usually were connected to the need to cover a prescribed curriculum and a fear of how misconceptions might hinder future learning. Statements made by some teachers indicated a belief in *certain* knowledge, the idea that knowledge is absolute and unambiguous (Schommer, 1990). This limited understanding of the core principles of knowledge building may have contributed to the erroneous belief of some of the teachers that knowledge building is something that "happens all the time naturally" (DR, 192) or that "educators are using (knowledge building) but not calling it that" (RC, 165-166).

Face-to-face and online discourse

The teachers saw the value of the online environment primarily in the possibility to comment on each other's ideas and to communicate with distant classrooms. Most teachers saw the online discourse as the characteristic feature of knowledge building, but did not recognize that each medium provided different affordances. (Asynchronous discourse can be more intentional and more reflective than synchronous discourse.) Some teachers stated a personal preference for a particular medium or raised issues about which they were passionate. For example, one teacher felt strongly that children spent too much time in front of screens (TVs and computers) and therefore did not support the use of computers to have children share ideas; she stated her personal preference for face-to-face interaction versus interaction with others via a computer screen.

Individual differences

We observed several individual differences among the participants in the study. (1) Preference for different discourse modalities (face-to-face versus online). (2) Experience and comfort level with computers. And (3), interest in the topic – a principled understanding of electricity. One teacher noted that she was motivated to contribute to the online discussion as part of the electricity inquiry, in which she was interested, but not to follow up on other class activities, in which she was less interested. Further, most teachers could see that knowledge building could work for *some* of their students, but did not believe that any given topic could hold the interest of *all* of their students. One teacher was concerned about a substantial number of her students with "behavior problems", and students who had low prior achievement, especially in reading and writing.

Conclusions

The study allowed us to gain some insights into how to provide professional development for teachers interesting in knowledge building. First, our findings suggest that there may be a *hierarchy* to the ideas underpinning knowledge building. For example, the idea of collaboration was less problematic for teachers than some other aspects like progressive problem solving. Thus early in the life of a knowledge building community we may find only some aspects of knowledge building represented (van Aalst & Chan, 2001). Examples of progressively more sophisticated knowledge building discourses may give teachers a better sense of what to expect in the early phases of implementation. Second, the mutual roles of the face-to-face and online discourses is easily misunderstood and should be examined explicitly in working with teachers. (This also applies to the role of hands-on activities.) Finally, it appears that teachers could benefit from empirical evidence that shows how students of diverse interests and abilities can participate in and benefit from knowledge building, especially in light of external expectations such as the prescribed curriculum.

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Extending The ARIADNE Web-Based Learning Environment

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Abstract: One of the central notions of the ARIADNE learning platform is a share-and-reuse approach towards the development of digital course material. The ARIADNE infrastructure includes a distributed database, called the Knowledge Pool System (KPS), which acts as a repository of pedagogical material, described with standardized IEEE LTSC Learning Object Metadata (LOM). Web-based tools enable content developers to describe their material, course builders to search for appropriate material to include in their courses, and course managers to develop, maintain and distribute computer-supported courses. It is important that a learning platform such as ARIADNE is open to external components, so that dedicated tools for the specific needs of a particular audience can be added to the generic toolset. In this paper, we will discuss several modules we have added to the general ARIADNE infrastructure. These modules include template-based delivery of web courses, a workspace application for sharing documents, a discussion platform for asynchronous communication, and an online questionnaire system. Based on our experiences, we have further refined these components, so that they can be applied more widely in the future.

1. Introduction

The concept of share-and-reuse for educational resources is obvious when one considers how hard it is to produce good quality digital material for education. In order to promote this collaborative approach to computer-supported learning, the ARIADNE Foundation provides a distributed infrastructure for the production of reusable learning content, its description, storage and discovery, and its exploitation in well-structured courses [Forte 1997]. The core of the ARIADNE infrastructure is a digital library of reusable educational components, called the Knowledge Pool System (KPS) [Duval 2001].

2. Knowledge Pool System

In ARIADNE, the term Knowledge Pool System refers to a large store of electronic pedagogical material. The KPS is in essence a distributed database of multimedia pedagogical documents (the data) and their descriptions (the metadata) [Cardinaels 1998]. It is important to note that the KPS can include any digital material. There are no restrictions on the format. As such, the term document should be interpreted in a very wide sense, including educational applications like simulations.

ARIADNE metadata are compatible with the IEEE LTSC Learning Object Metadata standard (which is in fact based on earlier ARIADNE work). They can be regrouped under several categories [Duval 2000]:

- General information (title, authors, language, etc).
- Semantics of the underlying pedagogical document (discipline, concepts, etc).
- Pedagogical attributes (end-user type, document type and format, difficulty, etc).
- Technical information (size, platform requirements, etc).
- Conditions for use (usage, price, etc).
- Meta-metadata or information about the description rather than the resource (indexer, validator, etc).

In order to describe documents (i.e. to generate metadata for them), an indexation tool that interacts with the KPS has been developed. This tool basically prompts the indexer to provide values for the elements in the ARIADNE educational metadata set. Document type specific ARIADNE authoring and segmentation tools can even generate some of these values automatically. ARIADNE also provides a query tool for searching the KPS, so that the rich set of metadata really becomes useful to an end-user. The latest version of this tool has a web-based interface [Verhoeven 2001].

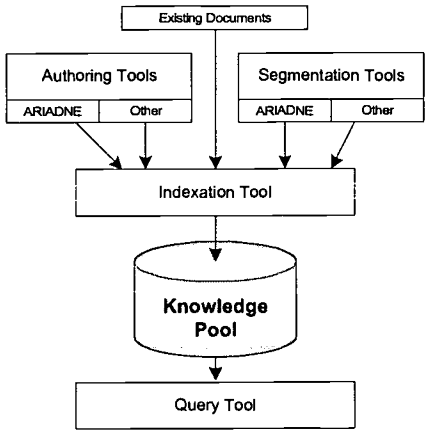

Figure 1: The ARIADNE Knowledge Pool System

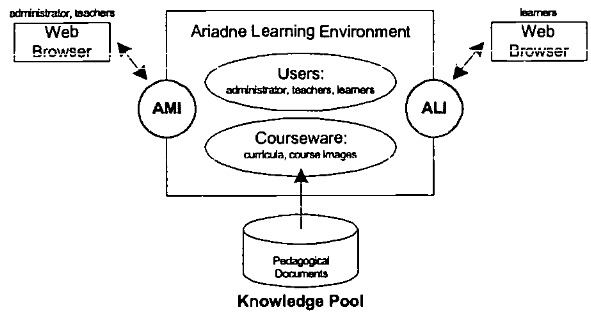

Figure 2: The ARIADNE Web-Based Learning Environment

At the moment, the KPS contains about 3000 documents. Roughly 25% of these documents can be considered as active, i.e. they require a reasoned action by the learner (an exercise for instance). The remainder of the documents is expositive, i.e. they require the learner to listen, read or watch (a video clip for instance). Most expositive documents are text documents.

3. Web-Based Learning

Within ARIADNE, a Web-Based Learning Environment (WBLE) has been developed for the creation, maintenance and distribution of courses [Macowicz 2000]. Using the ARIADNE WBLE, an educator can

- create and maintain pedagogical curricula, incorporating learning objects from the KPS, and
- distribute these curricula to students with minimal follow-up.

The ARIADNE Management Interface (AMI) allows educators to edit courses, to transform them into web sites, and to maintain and deploy them. Once deployed, a course is available to students for computer-based training through the ARIADNE Learner Interface (ALI). Using a normal web browser, students are guided towards relevant material and information.

An ARIADNE course description includes general course information (title, summary), and an overview of all sessions within the course. References to internal (within the KPS) or external (not within the KPS) documents can be linked to one session or all sessions. The translation of a Course Description File (CDF) into a web-site is done automatically.

4. Extending The ARIADNE Web-Based Learning Environment

4.1. Template-based Look & Feel

In the current version of the AMI, the translation of a course description into HTML always looks the same. Some teachers however may want to change the look & feel of the generated web site for the specific context of their users. A solution towards this problem consists of integrating a template-based generation system within the AMI. Several approaches are possible. One could imagine dynamic generation of pages using some web server extensions. Another approach could consist of using XML and XSL for transforming a CDF into a web course. Because the current AMI implementation generates the necessary pages once (no on-the-fly content), another approach was taken. Using Freemarker [http://freemarker.sourceforge.net], an open-source implementation of a template-based HTML system, an extension or plug-in for the AMI was constructed.

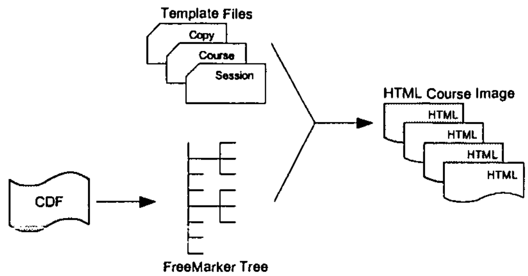

Figure 3: Template-based extension for the AMI

Within Freemarker, the source code for a template is an HTML document that contains special directives for including dynamically generated data. Software has been developed for mapping a CDF to a data tree structure. Figure 4 illustrates this mapping for a course with 4 sessions. Figure 5 illustrates how a template uses this tree to generate the appropriate HTML

```
Begin Curriculum
Title: IPS
...
Sessions:    4
Session 1
Date: ...
Title: Introduction
Description: ...
...
Session 2
Date: ...
Title: Classes and Objects
Description: ...
...
End Curriculum
```

```
template root
> title = IPS
> sessions
  ❶ title = Introduction
    > ...
  ❷ title = Classes and Objects
    > ...
  ❸ title = ...
    > ...
  ❹ title = ...
    > ...
> ...
```

Figure 4: Translation of a CDF into a data tree structure

```
<html>
<head>
<title>${title}</title>
</head>
<body>
<h1>${title}</h1>
<ul>
<list sessions as session>
<li>${session.title}
</list>
</ul>
</body>
</html>
```

```
<html>
<head>
<title>IPS</title>
</head>
<body>
<h1>IPS</h1>
<ul>
<li>Introduction
<li>Classes and Objects
<li>...
<li>...
</ul>
</body>
</html>
```

Figure 5: Translation of a template file into HTML

4.2. Forum

The ARIADNE infrastructure, focused on share and reuse of pedagogical documents, does not include interaction facilities for communication from students towards educators, or between students themselves. In order to support these additional interaction facilities, the ARIADNE learning platform has been extended with external components or modules. We have developed a discussion platform for asynchronous communication between students and educators. The use of an online discussion system has some obvious advantages like public availability on a twenty-four hour basis, the ability to reuse an answer when the same or a similar question is asked, and the possibility to post questions as they arise during study. Because most existing implementations have too much/few functionalities and they can't be customized easily, we implemented our own web-based threaded discussion system.

Students as well as educators can participate in online discussions from within the generated web site of a course. Our *Forum* implementation, based on MySQL [http://www.mysql.org] and PHP [http://www.php.net], provides some interesting features, like:

- email notification of authors if a reply article is posted,
- email notification of moderators if an article requires their attention (students can enable this option when posting a question),
- attachment support (articles can be augmented with several file attachments),
- relevance indication for threads (moderators can mark certain threads within a forum as especially interesting; it is possible to define several levels of relevance within a configuration file),
- generation of an all-in-one version for a discussion group, which can be distributed as a FAQ (Frequently Asked Question) afterwards, and
- GUI customisation through the use of cascading style sheets [http://www.w3.org/Style/CSS].

A recent add-on consists of the possibility to post mathematical articles within a discussion group. Using MATHML [http://www.w3.org/Math], an XML-based language for expressing mathematical content, several formulas can be included within a post. Based on a commercially available system [http://www.webeq.com], we developed a server script capable of transforming a MATHML string into a picture. We integrated this script within our *Forum* system.

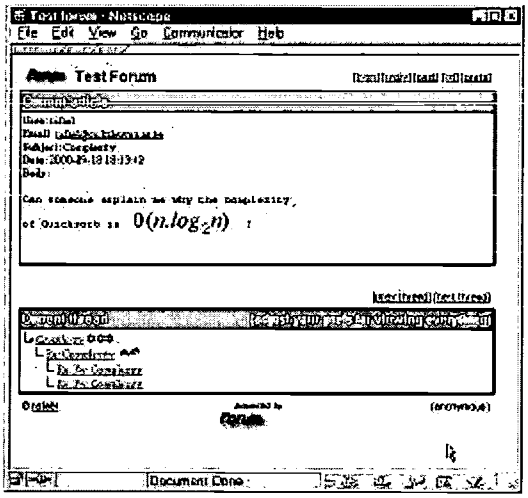

Figure 6: Forum in action

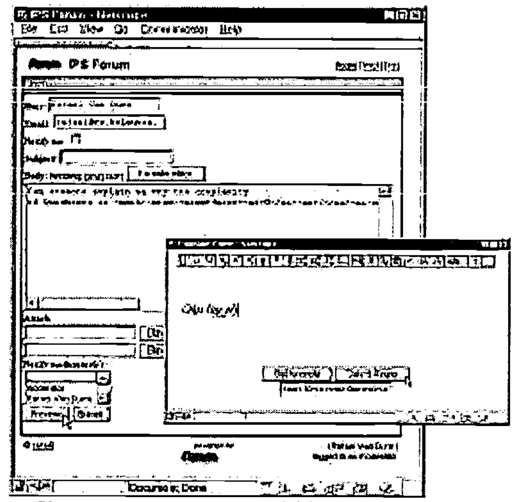

Figure 7: MATHML within Forum

4.3. Workspace

In a collaborative learning setting, students work together on an assignment, discuss the content of a course session, or share insights to solve a problem. Electronic aids like document sharing systems can help students perform these tasks. Our *Workspace* application enables students to upload and structure documents using a web interface.

As it may be difficult for educators to keep track of who has done what, or whether some students need help (either technical expertise, or with their planning), a matrix add-on with annotation and deadline support has been developed. For instance, if a course requires students to perform several group assignments, a matrix can be used to show the relevant documents for each assignment for all student groups. Besides a deadline, an educator can associate annotations with a solution for an assignment (a cell within the matrix overview). Public annotations are visible for everyone and typically used for scheduling meetings. Private annotations are visible for educators only and typically used for grading.

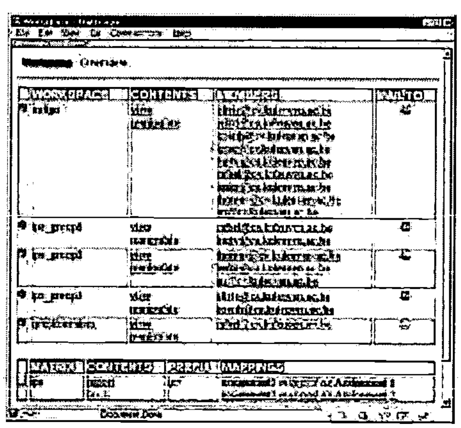

Figure 8: Workspace in action

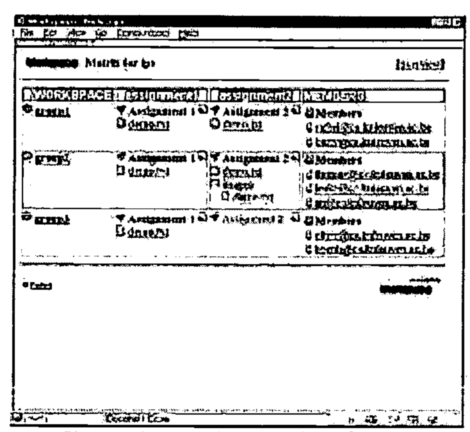

Figure 9: Matrix overview for IPS

Figure 9 illustrates the matrix concept. For a course called IPS, two assignments (columns) have to be made by three student groups (rows). There is a public annotation for the first assignment of the second group (a meeting); the third group failed to reach the deadline for the second assignment (the number of uploaded files is zero, that is why the title is coloured red).

4.4. Questionnaire

Online tests are an interesting tool for helping students auto-evaluate their progress and knowledge. ARIADNE supports this type of self-assessment with the QuizCode toolset [http://www.codeonline.com]. Using a simple authoring environment, educators can create and distribute quizzes. Students can try to solve these quizzes online; they immediately receive appropriate feedback. Finally, educators can interpret the different answers using an analyser tool. The current implementation of QuizCode is XML based, which enables us to develop an additional component to overcome some important limitations. For instance, formatting of questions is difficult, there is no support for mathematical formulas, and it is not possible to associate metadata with a question. The solution towards this problem consists of a lightweight web implementation of the QuizCode viewer for solving quizzes.

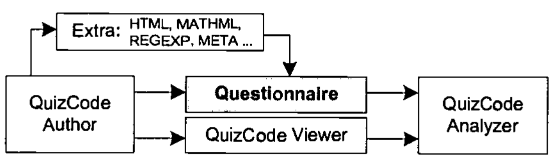

Figure 10: Questionnaire

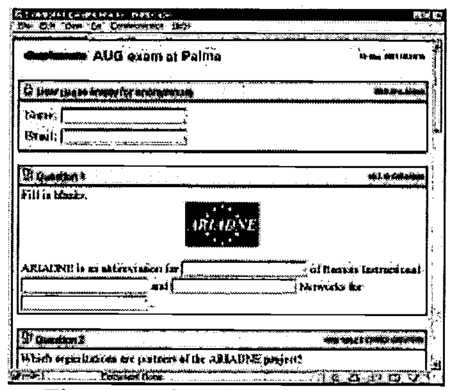

Figure 11: Questionnaire in action

Our *Questionnaire* application has some interesting features as opposed to the original QuizCode viewer software. These include ...

- Full HTML formatting of questions.
- MATHML support for the inclusion of mathematical formulas within questions.
- Regular expressions as answers:
  The answer can be expressed as a pattern rather than a case-(in)sensitive string. For example, if the answer to a geographical question is the *USA*, then also *United States of America* should be considered as correct.
- Metadata for questions:
  Students use this metadata for generating a quiz based on their selection needs. If for instance the metadata includes a topic and a difficulty indicator, a student can compose a quiz with easy questions on topic *X* and *Y*.
- GUI customisation of the student web-interface through the use of cascading style sheets [http://www.w3.org/Style/CSS].

Questionnaire is compatible with the QuizCode authoring environment and most features of the analyser tool. There is support for 8 types of questions: multiple choice, radio button (a multiple choice question with only one correct choice), word, essay (this type of question cannot be graded automatically), graphical, numerical, fill-in, and true/false. For the moment, the inclusion of the extra features is done by hand.

5. Experiences

The extended ARIADNE infrastructure was used during the academic year 1998-1999 within the *Electronic Student Counselling* project sponsored by the K.U.Leuven [Van Durm 1999]. The aim of this project was to create a virtual guidance environment for first year students. The experiences gained from this experiment led to the development and refinement of several ARIADNE add-ons. In 1999 another project sponsored by the K.U.Leuven started. The aim of this project was to construct an electronic environment supporting guided self-study, demonstrating that online collaboration and online learning communities can impact and enhance the learning process. During the academic year 2000-2001, several courses use our ARIADNE-based environment. These include a first year programming course, a course on information and programming constructs, and a course on human computer interaction.

We will evaluate the quality of our ARIADNE-based guidance environment at the end of this semester through doing a study for mainly examining the functions, interface, content, and learning experiences by means of questionnaires that embrace specific questions. We can now already observe that ...

- *It is sometimes hard to involve educators.*

The Internet is all about sharing and cooperation. A good number of educators are clearly prepared to integrate this spirit within their teaching. Others however are rather reluctant towards this idea. They complain that, after an initial effort, an educator is forever in a continuous process of assessment, modification, learning modern techniques, and implementation. We believe that this has in fact always been the case. The web has just introduced different details and a new medium to stimulate learning in a more effective manner than before.

- *It is sometimes hard to (actively) involve students.*

Our computer science students have almost no trouble in taking full advantage of the power of our web-based guidance environment. A recent experiment with students from another department showed that, although the Internet is very popular today, not all students are willing to interact within a virtual environment.

- *A tighter integration of several plugins with the existing ARIADNE toolset might be useful.*

Students and educators interacting with the different modules within our guidance environment often need to authenticate themselves. For the moment, most modules have their own authentication mechanism. A shared authentication service would be appropriate to solve this peculiarity. Work is being done for integrating LDAP-based authentication [http://www.innosoft.com/ldapworld/] within ARIADNE.

ARIADNE supports multilingualism both in the KPS and the WBLE. Within the AMI, a course manager can select the language for a web site to be generated. Our components however provide an interface in one specific language. Thus, making these components multilingual is also on our to-do list.

6. Conclusion

Using the extended ARIADNE infrastructure enables educators as well as students to work together within a virtual environment. Educators can share pedagogical material using the Knowledge Pool System. A web-based learning and guidance environment enables them to stimulate students creatively. Students interact with multimedia material, discuss within several fora, try to solve some quizzes, and share documents with each other. An ongoing extensive evaluation including user inquiries (students as well as educators) will provide us with the necessary insights for further developing, extending and promoting our virtual environment.

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Joining the Ranks of the E-literate 'E-lite': a First Encounter and the Office Root Metaphor

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Abstract: The theme of this paper is the problems associated with pedagogy of initial computer literacy education for adult learners in South Africa, and more specifically the learners' interpretation of iconic symbols of the Microsoft applications. In a first phase of a study of 21 students in such a course we found that it was not, as we had assumed, the language of learning (English, which is a third or a fourth language for them) or experience with electronic technology, which posed a problem. The major obstacle for these learners was the lack of knowledge of the root metaphor of the Windows and Microsoft Office GUI interface. They had little, if any, everyday experience of life in an office, and therefore the ostensibly simple and straightforward icons that were derived from the physical space of 'the office', were not known to them. The icons were thus mostly used as 'semantically limited' tools.

Context and Framework

In this paper we will argue that a first encounter with computer technology reveals person-technology dynamics that vary in different contexts, and that the notion of the 'office' as root metaphor for Microsoft applications can in itself be a marginalizing agent. In a developed world setting, adult learners often experience typical difficulties in becoming competent as e-learners and communicators. These may be navigational problems and the general clumsiness and apprehension with which first-time adult learners approach the interface. However, in a developing country, such as South Africa, with its unique socio-political history, the majority of the present generation of adult learners did not receive exposure to environments such as the 'office' as workplace. Students that were earmarked by policy of the state for manual labour or for a service vocation, do not have the everyday knowledge of the mechanisms of 'the office', a place that was known to an elite in the corporate world and to selected whites who formed the civil service. If learners with this type of background then learn to apply symbols linked to this metaphor, they do so with limited semantic backup[1], or by means of a rerouting of the analogy, both of which take up more time and slow down their learning process.

With this phenomenon in mind, we have set out to capture more detail about the activity at the interface in a longitudinal study of three years, the first findings of which will feature in this paper. The focus of this paper will thus be the data emanating from a *thick description* (Merriam, 1998) of a very first encounter. We approach this study not only from the position of what Nardi (1999) refers to as 'information ecologies' (an approach that we find essential in teaching computers to what has been until recently a predominantly oral culture with many students being first generation literates), or from a general Human Computer-Interaction (HCI) perspective (Preece et al. 1994). We also approach the inquiry from the specific position of cultural linguistics as propounded by Palmer especially (1996), with emphasis on the use of metaphor and the activation of relevant schemata in learning new procedures and skills. Palmer (1996) refers to Lakoff and Johnson (1980), who use the phrase "experiential *gestalts*", by which they meant "ways of organising [multidimensional experiences] into

[1] We use this term with some care, meaning that the symbols do have meaning, but only superficial operational meaning.

structured wholes". Single acts, especially using metaphors as organising principle, invoke a whole array of life experiences and coherence-making mechanisms, which invoke networked images (also linguistic images) that are used to frame and to found new knowledge construction. Palmer argues (1996):

> We have the cognitive ability selectively to focus attention on different components of complex mental images, to consider them from different perspectives, to zoom in and zoom out mentally, to trace paths through them, to turn them over in our minds, and to experience them as processes, that is, to play them back in our minds and view them at different phases, This sort of construal and reconstrual probably applies to all kinds of imagery, from complex social scenarios to elementary special schemas, such as *container*, *link*, and *source-path-goal*. The relations that arise between various construals of image-schemas have been called "Image-Schema-Transformations" (Lakoff, 1987:440 – 444; 1998: 144 – 149).

The recognition of a metaphor, or any other sign or symbol for that matter, does not mean a linear recall of meaning. The meaning is reconstructed through many processes of reconfiguration of images and other knowledge schemas. Viewing learning *of* the interface *at* the interface, although epistemologically radically constructivist, at the same time also invokes a social constructivist and sociocultural view, because of the role of life experience in the reconstruals. A perspective that focuses on individual learning, but against the backdrop of a broader sociocultural perspective, is of activity theory, which we also use in our interpretation and framing. Nardi (1996), who proposes that activity theory is a viable analytical and descriptive tool for HCI research, maintains that it has been recognised that "technology use is not a mechanical input-output relation between a person and a machine; a much richer depiction of the user's situation is needed for design and furthermore says that it is not clear how to render this portrayal that is not simply ad hoc. She proposes that activity theory can be used as tool to study the interface and to explore HCI in rich matrices of understanding.

Two other activity theorists (Cole & Engeström, 1993) argue that language, as mediation tool, is the 'master tool' of learning. We add to that, that the linguistic imagery which Palmer (1996) uses as central concept to propound the theory of cultural linguistics, captures the role of language as major constituent of the *reconstrual of imagery*, which Lakoff speaks of (Palmer, 1996). For the purposes of this inquiry this means that 'office'-like analogies will presuppose schemata for *office life* (as well as the language to label this) from which to draw the reconstrued procedural knowledge that is needed to perform certain functions at the interface. Whether these are in the representational form of concrete objects or of abstract symbols (Preece et al. 1994) is not really the issue here, and whether the original symbol was presented in linguistic form or not is not of primary importance – the reconfiguration of images and the reconfiguration of meaning are the issue and that, we claim, is networked and fuzzy. Without a clear root metaphor the fuzziness can become a major obstacle in cognitive functioning, because the organising tool is not known (well enough). From this position we argue that during encounters at the interface, and more so with specific reference to first encounters, that the learning of skills and the mastering of tools are only part of the human activity that constitutes consciousness, and that human consciousness includes a socio-historical and cultural matrix (Nardi, 1996) in which activity is embedded. If the analogies used are too strange, the cognitive burden becomes heavier, and progress is retarded.

Additionally, we argue that consciousness is expressed and communicated mainly through human language. Thus, when African teachers, who use English as a third or a fourth language, meet with computers for the first time, they do not meet with a tool or instrument only, they also meet with a way of life that has been constructed in the think-tanks of societies that they do not know very well, and which can appear hegemonic, managing their knowledge construction and access to information, and using the powerful world language. Their first encounter may again affirm what these learners were made to believe in a life of *education as indoctrination* – cognitive and personal autonomy is not within their reach. Warschauer (1999) addresses this issue of equity (and equality) and refers to the renowned scholar, Manual Castells, who has investigated the role of e-equity and who has concluded that the "global village" consists of "customized cottages". Disempowered inhabitants of the "cottages" in Africa (where only 0,6% are connected to the "village", 98% of which reside in South Africa) cannot appropriate a "village" discourse if they do not comprehend the basic tool of the interface in an emancipated fashion. Unless they do, they will continue to 'copy' and execute orders and 'commands'. They may, also therefore, from the very beginning, believe that computers are used as instruments and are not extensions or prostheses of the personal and the communal mind, or networking agents in distributed cognition (Di Sessa, 2000 & Brown, 2000). We argue that this type of appropriation could perpetuate the knowledge and information hegemony, with the knowledge economy functioning at the table of the 'e-lite', the first generation of e-literates, and thus also the inhabitants of the 'first' world. Initial contact with computers, we believe, should thus send a clear message that personal autonomy is valued and that understanding is empowering.

As we have become aware of the complexities involved in first encounters through many years of education and training with African adult learners who were educated for the most part of their lives in the educational system of apartheid, we wished to capture the detail of this encounter, trying to give a thick description of activities, events and qualities of a group of teachers' first interaction with the computer. Our aim was not only to describe their interpretation and use of signs and symbols on screen and in communication, but also ultimately to try to assist them by designing a training package that follows a different and culturally-experientially more effective route, using additional analogies as supportive analytical tools where necessary. We also wished to capture their personal interpretation, their perceptions and experiences upon this first encounter as possible evidence for the claim that, according to activity theorists, consciousness "is not a set of discrete, disembodied cognitive acts (decision making, classification, remembering), and certainly it is not the brain: rather consciousness is located in every practice: you are what you do. And what you do is firmly and inextricably embedded in the social matrix of which every person is an organic part. This social matrix is composed of people and artefacts" (Nardi, 1996). The social matrix of the designers of the interface can hardly be a universal template in which different matrices can be placed or forced, especially if the matrices of those who need advancement and access most are delayed in their progress, due to the exclusivity of the metaphor. Designers in the think-tanks of the great IT companies, spending vast amounts of money and resources on research and development, construct products that address an audience who will decode their registers and who will interpret their genres successfully, otherwise their profit margins will shrink. For the masses that need to still join the knowledge economy the decoding of the interface and the interpretation of its genres need to be made more 'affordance-able', assessing their 'zone of proximal development' or ZPD (Vygotsky's term for the cognitive space that is eligible for learning with scaffolding [Newman & Holzman, 1993]). Our inquiry looked at the way novice computer users respond at the interface – how their social matrices fit the templates of Silicon Valley, the systems from Seattle and the machines from Dublin, and how the tuition addresses their ZPD.

The Inquiry

We identified a group of 21 practising teachers who are enrolled to participate in a basic computer literacy course. They entered the course as novices, and in a typical two-day program we investigated their experiences. We worked with the whole group of 21 students for in-depth description and analysis of what they said and did during these workshop sessions, using a number of research activities:

1. Upon entry they completed a battery of English language proficiency tests that assess speaking, listening, reading and writing. The texts contained many of the linguistic terms associated with icons and other signs and symbols that feature in the introductory course on computer literacy. The aim of this assessment was to evaluate students' language use for communicative purposes generally, but also in the register of the GUI and of MS Word. These 'tests' were analysed for general language competence, focusing on coherence, range of vocabulary, syntactical appropriateness, and authenticity. The reading exercises were geared to capture typical information texts on computer and the listening tests were engineered to check for communication understanding in English in a course context.
2. Students also wrote short paragraphs about their experiences with technology, both electronic and otherwise. They included early childhood learning experiences. In this activity the aim was twofold; on the one hand we wished to assess their free writing composition and on the other hand we wished to find out to what extent they use technology, and are able to write about it, while getting a picture of their learning background. We also conducted a "complete the following sentence..." data collection exercise in which they had to present information about their use of technological devices and their reading and writing habits.
3. The group was asked to "make sense" of MS Word icons, and other MS Windows symbols before their first-time introduction to the computer. The icons and other symbols were printed and they responded by writing their interpretation.
4. Two focus group interviews were conducted with this group prior to the course, the topic being their anticipation about the course, and their experiences that led them to enrolling.
5. During the course, individual students from the sample were interviewed about their experiences in the course.
6. Individual students from the sample were video-recorded during their interaction in the course, with all the other students' included in the background of the video shots.

7. Towards the end of the course individual students were interviewed about specific difficulties that they had.

Analysis of data and summary of findings

The verbal data obtained from the interviews, the paragraphs, and the sentences were transcribed (where needed, such as in the case of the interviews) and coded, then clustered and analysed for content, but also for discourse indicators. The language proficiency tests were analysed for competence, applying error analysis techniques and assessing the coherence and the syntax for clarity. During the first phase cluster (or primary categorisation) the data from a single collection source, such as the completion of sentences or the interviews, were condensed in clusters. Subsequently the clusters were grouped together across sources, emanating in the final categories or themes (Silverman, 2000; Flick, 1998 & Merriam, 1999):

- We found that they had, firstly, appropriated the electronic world with confidence, with most of them using cellular phones and other electronic devices frequently and intelligently.
- They also seemed to read and write adequately, in terms of quantity and quality. Their English proficiency was certainly sufficient for the needs of the course.
- The students' definitions of icons were probably the most revealing of their conceptions of the interface. The most prominent aspect of the analysis of these data was that, although there was little direct link between the symbols and the concrete representational objects (Preece et al. 1994) of the 'office' root metaphor and their individual interpretations of these symbols, the students logically deducted meaning from icons and would probably make a secondary link to the function of the icons when learning to use them in the context of the course and later on. However, although their own analogies were sophisticated in some cases, using tangible objects as starting point and then trying to explain the possible use of the symbols at the interface, the conceptual link between these would be contrived. We identified this as a crucial component of the findings. *The absence of real office experience and knowledge could deprive the students of authentic analogical links* and the operation at the interface would therefore be based on mnemonics or a non-conceptual retrieval from memory, which we labelled as 'non-semantic'. We believe that this could slow down their progress. The example of the "copy" icon explains this: the symbol of the "two pages" was described as objects from their lives, such as "two barrels". Although the link is there, in that the 'containers' (the barrels) would have to be 'filled' with something, the analogy makes for a cumbersome transfer to the interface meaning of making a copy of an existing text. If too many of these associations were to function at the interface the cognitive load would be heavier and proceduralisation would be slower. Another example was the interpretation of the "paste" symbol, which was described by many as 'luggage', with one student referring to it as " the suitcase of a man who went home to his family after working in the city" (this is not an uncommon practice in South Africa where many men and women work far away fro their homes in rural areas and then commute a few times per year). There was an abundance of these types of analogies that were 'non-office' in character and that were therefore also not coherent, as they did not share the same *root metaphor* and did not fit the organising metaphor of the desktop as originally conceived by the Xerox company. Some more examples are as follows:

  The "open file" icon: dustbin, refuse bin, bookshelf, ships in the water, it means there is enough information; it even pushes the door open, it means the information has to be stored.
  The "save" icon: entertainment unit, a reflection of the TV on the computer, a screen of audio-visual apparatus, an object that looks like a screen with part shaded, this means that you have to pause while writing, incinerator/furnace
  The "view" icon: faulty page, a magnifying glass, a battery, a projector, cutter of some fruit with the fruit
  The "copy" icon: computer symbols of houses, typed pages, two printers, two pitcher(s), two written pages that are folded on top right.

- In the interviews the main theme was that they were motivated to master the computer and to access the Internet, but that they were very apprehensive.
- Although students were apprehensive, and although some of them remained tentative, they said that tried to work through all the activities, even though the majority were hyper careful and also extremely

slow in moving from thought to keyboard and mouse and to and from the screen, with continuous refocusing of vision. It was evident that the pace of the activities was too fast for them, and that a great deal of in-between thinking and processing had to take place, especially to decode the icons. The affirmed this in almost all the interviews.

- Throughout the introductory course, they all felt that they had made a start and that they would come to the university computer centres as often as possible (the centres are open 24/7).

In the *video data* the verbal data were born out.

- Seven of the participants were indeed far slower in their reactions and found the use of the mouse daunting.
- The students also found it difficult to switch from listening to the instructor, keeping an eye on the instructor's projected screen image and working on the keyboard. The shifting of vision, the simultaneous use of keyboard and mouse, while listening to fast paced explanatory instruction, caused some discomfort.
- Five people in the group struggled with clicking the mouse, exacerbating the problem by what appeared to be left-right confusion.
- Students tried to assist each other, which is also not uncommon in this socio-cultural matrix, and were surprised that the instructor prohibited them from continuing to "lean over to a neighbour", as one student put it. During these working interludes there was also laughter (often to release tension, but also because some of the things that happened and were said were truly humorous).
- When students focused on the keyboard only they worked quite harmoniously, although very slowly. When they switched to the screen, the rhythm stopped and each time there was great consternation to decide which icon to use.

Discussion

It is evident from the data that the social and educational background of the students impacted their participation. In their school careers they would hardly have learned to type, or to use instruments, including musical instruments. They never experienced instruction in which they learned to work with an instrument or device, except for pens and pencils and sometimes paint brushes. Their science education, for example, was usually only theoretical. In a few instances they may have had some practical training in woodwork. Consequently, this course could have been, in most instances, their very first encounter with a 'machine'. It was, therefore, not so much a question of not being able to learn at a faster pace, but more a question of being unaccustomed to learning in this mode, functioning in this type of educational culture (Bruner, 1996). The set-up, in a computer centre, with an instructor showing examples on the 'big screen' and having to translate those messages into working on a keyboard and on the 'small screen', was, for most of them, a completely new experience. Coupled with their lack of experience or knowledge of "office' life, the learning burden was indeed heavy during the first encounter with computers.

Another aspect of their first experience of this learning environment was that they spontaneously wanted to assist each other. The notion of working completely individually was upsetting for some of them. The instructor had experienced through many years that novice users of computers transfer their own misunderstandings and faulty use to others and has therefore drawn up a 'code of conduct' that prohibits too much collaboration. Although this may be beneficial in a limited sense, the disadvantages seem to outweigh the single advantage of making only 'your own mistakes'. In the spirit of social constructivism and the impact that the theory of situated cognition and apprenticeship has had on education (Rogoff & Lave, 1994 and Brown, 2000), suffice to say that there are always moments in learning events that are shared, and that the spontaneous assistancc of adult learners for each other could be used as a learning management tool in a learning environment that is ecological.

Important aspects of the findings now have to be engineered into the design of the learning programme. The designers will have to craft a curriculum that uses their socio-cultural matrix as a resource and not see it as a deficiency. In other words, if the 'consciousness' of the students requires a learning ecology that celebrates joint efforts and joint failures, then the curriculum should take cognisance of this. There should really be no code of computer centre conduct that inhibits cooperation and social learning where it is suitable. The instructor, and the course, should guide and scaffold the learners, without disturbing the emergent learning ecology.

In addition, the world of 'the office' needs to be explored with real experience, before the interface is introduced. Students need to see a number of offices in action and work with files, copiers, and sit at the desks of typical office workers in a conventional, not too high-tech environment. The genesis of metaphor of 'the office' would have to be explored, in order to give substance to the words and the iconic symbols that abound in the Microsoft platform and in hardware and software generally. This preparation would have to be done before the learning on computer commences, and should also be integrated into the initial literacy courses in a subtle way.

Furthermore, the programme that would probably best suit students who have not learned to 'use machines' in this way would have to be optimally engaging and would need to engender the development of procedural knowledge without too much obvious mechanical drilling. We therefore suggest an e-learning hypermedia-based programme, where only the steps needed to get to the first learning objective would be learned initially, and they would be repeated, with 'electronic rewards' featuring when the path of learning has been achieved. The learning units would be small (at present the students are bombarded with procedural and conceptual information at a very fast pace) and designed to scaffold competence and understanding. This means that the learning to use the computer will be happening through medium of the computer – a twofold curriculum that serves *to* teach e-learning *while* it teaches 'e'. The design would be simple to begin with, but as the skills of the learners increase, the complexity will increase. Discussion with fellow learners will be invited, both orally and via the e-learning mechanisms. We would aim for a truly empowering design that would lead to independent growth in competence, but especially in confidence. To develop critical use of the medium, we would later on introduce critical e-literacy as well, pointing out the power of the computer user over the computer and the contents of the Internet.

Conclusion

What set out to be an argument for culturally 'sensitive' instructional design and curriculum ended with a more than cautionary note about the need to understand the semiotics of the interface and preparing a course that will activate prior schema of the learners in a constructivist way, mediating the symbols. The inquiry thus also serves to illustrate that if the digital 'haves' are at all serious about crossing the divide and about creating opportunities for the knowledge economy to reach those who are eager to join, that they will have to consider the life-worlds of those who stand waiting for 'e-crumbs' from the table of the 'e-lite'. The organising metaphor of the desktop is not as universal as its originators and many authors may think (Preece et al. 1994).

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Interactive Virtual Electronics Lab

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Abstract: The paper describes the developed virtual laboratory that makes possible to play and learn static VA characteristics, *ac* behavior and important applications of basic semiconductor devices via standard Web browser. Virtual lab is implemented as Java-based applets embedded in HTML page. It permits student to arrange experiment and to obtain hands-on experience operating with virtual signal generator and dual channel oscilloscope in a way they do this in real lab.

Introduction

The technological development and the modern society continuously required more qualified and competent citizens. To maintain their innovative forces in the future, highly qualified experts with a multidisciplinary background, experimental skills and social attitude must be educated. The ever growing importance of knowledge and greater numbers of people being educated and trained at a high level have increased the responsibility of educational institutions, particularly universities which are under strong pressure to change (Donaval 1999). At the same time decreasing level of secondary school education and lack of student motivation, have led to great difficulties in the teaching situation and decline of exam results at the universities. Out-of-date laboratory equipment can't support students' skill obtaining and leads to financial problems for university budget. Obvious there is a need for change not only leading to better study results but also in finding a new infrastructure meeting the need for less expensive teaching localities.

To fulfil these requirements, the e-Learning tools should be developed and introduced into the educational scheme in general (Colleman 1998). Their wide use and dissemination is enhanced by rapid growth and use of the Internet and WWW, which have become the inevitable base for all type of life long and/or distance learning. To address these issues, we have developed a virtual lab, which allows students to enhance their experimental skills and *interactively* to study *dc* and *ac* behaviour of semiconductor devices via standard Web browser.

Structure of the Virtual Lab

The virtual lab consists of two basic facilities – one for obtaining *static characteristics* of semiconductor devices and second concerning *ac applications*. Virtual lab is implemented as Java-based applets embedded in HTML pages. Applets are designed as general tools permitting analysis of different semiconductor devices.

Static characteristic applet, shown in Fig.1 contains schematic field, characteristics display area, and control panel. The schematic field visualises the circuit required for VA characteristics measurement. Physical processes occurring inside the device can be observed in the same field. A control panel permits students to choose the device and the characteristic types, to set appropriate voltage value, and to start simulation. Family curves are automatically scaled and plotted in different colours in the applet's display area. The parameter value is also visualised. Figure 1 shows output curves of an enhancement mode MOSFET. Using the same tool one can obtain transfer characteristics of an enhancement/depletion mode MOSFET. Diodes, Zener diodes, bipolar transistors and JFET can also be studied.

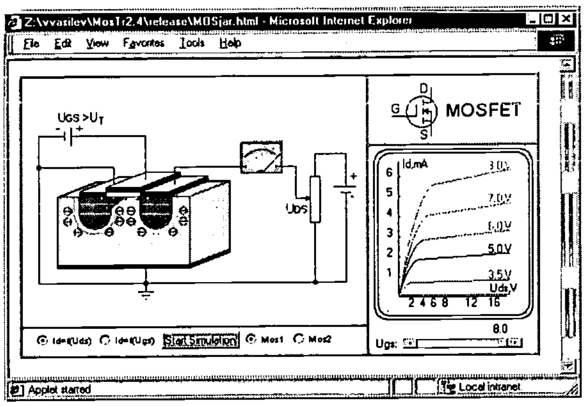

Figure 1. Interactive tool for VA characteristics

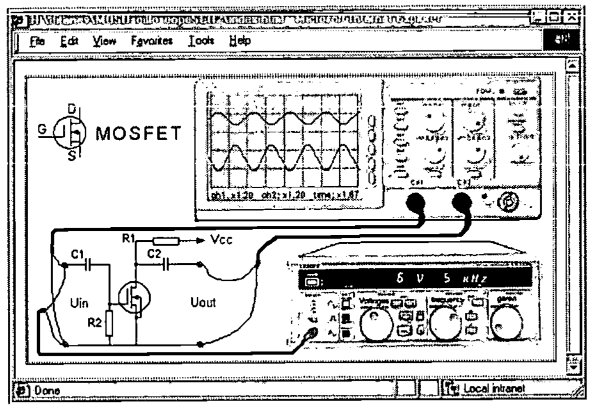

Figure 2. Virtual electronics lab

AC device behaviour can be studied interactively by *virtual lab* containing dual channel oscilloscope and signal generator. Both measuring devices, like in real life need first to be switched on before starting measurement. The signal generator permits setting of different signal types – sinusoidal, pulse or triangular. Students can choose voltage levels or frequency as well as pulse duty factor. Simple simulator calculates the output signal depending of current application. Both input and output signals are displayed by dual channel oscilloscope. Students can manipulate these signals like in real oscilloscope – move in *x* or *y* direction, change voltage levels or frequency. Fig.2 shows laboratory arrangement for analysing MOSFET amplifier. Observing simultaneously input and output *ac* signals student can examine differences in phase and voltage level between these signals as well as voltage gain.

Virtual lab can be used for studying typical applications of basic semiconductor devices as diode rectifiers, voltage limiters, bipolar, JFET and MOSFET amplifiers, CMOS inverters, multiplexers etc. It permits students to obtain hands-on experience operating with measurement devices, to achieve qualification in setting appropriate input signals and in analysing output signals as well as contributes to easier and deeper understanding of learning material.

Conclusions

We have developed a Web-based e-Learning tool, aimed to enhance practical training of the students.The developed virtual laboratory consists of Java based interactive modules, which permit students to arrange experiments and to study *dc* and *ac* behavior of semiconductor devices. All modules are directly accessible through the Web browser.

Interactive web-based tool is developed as a part of e-Learning material dedicated to self-learning as well as a complementary material to regular training. e-Learning allows university to start creating a better skilled, better performing workforce today. These tools can be used most effectively to leverage the teacher's time and energy, so that the teacher spends the most time doing those things that add the most value to the learning process.

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Online Workshops as a Tool for Creating Professional Learning Communities

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Abstract: The idea of creating virtual professional learning communities has been the starting point for a set of three online workshops that have been organised by the European Schoolnet and the Centre of Educational Innovation & Technology of Delft University of Technology. The results show a promising potential for online workshops in forming communities of professionals. With the workshops a total large group of 49 people all over the world have been reached who have actively participated in discussions with each other. Some of them have even participated in two or three workshops. Many evaluation respondents say that they have made contacts during the workshop that will last after the workshop. The results of this evaluation can be used to improve the workshops' technology and organisation.

The idea of creating virtual professional learning communities has been the starting point for a set of three online workshops that have been organised by the European Schoolnet and the Centre of Educational Innovation & Technology of Delft University of Technology. The workshops aimed at:

- Creating a virtual community of practice in which participants can learn and work collaboratively on educational issues related to their work as teachers, researchers and policymakers
- Building expertise of new technologies for professional development at a European level.
- Constructing models for effective ways of collaborative learning in online learning.

The subjects of the three workshops were self-directed learning in secondary education, problem based learning, and the implementation of ICT in education. The online workshops are supported by a website, which can be found at: http://www.en.eun.org/menu/training/online-workshops.html. This website contains information about the workshops, BSCW workspaces for groups, streaming video, an electronic evaluation form, and an electronic application form. The organisation of the community of professionals during the workshops reflects the efforts of trying to create human networking and developing a sense of community among the participants through the use of native language groups, native moderators, personal presentations, live video, sharing of experiences, and the use of different roles. Participants apply themselves for one of three roles: attendee (participates actively), observer (just observes), and consultant (someone with expertise on the subject). Each workshop has been developed and conducted by an expert in the field of education who defines the learning content and activities of the workshop and presents the subject of the workshop in the video sessions. The workshops are co-ordinated by two overall staff members from Delft University of Technology.

Method

A fixed format was chosen for all three workshops, thus facilitating comparison of the results. The evaluation is performed at the level of each workshop, the language groups within a workshop, and the individual level. The workshops have been evaluated by means of an electronic evaluation form and through the analysis of the BSCW workspace. The workshops are open to everyone who is interested in the subject of the workshop. These can be teachers, educational specialists in the field or policy makers. A total of 222 persons applied for the workshops. These participants live in 31 countries, all over the world. 64 people applied for the first workshop, 120 for the second workshop, and 57 for the third workshop.

Results and Conclusions

Creating a Virtual Community of Practice

The results show a promising potential for online workshops in forming communities of professionals. During the workshops, this has really worked. With the workshops a total group of 49 people all over the world have been reached who have actively participated in discussions with each other. Some of them have even participated in two or three workshops. The evaluation respondents say that they have made contacts during the workshop, which will last after the workshop. They feel they have learned a lot from the workshops: mostly about the subject of the workshop but also about learning together in a virtual environment. The workshops are highly valued. The organisers have come across the following critical issues in the process of building a virtual community:

- High dropout rates are a well-known phenomenon in free online learning activities. Measures to motivate people to participate have to be developed.
- Some participants don't write English well enough to function in a European group and therefore prefer to participate in a group of their native language. This helps to feel comfortable and fosters group cohesion.
- Participants also can have difficulties in exchanging resources because these resources are often written in their native language. There is no real solution for this problem at the moment, although the use of free automatic translation software can help to some extent.
- Moderators play an important role in the functioning of the groups. Finding moderators is hard because moderating is a time-consuming task. Payment of moderators could help in finding more experienced moderators. Clear instructions for moderators are compulsory as well as a manual describing measures they can take to enhance the discussion in the language group.
- Role specification of the consultant, the expert and the staff of the workshop should be worked out in more detail. This is crucial for their well functioning.
- A BSCW workspace in which participants can exchange ideas and documents with each other supports the functioning of the network. The BSCW environment, however, is not very user friendly for people who have little experience with computers.
- A database of professionals in which people could search for others with the same expertise or for someone who can answer a question has not been realised yet.

Professional Development

The online workshops facilitate both individual and group learning. Individual learning concerns the use of technology in education, online education, experiences of others, and the educational content of the workshop. Group learning outcomes relate to sharing knowledge with others, experience other ways of thinking, and meeting colleagues. This shows that the online workshops contribute to a professional identity in which the professional considers him or herself as part of a greater European-wide network of professionals from which much can be learned.

Models for Online Learning

The series of workshops started from a model on the organisation of the community of professionals during the workshops and a format for the content of the workshops.

- In the original plans for the workshop, participants were supposed to form local working groups. In reality, most participants subscribe individually and hardly form local groups. Learning activities should be designed in such a way that they can be done individually.
- The length of one week has appeared to be the most appropriate time length for the workshops. Although participants sometimes ask for a longer period of time, the experience with the second (and longer) workshop shows that participants lose their interest after one week.

- The live video sessions give the participants the feeling that they are connected to the expert and staff of the workshop. An important precondition for this is a good quality of video and audio. It has also been appreciated that the video sessions have been archived.
- The assignments guide the activities that take place within the workshop. Assignments that worked well, asked participants to write down their own experiences with the subject or asked participants to reflect on a case of practice of someone else. This case of practice should not be too advanced in order not to scare away participants who have little experience with the subject and feel overwhelmed by the case of practice.
- The resources are consulted very often. It was the intention to create a database in which resources can be stored and searched for by professionals. Such a database would be a strong instrument to enhance knowledge sharing among the community of interest. This has not been implemented yet.
- The target group of the workshops is very broadly defined: teachers, researchers and policy makers. Most of the participants appeared to work in secondary education. This is due to the context of the European Schoolnet in which the workshops are carried out. Although secondary education teachers should be the main target group of the workshops teacher educators should also be addressed.

Experiences with the ARIADNE pedagogical document repository

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Abstract: The ARIADNE methodology and system exist since more than five years. A large amount of user feedback has been gathered. In this paper, we focus on what we learned from the feedback on two tools: 1. the ARIADNE Knowledge Pool System, a distributed database of reusable pedagogical documents and their associated descriptions (metadata), 2. the tools to store, search and retrieve such reusable learning objects.

1. Introduction on ARIADNE and IEEE Learning Objects Metadata

The main goal of ARIADNE, started in 1996, is to promote '*share and reuse*' of educational resources. A distributed infrastructure has been developed for the production of reusable learning content, its description (metadata), storage and discovery, and its exploitation in well-structured courses [Forte et al. 1997a, Forte et al. 1997b]. The core of this infrastructure is a learning resource catalogue or digital library of reusable educational components, called the Knowledge Pool System (KPS).

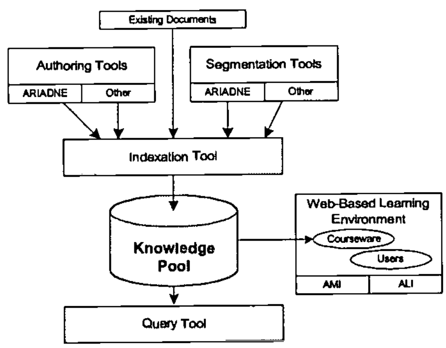

Figure 1: Core of the ARIADNE system discussed in this paper

Metadata are extremely important for the proper management and reuse of educational resources [Forte et al. 1999]. It should be easy to generate the metadata and to use them in order to identify relevant material.

As the KPS is a library, it requires 'traditional' metadata, such as title, authors, publication data, publisher, etc. Since the documents in the KPS are of a 'digital' nature, some extra metadata is needed: what software and hardware are necessary to view the document, does the document require a specific operating system etc. For the educational aspects of the resources, we include the categories *document semantics* and *pedagogic attributes*. We refer to section 2.2 for detailed information about the semantics category.

If we want the KPS to offer relevant documents for most users, it must hold a critical mass of good quality material. This is one of the reasons why we want to exchange metadata with other similar repositories (see also section 4). Therefor we have been deeply involved in the IEEE Learning Technology Standardization Committee (LTSC) Learning Object Metadata (LOM) Workgroup [LOM]. The LOM standard is based on earlier ARIADNE work, as captured in a submission made to the LOM workgroup in collaboration with the IMS consortium [Duval 1999a].

2. Enhancements gathered from experience and users

By now, the ARIADNE community represents 5 years of practical experience, from which valuable lessons can be learned (see for instance [Duval et al. 1999] for the evaluation in the context of one particular course). A large amount of useful feedback was collected by different means: mailing lists (separate ones for each of the different tools and general comments), SUMI (Software Usability Measurement Inventory) questionnaires [SUMI], evaluation reports and, last but not least, user and consortium meetings. This section discusses several enhancements we are currently finalizing, in response to that feedback.

2.1. Multilinguality

From the start of the ARIADNE project in 1996, numerous partners from different European countries were involved, and the project wanted to cope with the specific local needs of the different parties. Specifically, we want to respect and preserve the multilingual context of the users. We certainly do not want to enforce one specific language for the documents stored in the Knowledge Pool System. The same is true for the metadata: these can be inserted in any language. Note that the language of the document does not need to be the language the metadata are provided in.

Beside, multilinguality is also important for the tools. We want our tools to have a localizable interface. The latest ARIADNE core tools have the option to switch to another language during use. All the menus, attributes, buttons, etc. are presented in the preferred language, as shown in the figures below.

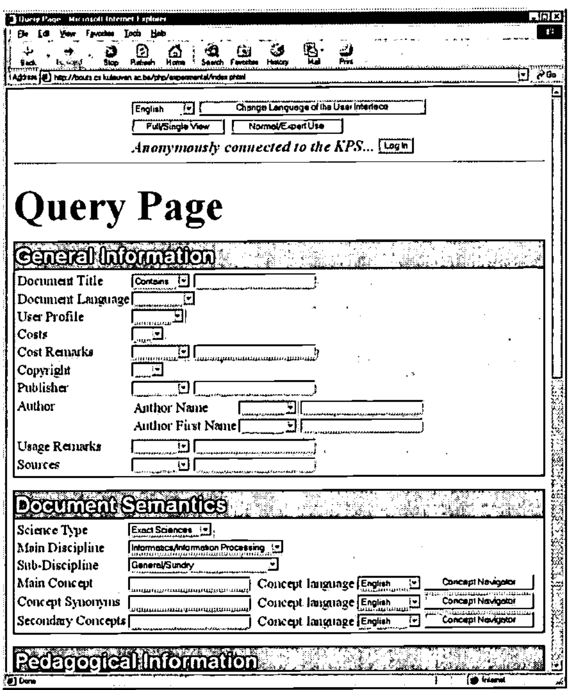

Figure 2: The Query/Indexation tool in English

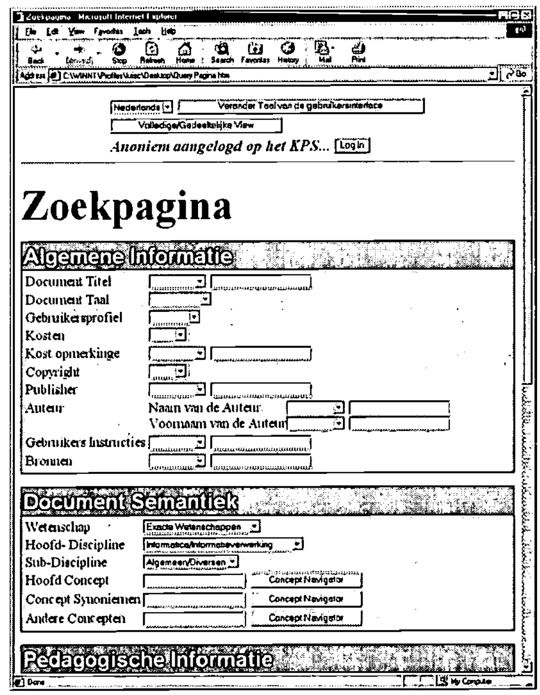

Figure 3: The Query/Indexation tool in Dutch

Multilinguality in the metadata has many consequences. On the one hand we want to support values in any language. On the other hand we want to provide translations for all values. This latter requirement can be met relatively easy for attributes with fixed lists of appropriate values, as these lists can be translated a priori. An example for such an attribute is the discipline of a document. ARIADNE defines a list of disciplines that can be used for cataloging the learning object. The name of each discipline is available in several languages. Free text attributes (e.g. installation remarks) can be inserted in a specified language with the option to manually insert multiple translations for those attributes: e.g. a description can contain an English entry for installation remarks ('You need a screencam viewer for this pedagogic document') as well as a Dutch translation ('Je moet over een screencam viewer beschikken om het pedagogische document te kunnen bezichtigen').

2.2. Structured navigation of document and concept space

An important part of the ARIADNE metadata is reserved for modeling the document semantics [Forte et al. 1999]. Initially a hierarchical structure was associated with each document. This structure indicated the main discipline, main concept, main concept synonyms and secondary concepts. The newly used metadata structure adds two extra levels to this hierarchy: science type (which becomes the new top-level) and sub-discipline, as illustrated in Figure 5.

In previous versions of the indexation and query tools an overview of the available concepts was presented as an alphabetically ordered list. Still, it was very difficult for users to identify relevant concepts when creating new descriptions or when searching for interesting pedagogical documents.

In order to use the already (implicitly) available concept structure in a more effective way, we developed a concept navigator, which enables the user to browse through the concept space in a more intuitive and flexible manner. First of all, users can restrict the concepts to only those within a particular science type, main discipline and sub-discipline. For example selecting 'Exact Sciences' as science type presents the user with a list of main disciplines defined within exact sciences. Selecting 'Informatics/Information Processing' updates the list of appropriate sub-disciplines.

Figure 5 displays the relevant part of the concept navigator enabling the user to impose restrictions on concepts. In addition to the hierarchical structure, the language of the label of the concept and a pattern for the name of the concept can also be defined. In the example of Figure 5 the user is searching for concepts belonging to 'Exact Sciences' → 'Informatics/Information Processing' containing the word 'use'. Several concepts were found satisfying those restrictions: 'Clause Use', 'Design of User Interfaces', etc. For each concept presented in the resulting concept list, a number indicates how many descriptions this concept is used in: e.g. the concept 'Design of User Interfaces' is associated with 4 pedagogical documents.

An illustration of the relation between documents and concepts is displayed in Figure 4. This (greatly simplified) extract of the Knowledge Pool System displays 5 concepts, 5 documents and the relationship between concepts and documents. The figure can be read from top to bottom (concepts are related to certain documents: e.g. the concept 'Pedagogical Indexation' is the main concept of document 1 and a secondary concept of document 2) as well as from bottom to top (documents have an associated main concept and optional main concept synonyms and secondary concepts: e.g. document 2 mainly deals with 'Knowledge Pool', but also with 'Pedagogical Indexation').

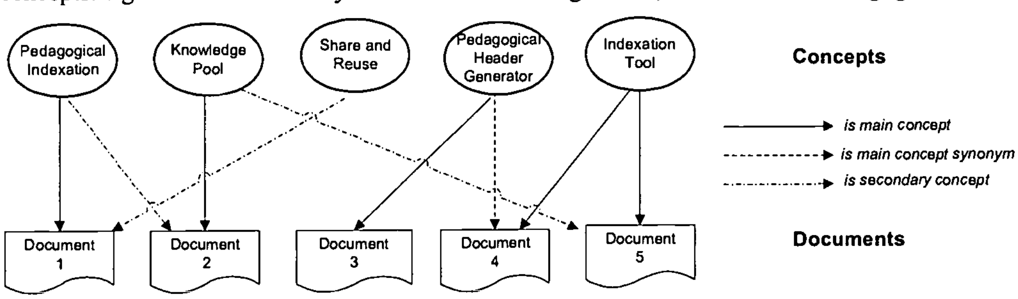

Figure 4: Part of the ARIADNE document and concept space

The concept navigator provides the user with a more manageable overview of the concept space. Since the naming of concepts is subjective there should be some support for concept 'relatedness'. Still using the situation presented in Figure 4 a search on the concept 'Share and Reuse' will result in document 1. However, the user may also be interested in documents on 'Pedagogical Indexation', which would broaden its result outcome to documents 1 and 2.

Therefore, we introduced a degree of relatedness between different concepts. This relatedness is based on the concepts used within one specific description: e.g. the concepts 'Share and Reuse' and 'Pedagogical Indexation' are used within the same description (more concrete the metadata for document 1) and therefor are related at level 1. This relation is extended over different descriptions using the transitivity relation: e.g. since 'Share and Reuse' is related (at level 1) with 'Pedagogical indexation' and 'Pedagogical Indexation' is (directly) related with 'Knowledge Pool', 'Search and Reuse' is related at level 2 with 'Knowledge Pool'. Using an extra level of indirection (more concrete the direct relation with 'Knowledge Pool') 'Indexation Tool' is related with 'Search and Reuse' at level 3. This is reflected in Figure 6 which displays the real overview of the concepts related to 'Share and Reuse' at a maximum level of 4.

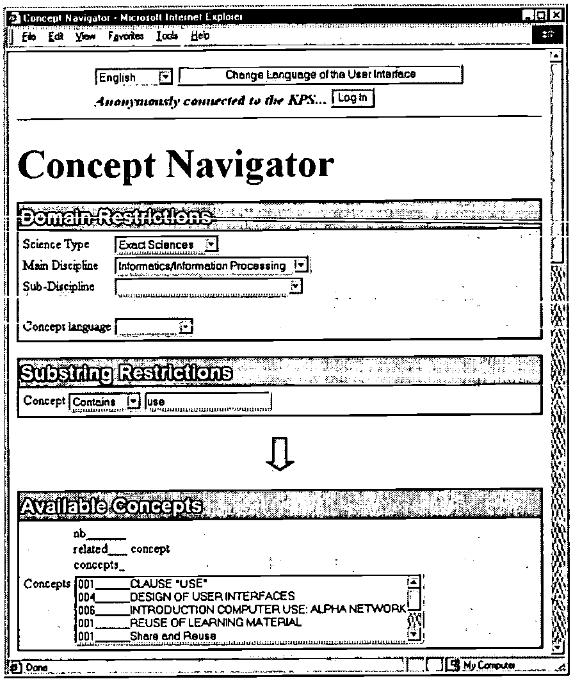

Figure 5: Upper part of the concept navigator used to search for relevant concepts

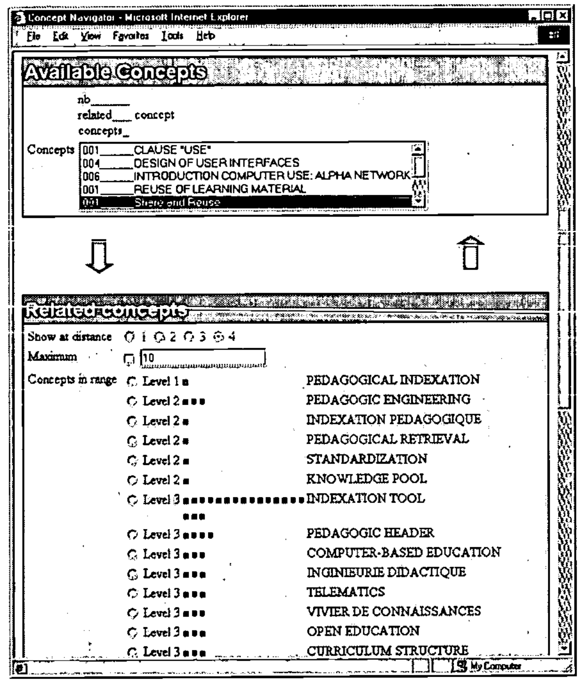

Figure 6: Lower part of the concept navigator to search for concepts related to 'Search and Reuse'

All related concepts are presented, ordered by their degree of relatedness. In addition to the text-representation and degree of relatedness a bar indicates how many documents this concept is associated with. The user can select one specific (related) concept and decide to take this concept as new starting point: e.g. to locate concepts related to 'Standardization' in Figure 6. This repetitive refining process offers the user the possibility to navigate through the concept space in a structured way.

3. Open problems

The experience we have with open and distance learning and the management of learning objects still leaves some issues unsolved. In this section we briefly discuss some of the problems we encountered.

- *Design for reuse*: By facilitating the process of identifying and retrieving appropriate learning objects, the ARIADNE system does make it easier to bridge this first hurdle to share and reuse. However, sometimes these objects can not be reused as such: learning objects may contain links to external web resources that may be inappropriate in a new context, or they may include information about people, locations or times that are not applicable, or they may use symbols that are different from those in other learning objects, etc. By following simple guidelines, many of these problems can be avoided. However, further research on 'design for reuse' is certainly needed. Also, granularity of the documents is important. A document stored in the knowledge pool should be an atomic element independent of other stored documents. This implicates that a document should be large enough to be reusable. On the other hand, the document should be small enough to fit in with other documents to make up a lesson. A precise definition for the size and granularity is difficult to state. In ARIADNE we leave it to the users to decide about this granularity of the documents: typically, the pedagogical elements stored in the KPS take between 15 and 120 minutes to study.
- *Quality assurance*: It is critical for widespread adoption of a learning resource catalogue like the Knowledge Pool to meet quality standards for both the learning material and the metadata that describe it. In ARIADNE, validators check the quality of the metadata. They are experts in a specific domain who can ensure the quality of the given description. It is their task to check for newly inserted elements and verify the quality of the metadata for those documents. ARIADNE does not formally check the quality of the learning material itself. Most users are experienced content developers that insert their documents in the knowledge pool for someone else to find and reuse it. Through annotations to stored documents (part of the metadata) other users can informally give feedback on their use of the documents.

- *(Semi-)automatic description of documents*: Because describing documents in some can be a tedious task, it would be beneficial to automate this description (partially) for some types of documents. Specific tools (like the video-capturing tool in the ARIADNE project) can fill in parts of the header automatically. Other more general tools could use plug-ins to generate metadata. Some of the metadata attributes (like document size, name, etc.) could even be filled in automatically by the knowledge pool system. When a batch of similar documents must be indexed, (description) templates can be used. Nevertheless, describing the pedagogical attributes of a document remains a manual task, which is rather time-consuming and is hard to automate.
- *Information visualization*: As the contents of the Knowledge Pool System increases, it gets more and more difficult to obtain a good overview of the available learning objects. Information visualization can be used to improve this situation, and to provide an alternative to querying based on an 'electronic form' approach [Schneiderman 1992]: e.g. a 2-dimensional representation of all descriptions whereby each field can be displayed on the X or Y-axis enables the users to search for commonalties and relations between different metadata fields. We have performed some experiments already as can be seen in Figure 7 which displays the ARIADNE metadata plotting the discipline (chemistry/biochemistry, civil engineering/architecture, economy/management, electricity/electrotechnics, electronics/microtechnics, informatics/information processing, life sciences/bio engineering, etc.) vs. their difficulty level (very easy, easy, normal, difficult and very difficult) on the axes. Squares are used to represent groups and their size is proportional to the number of descriptions. Selecting a square leads to zooming in on that group of descriptions. On the level of individual descriptions colors are used to denote the discipline of the pedagogical element: e.g. a brown block is used in Figure 7 to display the document belonging in chemistry/biochemistry of normal difficulty. The corresponding color legend is displayed in the bottom of the application window. This representation offers several insights that are difficult to conceive if you only use a form-based interface: e.g. most pedagogic documents (248) situate themselves in the informatics/information processing discipline and are of a normal difficulty level, the documents on life sciences/bio engineering are of a normal difficulty level, no very difficult documents are present, etc.

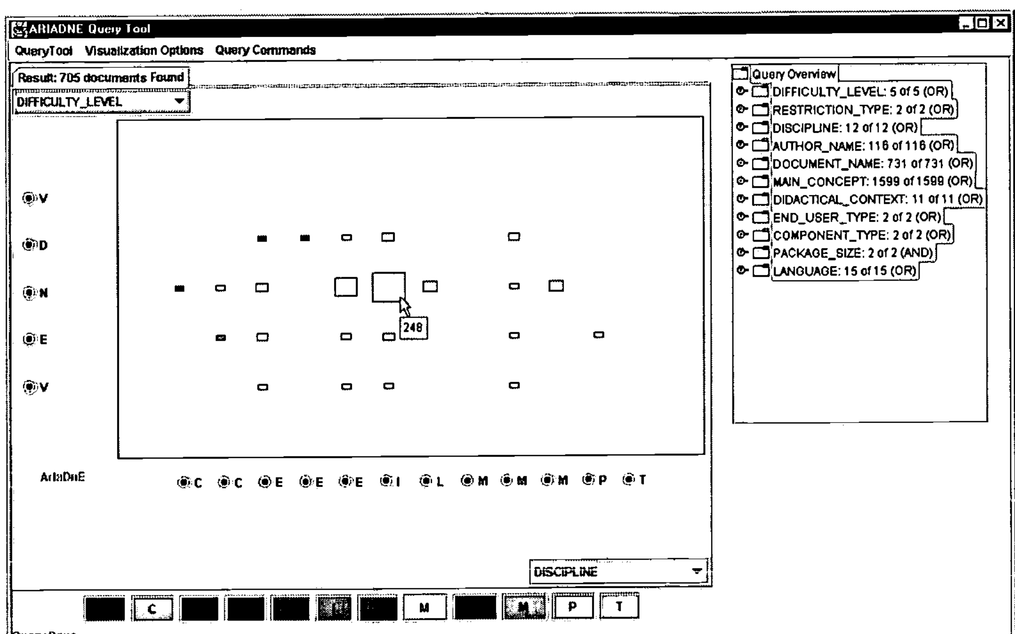

Figure 7: Information Visualization displaying discipline (X-axis and color indication) and difficulty level (Y-axis)

4. Related work

In [Koppi 2000] the authors write about the need for Learning Resource Catalogues (LRC) that must be implemented to enable share and reuse of learning objects. ARIADNE implements such an LRC in its Knowledge Pool System. This Knowledge Pool System stores the metadata about the learning objects, but also those learning objects themselves. In this way, a learning object will not be lost when the author decides to move or delete the object. This is a problem mentioned in [Currie 2000] for the IMS metadata project.

The ARIADNE Knowledge Pool System can be considered as a digital library of educational material. In this regard some digital libraries can be compared to it:

- The *Networked Digital Library of Theses and Dissertations* [NDLTD] is an initiative that shares some of ARIADNE's goals, but restricts itself to theses and dissertations. Architecturally, it operates on a different model of loosely coupled sites.
- The *Computer Science Teaching Center* [CSTC] builds a digital library of computer science teaching resources. Little attention is paid to pedagogical metadata for the resources.
- *SMETE* is an initiative for a digital library for Science, Mathematics, Engineering and Technology Education [SMETE]. This project also supports the LOM metadata standard, so the contents of SMETE and ARIADNE should be relatively easy to exchange.

Other projects support (educational) metadata based on standards or through a self-defined set of attributes:

- *Education Network Australia* [EdNA] supports a limited set of Dublin Core elements, but only one of it is a real pedagogical attribute ('user level'). Also searching is rather limited: only five fields are searchable.
- The metadata structure of the *Gateway to Educational Materials* [GEM] is also based on the DC set, but it includes more attributes adopted from LOM for indexing (searching is also limited to five attributes).

5. Conclusion

The ARIADNE community has a lot of experience in the field of pedagogical document storage, query and retrieval. User feedback on the Knowledge Pool System, facilitating share and reuse of documents, and the tools to index and query its contents lead to important improvements in the new version of these tools.

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Practice makes perfect: Preparing participants for an online conference

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In February 2001, two simultaneous, three-day International Online Conferences, in English and in Hebrew, "Opening Gates in Teacher Education" were held. The target audience was teacher educators from all fields, not only those involved in information or educational technology.

For the vast majority of the participating 600+ teacher educators, it was their first experience taking part in an online conference as well as being their first true contact with authentic use of Internet communication technologies. In light of this situation, the participants were offered preparation - technological, pedagogical and psychological - for the totally online event.

This demonstration will illustrate the practice sessions, the real time technical help, the posted presentations before the conference, the psychological preparation, and the testing carried out by the participants before the conference began. Finally, it will look at the effect of these practice sessions and conclude with the belief that pre-conference practice sessions must become an integral part of an online conference to ensure its success. In addition, it will look at the ramifications of this success in terms of eventual integration of technology into the teacher education classroom.

The conference can be accessed at http://vcisrael.macam.ac.il/site

Collaborative knowledge construction in electronic forums and integrative scenario development as bridges between the socio-constructivist discourse and its application in educational practice: An exploratory research with pre-service teachers.

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Abstract: This paper presents the preliminary results of our exploratory research concerning the impact of Information and Communication Technologies (ICTs) on students' perceptions about their role as future elementary school teachers. More specifically, we are trying to identify instructional activities that are likely to facilitate the shift from a teacher-centred approach to a more genuine learner approach. We will shortly present a Web site providing scaffolding tools to help students and teachers through the whole process of scenario production. In order to stimulate metacognitive processes and collective knowledge construction about the new roles of teachers, we use telediscussions in an electronic forum. Although we believe that ICTs provide numerous opportunities to render students more autonomy over their learning, and despite the knowledge and experience gained over the past years, we have noticed that many students still have problems assuming more control and freedom over their own learning experience. Indeed, when they are facing a novel situation or when they encounter a difficult problem, students tend to fall back on their old ways of learning. They do the same when they plan a lesson for a specific class situation. We will present an instructional strategy that we foresee as a possible solution.

Introduction

The integration of information and communication technologies (ICTs) in classroom activities is strongly associated with the systemic education reforms taking place in many North American countries. National and international committees/associations (NCATE, 1997; ASCD, 1998; NETS, 2001) have been insisting on the need for teachers to adopt socio-constructivist strategies in order to take full advantage of ICTs and to prepare teachers for the emerging knowledge society. But, the use of socio-constructivist strategies (Brown, 1997; Wenger, 1998) in daily activities is complex and requires, from most of us, technological and pedagogical competencies that are not included in our culture of teaching, as well as a major shift in our vision of teachers' roles, as it is the case for the adoption of the current systematic school reforms. Research on the adoption of innovations in education insists on the complexity of the adoption process and the time required to have the change to take place in practice in a deep and meaningful way (Laferrière, 1997; NETS, 2001). For example, in presenting the essential conditions for implementing National Educational Technology Standards, NCATE proposes ten issues going from a shared vision through school and university politics to support the integration of technology in learning. Once they have adopted a socio-constructivist vision of their role, teachers still face many problems before they can develop a rich and coherent socio-constructivist practice. A key issue seems to be what Schön (1983) called the espoused theory versus the applied theory problem. Even if teachers talk about and agree with socio-constructivist principles in their discourse they often stick to the traditional strategies to which they have been exposed. When they plan a lesson they often keep control over the learning process and pre-organise the access to information. We have observed this with pre-service and in-service teachers using ICTs. The emerging question is now how can we foster in parallel the adoption of a new vision of teachers/learners' roles and the adoption of new teaching strategies in lesson planning with ICTs?

Context of the study

Over the past six years, we have implemented a socio-constructivist approach in the two Information and Communication Technologies (ICTs) mandatory courses provided to students registered in the first and second year of the teacher education program at l'Université de Montréal. In the first course, students have to develop the basic technological competencies, a general culture of ICTs pedagogical uses and resources, a vision of ICTs impacts on society and education such as new roles and requirements for teachers and learners. The course's pedagogical approach rapidly moves from teaching the basic pedagogical concepts and technological competencies in delivery mode during the first weeks towards a direct application of project based learning in a collaborative socio-constructivist approach. This allows students to be exposed and involved in a socio-constructivist learning experience. Working in teams of three to six students, they choose a classroom situation for which they have to develop a complete pedagogical scenario (detailed lesson plan). Since two years, a Web site, http://facvirtuelle.scedu.umontreal.ca/scenaristes, called "Les Scénaristes", provides scaffolding tools to help students through the complete (or entire) process of scenario production : analysis, development of the content, selection of a learning approach, formative evaluation and implementation of the lesson plan. Scenarios are interactively constructed and stored online so students can keep trace of the evolution of their work. Final products (scenarios and accompanying resources such as student guidelines or a complementary web site) can be shared among the community. Finally, collaborative reflection and metacognition is supported throughout the course by a mandatory participation in electronic forums focusing on issues of ICTs integration in education. The use of the electronic forums has shown to be a major tool to support the evolution of novice students' perception of ICTs in education towards positive attitudes and vision (Viens & Rioux, submitted).

The second course, PED2000, is a full year course, mostly via the Web and open laboratory activities. It is fully project based, with tutoring in team meetings, Web resources, technology workshops and laboratory assistance. Teams of three to six students have to contact an in-service teacher who would be interested in implementing a scenario with his students, as well as collaborate with the students in the development of their project. Using the scaffolding approach and the Web site, students have to produce a more comprehensive scenario than the one they did in their first year. The field experiment allows the teams to experience a real life situation, while taking into consideration the constraints and realistic conditions of a classroom. This experimentation permits students to conduct a formative evaluation of their scenario and to develop experience in reflexive practice. PED2000 students also have access to electronic forums of discussion, with the difference that no themes have been pre-determined. It is the students and the tutor who create and launch topics of discussion as issues are emerging along the year.

The study

Goals

As we mentioned earlier, our goals are to understand better the perceptions that students might have about the impact of technology on their future role as elementary school teachers and to assess the impacts of these perceptions on their practice when they plan a lesson. Ultimately, the research results will be used to improve and to enrich our scaffolding approach, in order to help the students not only to discuss the socio-constructivists principles but also to adopt them in practice. To do so, we explored the links between the discourse held in the electronic forums and the application of the principles in the integrative scenarios.

Sampling procedures

In order to reach our goals, we studied the work of first year (N=35) and second year (N=187) students registered in the K-6 pre-service teachers' program. We wanted to identify students demonstrating a socio-constructivist discourse in the forums and then study their scenario to establish relationships and ruptures between their talk and their practice. We used four basic pedagogical characteristics of socio-constructivist pedagogy, inspired by Brown, Collins & Duguid (1989), Brown (1997), Wenger (1998) and Viens (in press): 1- it requires a high degree of autonomy and cognitive investment of the learner; 2- learning occurs in communicating and collaborating with others; 3- project based learning anchored to society (milieu) and involving high level problems or questioning; 4- metacognition (critical reflection on one's knowledge and strategies).

Thus, the first selection step was the identification of students who appeared to hold a socio-constructivist discourse about the respective role of teachers and learners. Despite the relatively large number of contributions (N=632), we realised that the second year group did not discuss socio-constructivist principles sufficiently in order to provide an interesting basis for comparison. Indeed, most messages were oriented towards practical questions on the experiment to be held in class and on other course related issues. This is probably due to the fact that in this course, the topics of the forums are initiated mostly by the students who express their basic practical concerns instead of offering a reflexive stance on socio-constructivist issues. Consequently, we decided not to pursue our analysis of the second year student work. In contrast, approximately half the first year students were holding, at one point or another, a socio-constructivist discourse. Taking into consideration the object of research, we then decided to focus on two relevant themes of the forums: "perceptions of the teacher's roles and responsibilities" and "conditions for the use of ICTs". Since the scenarios are produced in teams of three to six students we had to take into consideration the messages produced by other team partners who were not necessarily holding a socio-constructivist discourse. We assumed that this decision would contribute to understand better group dynamics and its incidence on the socio-constructivist nature of the scenario. Finally, the selection process reduced our original sample to 18 students, divided into four teams. The total number of messages analysed for this study is 80.

Criteria for analysis

Beyond the identification of elements of the socio-constructivist discourse, we assessed the qualitative nature of the messages in terms of depth of elaboration and justification. Three levels were set: 1= superficial message (surface statement, no elaboration, shallow talk, name dropping); 2= opinion message (some elaboration but no justification); 3= (elaboration and justification of views and ideas). Our intent was to probe the student's capacity to reflect critically, that is if they were able to develop and support their thoughts rather than merely contributing an unsubstantiated opinion (Quellmaz, 1987; Ennis, 1987). Two researchers rated the messages and compared their results resolving the few rating differences in consensus.

For the analyses of the socio-constructivist nature of the scenario, we used the same criteria as for the analyses of the electronic forums to which we added a fifth criterium: interdisciplinarity of the scenario. Here we evaluated each aspect individually to obtain a better picture of the nature of the scenario.

Learning strategies (autonomy). Notwithstanding the specific learning strategy to be used, we assessed whether the learner's during the instructional strategy was « directed », « guided », « rather guided », or «free ». Levels went respectively from 1 to 4.

Team work (collaboration). We examined whether the students planned to have their learners work individually (1), in teams but to conduct a fragmented task (2), or in teams to conduct a collaborative and collective task (3).

Content (project based learning). Did the students scenario provides a specific and linear content (1), a multiple path content (2), a framework with certain freedom of the learner (3) or did they leave it completely opened for their learners to decide of their subject, as in project-based learning (4)?

Pedagogical goals (metacognition). Aside from the usual well-stipulated instructional goals, did the students add other learning objectives such as transversal competencies or metacognitive activities ? No=0, Yes =1.

Interdisciplinary. Did the students focus on one subject matter or did they use the opportunity to integrate several disciplines? One subject = 1, More than one subject = 2.

Even though we used a Likert scale to evaluate each criterium our intention was not to cumulate frequencies but to guide our critical analysis of the constructivists aspects of each scenario. In this perspective, we considered the number of criteria with a rather positive level towards socio-constructivist principles as an indicator of the socio-constructivist nature of the scenario.

Results

Perceptions of the role of the teacher and critical thinking abilities

Although not all interventions under the theme « Perception of the role as teacher » referred directly to it, it is interesting to discover that the perception of the role is indeed changing. The students did mention that the ICTs will help shift from a traditional role of « content deliverer » to one that assumes more guidance, more facilitation. Terms such as « facilitator », « animator », « councillor », « advisor » were used relatively frequently. However, we discovered that many students limited their intervention at the opinion level. They only named or listed the role without providing an explanation or a definition of what they meant by « facilitator » for example. Furthermore, they did not establish a priori what they mean by « traditional role ». In other words, students talk about the changing role without defining their assumptions. No one proceeded to compare and contrast the two positions or provide an illustration to support their thought. Indeed, many participants merely identified keywords and did not attempt to engage in a more critical discussion.

Some interventions were also addressing the issue of the changing role, but indirectly. Some students talked about the fact, for example, that the ICTs will provide the opportunity for the pupils to be more active in their learning process. Here, the guiding role of the teacher is implied in the discussion. Participants mention the possibility that ICTs will encourage the active construction process and consequently, will contribute to a more significant learning experience. In fact, in those indirect interventions, the learners are considered to be at the centre of their learning, actively engaged in the construction of their own knowledge and experience. In sum, those students seem to think that ICTs can be used to favour collaboration between the learners as long as the learners' needs are respected.

Furthermore, the same group of students also discussed a specific aspect of teaching that will be affected by the technology: the impact of broader access to information. Some students recognise the fact that a wider access to information will bring new tasks for their learners. One student mentioned that their pupils will have to « clarify their own research goals, define their information seeking strategy, make choices in the information, and sort the information ». This type of anticipation regarding « transversal » competencies was certainly an interesting finding.

Scenarios

As one can see in figure 1, only one team has scored positively on four of the five socio-constructivist criteria. Two scored positively on two criteria while the last team did not meet any socio-constructivist criterium. Team 1 produced a scenario proposing learning strategies that were rather guided toward a collaborative project to be realised by the learners with objectives from multiple disciplines. Meanwhile, they did not propose specific metacognitive activities or activities oriented towards transversal competencies.

Team 2 produced a scenario with limited socio-constructivist features. They offered rather guided strategies and proposed metacognitive activities based on individual learning, close and pre-determined content, and objectives from only one discipline. Team 3 produced a scenario with collaborative activities and multiple disciplines but offered rather directed learning strategies with a multiple-path pre-determined content. They made no mention of metacognition or transversal competencies. These two scenarios are rather traditional in essence. Finally, Team 4 produced a very traditional scenario.

	Learning Strategies (directed/free) (1-4)	**Type of work** (collabo) (1-3)	**Content** (closed/open) (1-4)	**Learning goals** (metacognition) (0-1)	**Interdisci-plinarity** (subjects) (1-2)
Team 1	3	3	3	0	2
Team 2	3	1	1	1	1
Team 3	2	3	2	0	2
Team 4	2	1	1	0	1

Table 1. The score of each team's scenario according to the 5 socio-constructivist criteria.

Comparing scenarios and electronic forums

Table 2 presents the teams description in terms of number of students, socio-constructivist crireria reached and number of students for each level of depth for the electronic messages. Two trends have been identified in this comparative analysis of the electronic forums and scenarios. First, the students who are better able to support their opinions by providing examples, using the literature, explaining their thoughts, seem to be more capable of producing a scenario that uses a genuine constructivist approach. In fact, if all the constructivist criteria are applied whenever it is reasonable to do so, the tone used to describe the learning activity is more opened, more respectful of both the freedom of the teacher and the learners. Here, we noticed that the team who produced a constructivist integrative scenario, was constituted of four members who demonstrated some critical thinking abilities, by elaborating and justifying their arguments or their position.

The second trendshows that the students who claim that the role of the teacher is changing but who do not support their opinion, do not apply their values and perceptions in their integrative scenarios. In other words, they claim to be constructivist in the telediscussions, but they fail to transfer their thoughts in practice. As we anticipated, the majority of the scenarios produced were meant to be constructivist. Some teams for example, will have their students work in teams but in a fragmented fashion (individual students will provide parts that will make a whole); the content will be determined and not opened for change; the learner will be rather guided in the learning process.

These teams' lessons plans tend to be very organised and directed as well. The outcomes, ensuing the instructional goals are well planned. In fact, the pre-service teachers, remain perfectly in control of the predetermined outcomes. Despite their good intentions, the students remain in control of the learning process. The steps are not only too well defined, they are also not flexible. The outcomes of the intervention using ICTs are still pre-determined and nothing else, that is no incidental learning is considered.

	N. Students	N/5 socioconst. criterias	N students deep message	N students opinion message	N students superficial message
Team 1	5	4	4	1	0
Team 2	4	2	1	1	2
Team 3	3	2	0	1	2
Team 4	6	0	2	4	0
total	18		7	7	4

Table 2. Teams description in terms of number of students, socio-constructivist crireria reached and number of students for each level of depth for the electronic messages.

Conclusions

In this exploratory research we highlighted two trends. Students who demonstrate critical thinking abilities in electronic forums are more likely to apply successfully their values and beliefs in their productions of integrative scenarios. Secondly, students who do not support their opinion in the electronic forums will be less able to apply the socio-constructivist principles to their productions. They will remain in control of their pupils' learning. The next logical step would be to combine the use of the electronic forums and of the scenario development in order to help students to identify rupture points between their discourse and their practice. Such activity would directly support the development of critical thinking skills in the telediscussions and hopefully encourage a better transfer of the socio-constructivist principles to the development of integrative scenarios.

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CRACTIC: Lessons learned from the implementation of a socioconstructivist approach in a multiple classrooms collaborative project using the Web[1]

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Abstract. Fostering socio-constructivist practices with ICT in K-12 classroom activities is complex and requires numerous conditions to be met. In order to study these conditions and to develop a model of practices that take teachers' concerns and classroom reality into consideration, we initiated a community of research on collaborative learning with ICT, called CRACTIC. Over the past three years, this research "community" has included University-based educational researchers from two institutions, teachers and pedagogical support staff from three school boards, and the collaboration of topic experts from an ecological museum.

Socio-constructivist principles provide the theoretical foundation for Information and Communication Technologies (ICT) uses in almost every recommendation plan delivered by national orientation committees in the United States (NCATE, 1997; ASCD, 1998 ; NETS, 2000) and in Canada (MEQ, 2000). At the same time, a gap exists between these underlying principles and their interpretation, their practical meanings, and their day-to-day application in schools. In order to develop powerful understandings of socio-constructivist practices, we initiated a community of research on collaborative learning with ICT, called CRACTIC, the acronym for an expression in French meaning "Research Community on Collaborative Learning with Information and Communication Technologies".

The starting point of CRACTIC is the formation of a collaborative research community linking University-based educational researchers, grade school teachers and support staff, and domain experts, in order to implement a model of collaborative learning activities based on socio-constructivist principles. Teachers are selected to participate in the project based on their experience with project-based initiatives, access to adequate on-site technological infrastructure and support, and an interest in action-research about collaborative knowledge building. The project partnerships thus lays the foundation from which students in different schools embark on project-based learning activities integrating ICT tools. The main research objective is to understand how the classes are able to use collaborative technologies (Roschelle, 1995).

[1] Funding for educational research within CRACTIC, beyond the resources and expertise offered by the participants, is provided by a team grant from FCAR (Fonds pour la formation de Chercheurs et l'Aide à la Recherche, Québec).

One important way of developing and documenting the use of collaborative technologies in the CRACTIC classes has been through the iterative design and implementation, over a period of four years, of project management guidelines. These guidelines support the coordination of teachers and students in the various CRACTIC schools to exchange questions based on their common research sub-themes (e.g., whales, pollution) so as to generate and share research and topic information by using Web-based collaborative tools (discussion forums, calendars, etc). For example, the guidelines indicate how teams of students from one class can be paired with a team from one other class, in a coordinated way to facilitate the establishment of stronger relationships between participants (both teachers and students). The St-Lawrence River was chosen as a general theme due to its historical, economic, social and geographical importance, and because of its many curriculum connections. Project activities consist mostly in students engaging in jointly formulating deep questions and working on providing rich answers to these questions, using collaborative technologies to achieve this across classroom contexts. This represents an attempt to carry out Brown's (1997) FCL activities (e.g., modelling thinking and reflection, supporting statements with evidence, summarising) online in addition to in class. Finally, while the project guidelines suggest a minimum commitment of ten weeks, classroom exchanges and related activities often stretch over a number of months. The outcome of knowledge construction is an evolving collective Web site where each group posts their work.

Our methodology is based on on-site observations and analyses of multiple sources of information (e.g., meeting notes and reports; classroom observations; interviews with teachers, students and school administrators; student productions such as email messages, exchanges, and Web sites) to document the circumstances and outcomes of the CRACTIC practice.

Results are summarised in terms of an outline of the project management guidelines, patterns of classroom practices leading to collaborative exchanges online, the kind of support that has been observed as successful in achieving increasingly connected and collaborative practices within our community of inquiry, and the obstacles and impediments that we have encountered which are very similar to those observed by Zech & al. (2000) and Blumenfeld & al. (2000). Our discussion is mostly about how this project guides and fosters the emerging practices of a complex community that is targeting issues of teaching and research and wants to converge in increasingly successful ways.

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Towards a Compromise Between Talking Heads & Interface Agents: A Web-based "Mentor" for Computer Assisted Language Learning (CALL)

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Abstract: Animated agents are used to provide an interface between a human and a computer. Talking heads provide us with a realistic model of a facc which, when combined with speech synthesis technology, can give us a tool that can aid audiovisual perception of speech. Our aim is to combine these two technologies to create a talking animated interface that will be used within the FreeText project, a Computer Assisted Language Learning environment under development, to act as both a "mentor" and as an aid to pronunciation and understanding of speech. By adapting and developing the FREDA project we hope to achieve this aim.

Introduction:

When learning a new language the most difficult part is understanding spoken communication; research has shown that this understanding is greatly diminished when background noise, i.e. people talking, music or traffic, interferes with the speech. The results of experiments concerning the intelligibility of speech (Sumby & Pollack 1954) concluded that 'visible speech' aids the listener's understanding because he/she employs visual perception to clarify that the phonemes/words heard match the facial movements of the lips and jaw. This is the motivation behind developing and adapting the FREDA project (Mumford 1998) to be used within a web-based CALL environment.

FREDA (French Real-time Educational Displayed Articulation) provides real-time visual support for FIPSVox (French Interactive Parsing System, Vocal) (Gaudinat & Wehrli 1997), a French text-to speech synthesiser used in SAFRAN (Système d'Apprentissage du FRANçais) (Hamel 1998), a CALL application. FREDA uses a series of visemes to create real-time animation based upon the output of the text-to-speech synthesiser. The animation is then combined with the corresponding audio file to create a video file. This paper looks at the current research into agents, talking heads and facial animation and discusses the developments and adaptations that will be made to the FREDA project.

What is an Agent?

For the purposes of this paper we are interested in agents that provide an interface between a human user and a computer by means of an animated character which can be directly manipulated by the user. This type of agent is more commonly known as an interface agent and the definition we will use is that of Henry Lieberman (Lieberman 1997):

> "An agent is any program that can be considered by the user to be acting as an assistant or helper, rather than as a tool in the manner of a conventional direct-manipulation interface"

Using the list of properties of an agent (Franklin & Graesser 1996) it is possible to produce a good definition for a specific class of agent. An animated interface agent can therefore be reactive, communicative and having character.

Talking Heads:

A "talking head" is a synthetic human head which has the ability to speak. More formally, a talking head is an audiovisual speech synthesiser and the current research combines knowledge from the fields of computer graphics/animation, facial movement and speech technology. The ideas are based upon the fact that visual perception of speech aids the auditory understanding. Using the advances in 3D graphics a dynamic model can be created that not only looks human but also mimics human behaviour and facial positions.

Facial Animation:

Animators discovered that the best way to make their characters more "alive" was to give them moving lips, when they speak, which match the phonemes being spoken. For each phoneme in a language, it is possible to define a viseme - the visual interpretation of the position of the articulatory organs during the pronunciation of a phoneme. The animators found that a number of phonemes could share the same lip viseme, as the position of the lips is identical. The articulatory difference between many phonemes is internal, so it is something that animators rarely need to display. For our agent we will define a set of French visemes that will be limited based upon methods used by animators and using the work of Benoît et al (Benoît et al. 1992), which identifies twenty-one mouth shapes that describe the structure of the lips and jaw gestures used in French.

Aims:

Our aim is to create a web-based talking interface agent that will be used within the FreeText project http://lismore.ccl.umist.ac.uk/freetext, a CALL application, as a mentor. The mentor will exhibit agent characteristics by giving the learner help, both when asked for directly and when the mentor thinks that the learner may need a bit of advice. We will use the technology behind talking heads used for speech reproduction in order to provide realistic facial movements. The aim of this is to allow the learner to use visual perception of speech to increase the intelligibility of the phrase being spoken. The other advantage of using facial animation, in the field of CALL, is that it can be used as an aid to pronunciation; learners can mimic the mouth movements of the mentor.

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Empowering the citizen

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This paper carries the fundamental implications for healthy living and actual media concepts.

Introduction

Numerous initiatives and declarations have called for more support for public health, sickness prevention and increased self-empowerment for the public in the health services. The aim is to optimize the form, the intelligibility and the publication of publicly available health information within the health service for non-experts.

Study

Resulting from a representative telephone survey (n=2000) on health behavior and health empowerment and utilization of media answered the points: a) How does the citizen get information about health? b) How does the ordinary citizen use information? c) How does the layman judge the quality of health-related information?

Findings

Empowerment as a practical educational aim with regard to health includes the following factors: a) understanding health, b) asking questions, c) creating models, and d) implementing it in a social setting.

Conclusions

The conclusions of our study help us to create user oriented health information.

Extending the IEEE – LTSA

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Abstract The IEEE developed an architecture specification for learning technology systems (LTSA). This paper proposes an extention for the LTSA covering the learning cycle taking place between expert and learner. We describe a general production model to motivate the extention of the LTS architecture as described in [Farance and Tonkel, 1999].

Introduction

An Internet based course management system (*CMS-W3*) is being developed at Fraunhofer-Institute for Computer Graphics Rostock for the past five years. It is used by experts for distributing their courses via Internet and by students for learning with the material distributed. The "Course Management System for WWW – *CMS-W3*" (see [Voskamp, 1997,Voskamp, 1999,Hambach et al., 1999] supports self studies, group learning and communication among students and with the tutor.

There are various standardization processes on ICT(Information and Communication Technology)-based learning technologies running all over the world. One standard is developed in the IEEE 1484 Learning Technology Standards Committee (LTSC). The LTSC proposes the "Learning Technology Systems Architecture (LTSA)" [Farance and Tonkel, 1999].

Following these standardisation processes we tried to match the architecture of *CMS-W3* and the LTSA. One important part of *CMS-W3* was missing and was not described in the LTSA. Going back to underlying learning processes we found that the proposed LTSA is missing the part on how the knowledge is transfered through the system.

This article proposes an extention of the LTSA supplementing the process of knowledge transfer: from the expert to the resources of the system and back to the expert in form of experience.

IEEE - LTSA

The IEEE 1484 Learning Technology Standards Committee (LTSC) developes an architecture specification for learning technology systems, the "Learning Technology Systems Architecure (LTSA)". The LTSA is

> "...an architecture specification: the technical details can be used to specify or design systems as well as detailed systems components."[Farance and Tonkel, 1999]

The specification is beeing developed in close collaboration with the Aviation Industry CBT Committee (AICC), the European Commission PROMETEUS initiative (EC/DGXIII), the European Union ARIADNE Project, the European CEN/ISSS Workshop on Learning Technologies (CEN/ISSS/LT), the IMS Project, and the US Department of Defense Advanced Distributed Learning (ADL) initiative.

The LTSA proposes a basic top-level architecture for system design and components. It covers a wide range of ICT-based learning methods and even non-ICT-based models.

Setting up such a specification architecture is a great idea. Using an existing architecture standardization prozess makes things much easier, for example defining the exchange of courseware (see [Dodds, 2000]) or student profiles. Figure 1 shows the LTSA system components. See [Farance and Tonkel, 1999] for a detailed description.

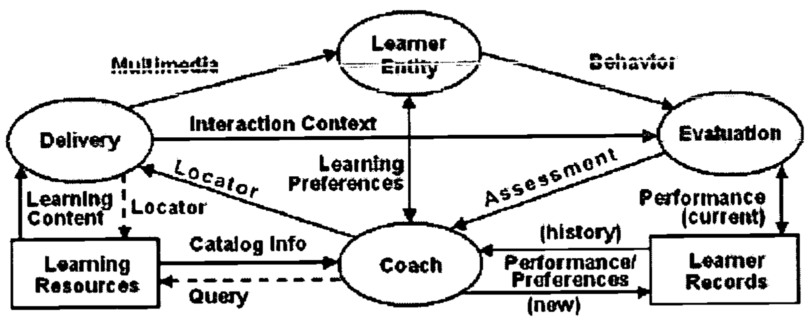

Figure1. LTSA system components model

Objectives of the LTSA

The LTSA specification states to be

> "...pedagogically neutral, content-neutral, culturally neutral, and platform-neutral. The LTSA specification is neither prescriptive nor exclusive."

Furthermore, it

> "...does not address the development systems (e.g., programming languages, authoring tools, operating systems) necessary to create the LTSA components, and the management systems (e.g., learning material lifecycle, quality assurance, access control, user administration) necessary to manage a learning technology system."

Consequently, the LTSA is an architecture describing general learning processes. Anyway, in our opinion the learning process is not completely descibed.

Missing points

The LTSA covers only a closed learning process. However, the knowledge to be "produced" in the head of the student has a source. It is either the knowledge the expert has or it is the experience of the student in finding and solving problems.

If there is expert knowledge to be passed to the student, this knowledge has to be translated into some kind of information (data plus multi-modal presentation). In working with and studying this information the student may aquire his knowledge – he learns.

The process of learning produces a learning history and learning performance which can be used by the expert to improve his knowledge about the way the information has to be passed to the student. This process is missing in the LTSA.

Extending the LTS Architecture

We propose to extend the LTSA by an expert process. The purpose of the extention is not to deny the LTSA but to extend it by a processes we think is essential.

The proposed extention is based on a production model which will be described in short in the following.

Production model

The relevant state S of a student for the learning scenario bases on his actual knowledge K_L and his mental state M. This state changes during one learning cycle – $S_t \rightarrow S_{t+1}$. The student starts in state S_t, which bases on the knowledge K_{Lt} and the mental state M_t where t defines the moment before the learning process starts.

$$S_t = \{K_{Lt}; M_t\}$$

Let I be a set of information objects IO. An information object contains the data which solely or in combination with other information objects is to be presented to the student.

$$I = \{IO_1, \ldots, IO_n\} \parallel$$
$$\forall i \forall j : IO_i = IO_j \Leftrightarrow i = j;\ n, i, j \in N$$

The student consumes an information $I_{t,t+1}$ during the learning process $l_{t,t+1}$ presented by a set of presentation types $P_{t,t+1}$(described later) where

$$I_{t,t+1} \subset I$$

A presentation can be a simple audio presentation, an interaction, an excercise, a test as well as a discussion forum or other learning tools. The learning process $l_{t,t+1}$ is a function depending on the information, the presentation types and the knowledge as well as on the mental state of the student.

$$l_{t,t+1}(I_{t,t+1}, P_{t,t+1}, S_t)$$

For the transfer of information to the student it can be coded in different presentation types (see [Mengel, 1999]).

Information objects IO are aquired out of the experts knowledge K_e to be passed to the student as well as out of the the knowledge of other students K_{sg}.

Experts are responsible not only for the information to be transfered to the student but for the type of presentation, too. They define a set of presentation types P. A presentation type PT is one method to present an information object IO.

$$P = \{PT_1, \ldots, PT_n\} \parallel$$
$$\forall i \forall j : PT_i = PT_j \Leftrightarrow i = j;\ n, i, j \in N$$

As described in [Reinhardt et al., 2000] every presentation type contains attributes which allow a decision when to use this presentation type. The presentation function $p_{t,t+1}$ returns the necessary set of presenation types $P_{t,t+1}$ to be used for the current information $I_{t,t+1}$.

$$P_{t,t+1} \subset P$$

$$P_{t,t+1} = p_{t,t+1}(I_{t,t+1}, S_t)$$

The aim is to maximize the learning function $l_{t,t+1}$. In order to maximize this function the best sets for $I_{t,t+1}$ and the best fitting set of presentation types $P_{t,t+1}$ has to be found. This is the task of the coach in LTSA.

However, $I_{t,t+1}$ depends on the learning function $l_{t,t+1}$. For this reason, it is necessary to optimize the presented information $I_{t,t+1}$, the information objects IO, the presentation function $p_{t,t+1}$ and the presentation types PT. This cannot be the task of a coach but has to be the task of an expert. For optimizing the information ojects IO and the presentation types PT expert knowledge K_e is definitly necessary.

Figure2 gives an overview on the production model.

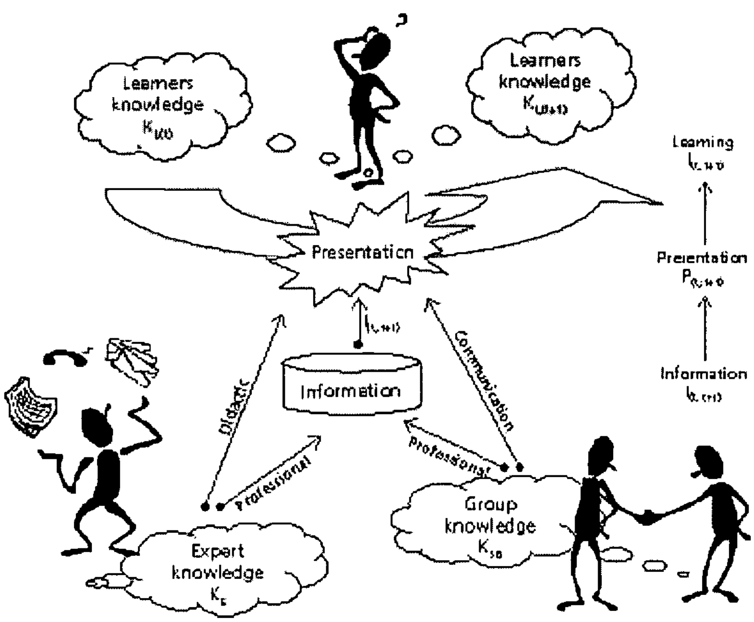

Figure2. Production model

Reasons for the extention

The main reason for the extention is to find a system architecture for learning technology systems that covers all learning scenarios – as LTSA is dedicated to be. As shown in section "Production model" the learning process is not covered by only presenting information to the student and using the learning performance to let the coach find the next information to be presented.

The learning performance of a student is used by the expert to train the coach in didactics and to transfer the right knowledge into information object to be stored in the learning resources. For ICT-based learning environments this recursion is not done for every single learning step. However, it is necessary to bear in mind that it exists. Therefore it should be included in the LTSA.

Extended Architecture

We propose to expand the LTSA by an expert process. The expert process is responsible for transferring information into learning resources and for training the coach in didactics. After the first learning cycle the expert process learns from the learner performance how the coach has to be re-trained and which knowledge has to be re-transformed into information. Figure 3 shows the extension.

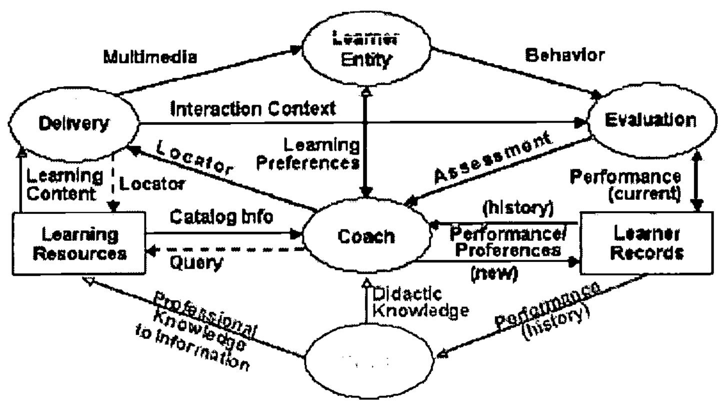

Figure3. Proposed extended LTSA

Following the description of the LTSA the coach can be an automatic process following predefined rules. This process is not able to define new didactic rules. It simply does not has the necessary knowledge.

The main reason for extending the architecture is that there is no knowledge-to-knowledge flow described in the LTSA as it exists in the real world. When trying to set up a learning specification it is important that this specification meets the daily learning business. Daily business in learning is a cyclic dependency between students and experts knowledge.

Review

The proposed extension for the LTSA adds an important part of the daily learning and teaching business. It says that the student does not only learn from the expert, but the expert learns from the student as well.

Background for the proposed extension are ICT-based learning environments. However, as stated in the LTSA specification the extended architecture covers daily learning processes like face to face learning, too, and much better.

The following list shows the steps during one learning cycle as proposed in the LTSA. The first and the last line are added due to the extension described.

1. ***Put expert knowledge into resources (knowledge to information) and didactic knowledge into the coach***
2. Start with human sensory input: multimedia delivery to learner (similar to entertainment)
3. Add coaching/feedback loop for human "unreliability"
4. Add learner records for varying teachers, infer intelligently about learner capability
5. Add rich learning resources, search, and lookup to support diversity of humans
6. Add negotiated learning preferences for direct communication with learner
7. ***Add negotiated learning preferences to give feedback to expert***

Conclusion

Using the extended learning technology systems architecture it is possible to describe the functionality of *CMS-W3* and other ICT-based learning systems. We use it as a starting point for further research in technical support for transferring expert knowledge into information objects, in didactic support for the coach and in organizing the re-transformation of information objects according to the students learning process.

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Learning Resource Catalogue Design of the UNIVERSAL Brokerage Platform

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Abstract: This paper illustrates how the issue of providing user-friendly access-mechanism to learning resources has been addressed by UNIVERSAL, an open, pan-European brokerage platform for learning resources. The focus is devoted to catalogue design; its creation, development, structure and organization. More attention is also given to the automated categorization of learning resources within the category tree, creation and maintenance of the catalogue hierarchy. The described approach enables gradual automation of the categorization process: from manual to semi-automated and finally to a fully automated categorization process.

Introduction

The European project "UNIVERSAL - Universal Exchange for Pan-European Higher Education" is an attempt to demonstrate an open exchange of learning resources (LRs) between higher education institutions across Europe. The goal is to create and manage an open market of learning resources by introducing a brokerage platform with a standard way of describing the pedagogical, administrative and technical characteristics of learning resources. The system will enable institutions to enrich their curricula with remotely sourced material. It is intended to be compatible with a variety of similar models pursued by different institutions, including open universities and alliances between peer institutions. The business-to-business oriented brokerage platform will embrace offers, enquiries, booking and delivery of LRs.

Based on the IEEE Learning Objects Metadata (LOM) standard, four aggregation levels of LRs are introduced: course, unit, lesson, and fragment. A course is defined as a set of units or lessons contributing to one learning goal and lasting not longer than one semester or term. Courses can be organized in units, which in turn consist of individual lessons. A full course description does not always have to consist of units, it can also be based on lessons. A lesson is part of a course or a unit, which does not necessarily have to be offered in UNIVERSAL as well. Lessons can consist of multiple fragments, which are also referred to as supporting material (Guth et al. 2001).

The platform supports synchronous as well as asynchronous material. The following examples of LRs are taken from the preliminary version of the UNIVERSAL catalogue:

- A course dealing with Icelandic Sagas (aggregation level: course; delivery mode: synchronous);
- A web-based training application instructing ophthalmologists on how to diagnose patients (aggregation level: unit; delivery mode: asynchronous);
- A recorded session of a course in international marketing dealing with a Levi Strauss case study (aggregation level: lesson; delivery mode: asynchronous);
- PowerPoint slides, exercises, and a term project description supporting an introductory course in information technology (aggregation level: fragment; delivery mode: asynchronous).

LR metadata is maintained by the UNIVERSAL metadata engine combining the eXtended Markup Language (XML) and the Resource Description Frameworks (RDF) approach. The RDF Schemas used for describing LRs and LR related information such as authors, delivery systems, taxonomies, etc. are available at http://nm.wu-wien.ac.at/universal/metadata. The XML:RDF approach used ensures scalability and transferability of UNIVERSAL repository of LR metadata instances (Guth et al 2001), because mapping the Universal metadata schema with LOM or Dublin Core can easily be carried out by generating LOM compliant or Dublin Core compliant metadata instances.

A key innovation of the UNIVERSAL project is the tight integration of the LR catalogue and the delivery systems. A delivery management engine prepares the grounds for the delivery of LRs by granting access rights and verifies the availability of the content. A thin generic interface layer provides communication functionality between brokerage and delivery system, such as availability checks, authentication and authorization services, delivery negotiation and delivery supervision. UNVERSAL will offer a fully implemented delivery interface to the following restricted set of delivery systems, but is also open to others by providing a generic delivery interface:

- Apache web server (asynchronous packaged content);
- Hyperwave's E-learning Suite (learning management system);
- RealNetwork's Realserver (asynchronous streaming content);
- Isabel (synchronous collaboration tool and video conferencing system).

Requirements for Catalogue Design

The UNIVERSAL catalogue is an essential part of the system, since it brings demand and supply together and has direct implications on the costs of deploying the system. Considering the effected user groups (potential LR consumers, LR providers, and platform administrators), several issues arise. On the one hand catalogue design has to assure that potential LR consumers have efficient access to the LR they are interested in. It is essential for the potential consumer to find a desired LR quickly and with ease, since high search costs reduce the perceived net-value of a web-based information system (Kaukal & Simon 1999). On the other hand, platform hosts are interested in keeping the catalogue maintenance costs at a minimum level. Brin and Page argue that human maintained catalogues are expensive to build and maintain (Brin & Page 1998). In this paper we present a scalable approach that should make up this drawback.

The catalogue requirements from a LR provider's perspective are based on a qualitative survey at Austrian universities. Seven higher education experts, managers or pioneers in applying new media in the field of traditional higher education have been asked about potential obstacles for using systems such as UNIVERSAL. Concerning catalogue design the survey revealed that faculty members are reluctant to provide LRs of high quality when the quality of the listed LRs is not of a similar level. There is also a need of accessing LR-specific assessment and usage data in order to charge LRs depending on their quality.

A catalogue must have structured content of a well thought and well-defined standard set of fields that can be extended to all metadata elements to accommodate the uniqueness of the different types of resources as the number of catalogued resources increases and as the category tree expands.

The content of a catalogue must answer the following questions:

- What is available on the subject of user's area of interest (AOI)?
- What is the quality of available LRs and what do they look like?
- What is the procedure for the user to get a specific LR?

The Categorization Process

A hierarchical structure of a catalogue in the UNIVERSAL project will be presented in a multi-level hierarchy. The first level is a subject-centric level with main thematic categories which provide the subject structure of the catalogue content based on keywords from a selected classification schema, such as the Dutch Basic Classification (available at http://www.konbib.nl:88/kb/resources/frameset_kb.html?/kb/vak/basis/bc98-en.html).The top division of the classification schema is of particular importance, since it provides the first entry point to the catalogue and effects the organization of all the following categories. The second level is a title/authors/publication time/etc.-centric level where the structure is based on a certain elements of the LR meta-data instances. These attributes are used for building categories (title/authors...- the middle division). These elements (categories) are selected by the catalogue administrator. As the number of LRs grows the number of categories used in the middle division will expand. The second level may be repeated several times with a different category in each level (repeated middle division). The next level is a type-centric level with four types of LRs: course, unit, lesson and fragment (actually it is a specific type of middle division). The last (the bottom division) is for the actual links to resources with all the important information for every resource, respectively. The top and middle division(s) are essential for navigation around the catalogue, and the bottom division holds information where the content of the catalogue is found.

The goal of the categorization process is to find the most appropriate categories under which every LR should be classified. The categorization process has two inputs. On the one hand, XML:RDF metadata instances of LRs are exploited and, on the other, the pre-existing category tree in a catalogue (let us assume that an initial version of catalogue exists) within which every LR must be categorized is taken under consideration (Fig. 1).

The category tree consists of a tree with a description for every node, which identifies the category and helps to properly categorize every new LR, which is to be added to the catalogue. The output of the categorization is a vector of weights associated to each node in the category tree. Each element of that vector represents the probability that the resource should belong to the category represented by each node. The vector of weights will be determined by using natural language processing tools, which will take advantage of a UNIVERSAL ontology

The classification algorithm considers each node in the category tree as a context path. The weights from all context paths of the same resource are added (sum of weight vectors is performed) and if the normalized sum for a certain node is greater than a certain threshold, the resource is classified under that node. The mechanism allows classifying a resource under more than one node. However, the same resource could never be classified in nodes, which are descendant of one another. The title of a category is not sufficient to fully identify the category. The whole path (context path) is necessary to disambiguate among the categories.

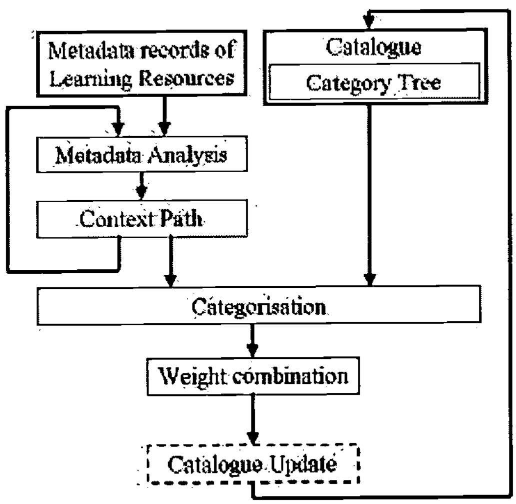

Figure 1: Building a catalogue hierarchy based on categorization. Categorization exploits metadata instances of LRs and category tree in a catalogue (double rectangles). The final outcome of the whole process is "catalogue update" (dashed rectangle).

The categorization algorithm works as follows: it first computes candidate context paths for classifying a resource, then it selects among candidates, and finally it updates the category tree and the entire catalogue. Every context path in a category tree (path from the root node to each node on every level in a category tree) is represented by a vector of weights $C_1, C_2, \ldots, C_n$, where n is the number of levels in a context path. Each weight presents the probability that the resource should belong to the node. The initial value of every weight is 0. The values from the metadata instance are searched for an identifying description. If the value is found in node j (j = 1, 2...n), a certain discrimination weight is added to the weight Cj. Any path containing non zero elements is considered as a potential candidate. The selection among these candidates is performed as follows. Any path with zeros in its leading fields should be discarded. This means that matches are found only in some subcategory, but not in the top-level categories. If more candidates remain then a candidate with longer path should be selected. This forces categorization under the most specific category. The selected candidate paths associated to the resource are stored in the database. If the same LR could be classified into different categories with different context paths (the same resource is reached from a different path), the categorization mechanism should either enforce the indication of the category for a resource or should suggest alternative categories for the resource (creation of a new category).

There are two possible cases when the categorization process should extend the categories in the catalogue. The first one is when the number of entries of a category exceeds a certain threshold (e.g. 40 entries). In this case the list of LRs would become too long for displaying it in a user-friendly manner. Re-classifying those LRs in new subcategories would significantly support finding desired LR effectively. The second case is when an alarming number of resources do not find a proper place in the catalogue hierarchy. Then a new category should be created.

To extend the categories, the context paths should be analysed further (Maarek & Shaul 1996). In both cases, the context path in a single large category should be searched for elements in the metadata, which produce partitions of the resources. All unused elements from the metadata instances of resources in that part of category tree should be considered as candidates for creating new categories.

Since several partitioning alternatives may arise, statistical or neural analysis techniques should be applied to rank the most promising alternatives and present them to the catalogue administrator who will decide which subcategories to add to the catalogue. The experienced catalogue administrator could do the selection of an adequate category instead of applying automated statistical or neural analysis techniques. However, we can already find products such as Autonomy and Vistabar on the market that are designed to automate the process of categorization. The choice between the manual or automated categorization lies in the decision of the level of automation of the whole cataloguing process (Salton et al. 1994).

User Interface Design of the UNIVERSAL Catalogue

Fig. 2 illustrates the two different types of user access to a repository of LRs: browsing and searching (Manber et al. 1996). A user starts browsing through catalogue and wants to discover what is available on his AOI. The top-level category (root node) is the starting point in his attempt to find a resource meeting his general idea of the item of interest. Then in the information discovery process user continues to browse and progresses to more and more details by refining the selection in every node moving from higher to lower level to the last possible selection. Browsing mechanisms enable users to locate and identify their AOI. At the same time a user can view relationships such as overlapping, intersecting and containment of the available resources with their AOI. A second way to explore the content of a catalogue is by defining an AOI with the search query. This process could be repeated several times and every time with a different function: search or browse. Therefore a list of resources from the search function must also contain information in which node of the category tree a resource can be found.

Catalogue Browsing Interface

The UNIVERSAL catalogue will provide a structured view on the LRs offered through the UNIVERSAL brokerage platform by introducing multiple levels of categories. For every node in a category tree index will be unique. An index is understood as a list of LRs sorted in a specific way (most common is descending alphabetical order) (Srihari 1995). Each index page should present its hierarchical location in the catalogue. The user interface should allow users to click on any node in the hierarchy (when a user is visiting certain node, the whole context path should be visible as array of hyperlinks) and when clicked it should send a user directly to that catalogue node. Which nodes (hyperlinks to nodes) should be visible (click-able) from certain node is a matter of discussion. However, the rule must be the same for all nodes (for example: all nodes in a context path and first descendant level to that node - if existing).

The catalogue in UNIVERSAL will use a hierarchical arrangement. In other words, users will be able to "drill down" from general to a more detailed level within the catalogue. Here a hierarchy may be presented as a triangle, with the root node at the top corner, and the lowest level of detail as the bottom edge of the triangle. If the hierarchical structure of this presentation is close to an equal-sided triangle then the hierarchy is assumed to be sensible and adequate. Smaller catalogues usually need only a few levels, while bigger may have a middle level of nodes between the root node and the lower level. As one same resource can be assigned to more than one catalogue node the same LR can be found also in several catalogue nodes of the category tree (if selected elements from the metadata instances allow categorization of the same resource into those nodes).

Search Interface

When search is performed the user searches a catalogue with a specific, focused goal. The search interface of the UNIVERSAL brokerage platform will provide the input dialog or selection fields to enter the specifics. The search could be performed "globally", i.e. within the complete repository of LRs. However also "local" search will be supported. Here only the content of that part of the catalogue, where the user is browsing will be subject of the search (this includes all nodes bellow a certain node). The search results are returned as a list of LRs. Then, the user can explore the details of the returned matches through further selections, query refinements, and viewing of all information relevant to meet the initial specifications as closely as possible (Chalmers 1998). It is planned that the LR search engine will support previews and users will be able even to download a sample set of the resources to determine their match to the AOI.

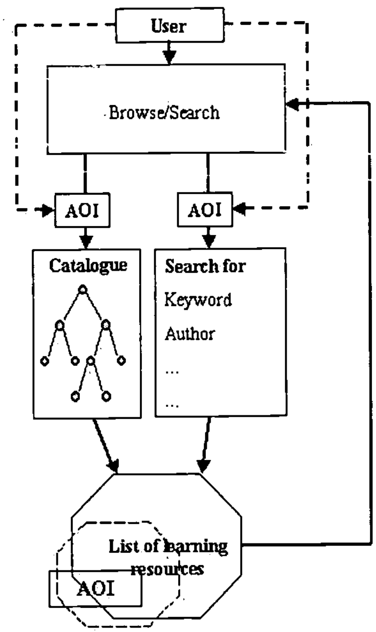

Figure 2: A user may access resources in two ways: by browsing through the catalogue or by searching mechanism. Users are looking for offered resources meeting their Area of Interest (AOI). A link between the area of interest and the catalogue shows resources available in the catalogue meeting their AOI. The result of a Browse/Search activity is a list of resources (Browse/Search activity can be performed further on this list of resources). List of resources in every step is different moving from one position/size to another (dotted stop sign shape square) with goal to match with AOI square as much as possible.

The search engine of the UNIVERSAL brokerage platform will perform search based on the descriptions of resources (content of metadata instances) and will provide results as a linear list of resources. This is unsatisfactory because the list can be quite long, and indication of possible grouping of related material is essential. Splitting the list of resources into categories and displaying hits based on catalogue categories will significantly facilitate selecting those LRs the user is most likely interested in.

The scope of a search in a UNIVERSAL catalogue will be limited by the user's search location within the category tree. To search over one category a user should go to this category node. To search over whole catalogue (all LRs), he should simply go to the top-level node (root) and search from there. Therefore the user in order to broaden or narrow his search scope has to go to a more appropriate node in the catalogue.

When search will be performed a list of LRs will be displayed. A user is usually interested in how this list is near his AOI. The title of the LR is often not enough for a user to identify if a LR is on the subject of user's interest. The following information will be available: language, title, aggregation level, learning goals, educational aims, description, author, keywords, duration, costs, copyright restriction and categorization within the category tree. Depending on the LR aggregation, additional information is provided:

- For fragments: learning resources type (lecture, case study, exercise, simulation...), format, version, status (draft, final, revised);
- For lessons: instructional design (directed learning, self directed learning, collaborative work), starting time, ending time and time zone (for live lessons), delivery platform specifications;
- For units: pre-requisites (knowledge, experience), instructional design (see above);
- For courses: pre-requisites, program (undergraduate, graduate, postgraduate).

Conclusions

There are many approaches for building a catalogue hierarchy described in literature (Hahsler & Simon 2000). The proposed approach in this document is taking advantage of highly structured and highly flexible repository of metadata instances achieved by combining the advantages of XML and RDF (Guth et al. 2001) and enables full automation of a cataloguing process. This has an impact on fast and objective categorization of LRs into categories avoiding subjective estimation of the catalogue administrator or users in which category specific LR should be found (Cleverdon 1984). This approach also manages fully automated growth of catalogue and category tree as the number of LRs offered through UBP increases. Moreover, it facilitates a gradual automation of the whole categorization process. In an early stage of the project manual categorization will be done. Planned stages are:

- Fully manual categorization and manual managing of a catalogue (expansion of a category tree);
- Automated categorization in an already existing category tree and manual expansion of a category tree;
- Automated categorization of LRs and automated expansion of a category tree by applying analysis techniques of metadata for further partitioning of categories.

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Is the Web Too Powerful?

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Introduction

The Web has become a phenomenon in education, particularly in the Western world as Western nations are heavily industrialised and information technology occupies an important role in their development, economically and politically. The role of the Web in the so-called 'global village' has been endorsed by many and has also been critically questioned by others. Is the Web just a tool or is this tool too powerful? For those who question the impact of the Web in a global context, the Web in not just a tool as it also creates some social discrepancy and a paradigm shift. Paradigm shift refers to a meaningful change from one alternative to another. This can happen if current discourses are taken for granted and we are not critical of various aspects of our discourses, which include the Web culture. The Web is seen by many as a powerful tool for teaching and learning. The word "powerful" tends to designate usefulness to its users. However, if we view the Web in a critical discourse perspective, we start to wonder whether it could be ideologically free when it enters the educational discourse.

Tool and ideology

Recently, a new force under the names of Critical Theory, Critical Discourse Analysis, post-modernism, which promote debates social issues in the cultural and intellectual scene in many academic discourses. Advocates of these critical views aggressively criticized traditional culture, theory, and politics. They provide a critique of representation and hold the view of relativity which stresses that theories at best provide partial perspectives on their objects, and that all cognitive representations of the world are historically and linguistically mediated. From a sociologically perspective, they reject assumptions of social coherence and notions of causality in favour of multiplicity, plurality, fragmentation, and indeterminacy. They question the rational and unified subject postulated by much modern theory in favour of a socially and linguistically decentered and fragmented subject. The Internet has become another 'battlefield".

Ideology plays a crucial role in the development of critical theory. Interest in ideology leads to an understanding of, and sympathy for, the culture of the disadvantaged. Critical theory operates by empowering people from the coercion of ideology, by enabling them to recognise the reality of their situation and thereby giving them more control over their lives. From a critical theory viewpoint, educational practices are not themselves ideologically neutral, but reveals a context of cultural and political imposition. As Comber (1994) points out in reference to literacy education:

> Literacy practices are not in themselves neutral, but work culturally and politically to privilege particular kinds of literacies and therefore particular kinds of literate students.
>
> (Comber, 1994, p. 26)

As the Web is a powerful tool produced to serve a discourse, its neutrality in interaction and education can be questioned. Is the Web value-free from an ideology-loaded discourse? For those who consider the Web merely a tool, it is morally innocent and ideologically neutral.. Like many other tools, it is a physical entity which is subjected to good use or abuse by human beings. However, it can be argued that the Web is a product and an instrument which cannot be divorced from its historical background and functioning. It was invented and has been maintained by a professional group or elite for serving their growing needs and reinforcing their images and metaphors of their worldviews. The Web is there because it helps to maintain a system of social interaction. It is embedded in a social discourse and should not be treated as a separate entity.

According to Critical Discourse Analysis (CDA), a discourse can enhance some people and discriminate against others. CDA is a type of discourse analytical research that primarily studies the way social power abuse; dominance and inequality are enacted, reproduced and resisted by text and talk in the social and political context. With such dissident research, critical discourse analysts take explicit position, and thus want to understand, expose and ultimately to resist social inequality. The Internet is no longer "innocent" in their critical eyes. Metaphorically, the Internet is an international superhighway, which is not free from traffic. There are always carriers on the superhighway and cross different cultural territories. These carriers are not content-free and culturally neutral. They represent some powerful forces with explicit and implicit agenda.

The Web is exceptionally powerful as it can perform huge tasks with its electronic power. The newly introduced prefix e- such as e-mail, e-commerce, e-trade, e-banking, e-book, e-paper, etc. shows clearly the impact the Internet has in modern society. It empowers many institutions to revolutionize their old practices. The Internet and globalisation walk merrily together. However, this is not the way emancipation is perceived from a critical perspective. The dichotomy of empowerment and disempowerment is relative depending on a discourse community and external interference. It could be seen as disempowerment when the Internet brings along the gap between the e-people and those who cannot afford the Internet or those whose culture does not accept or worship the virtual reality. We all know when a highway runs across a village, its culture and environment are no longer the same.

According to Davison (1997) the importance of personal knowledge of the people involved in Internet-based learning is sometimes lost in a context of "globalisation". Education is a moral activity. It is concerned with people significantly affecting the lives of others and educators have a moral obligation to consider how their individual actions in the teaching/learning nexus might significantly affect the lives of those immersed in it. Education should seek to overcome false consciousness as individuals are caught up in a social context in which they are blind to inequities of their situation and can be exploited by the dominant class.

In order to seek students' views about the role of the Web in education, particularly from the Critical Theory and Critical Discourse Analysis perspectives, a Web-based discussion board was established to provide Education students at our university with a forum to express their views and attitudes toward the Web in general and its role in education in particular. The result indicated that the Web was considered as a resource for teaching and learning. However its usefulness depended a great deal on the theoretical orientations of course designers and instructors. Majority of students' comments tended to focus on the instrumental function of the Web in education, and little attention was given to the ideological aspects of the Web.

Conclusion

The challenge by Critical Discourse Analysis to the educational establishment is important for educators because it raises crucial questions regarding certain hegemonic aspects of modernism and by implication how these have affected the meaning and dynamics of present-day teaching and learning. Educators working in a Web-orientated cross-cultural discourse need to question how the master narratives become constructed and how they influence the thinking and living experience of others.

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Novice Professionals, not Senior Students

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Abstract: A masters-level music analysis course was designed to introduce students to "real world" practice. All activities led to writing publication-quality articles, which were published in a peer reviewed and edited web journal. The students created an on-line community using the conferencing software, and posted the journal on a web server. The course was ranked very highly by the students for helping them to learn as well as being relevant to their future. The professor considered it a success in that most produced work that significantly exceeded his expectations.

The Case Study

For many students the transition from school to the working world is difficult. When a colleague shared this concern, I proposed a design experiment (see Collins 1992) to explore structuring his course to help bridge the gap. The framework was Legitimate Peripheral Participation (LPP) (Lave & Wenger 1991), in which the learner works as a novice professional (or apprentice) at the periphery of practice in their chosen field. Such a situated approach to learning builds on constructivism (see Honebein, Duffy, & Fishman 1993) and cognitive apprenticeship (see Collins, Brown, & Newman 1989) but stresses the socially constructed nature of knowledge as situated in communities of individuals working at similar practices. Rather than "learning facts" the learner addresses the practices and skills of the community. While students leave school with a wide array of knowledge, its application is often left for them to "pick up on the job." Lave and Wenger argue that this knowledge is both valid and teachable.

Within the framework of LPP, the concept of communities of practice is crucial (see Brown & Duguid 2000). These groups working on similar activities can be as close-knit as a class of students or as diverse as an entire field of inquiry. One of the challenges for applying LPP to education is the identification of appropriate communities of practice. For graduate school, I ssumed that writing articles was a valid activity of the students' communities of practice after graduation, since they were working toward a practical degree in music criticism. The professor agreed, and changed his original requirement for a final term paper to that of a journal article.

Qualitative methods of research have been shown effective in studying educational cases (see Merriam 1998) and design experiments (see Brown 1992). As this was an exploration, I chose case study as the methodology. With another person to actually teach the course, I was free to study the class as a participant-observer (see Spradley 1980) and take field notes during each of the class sessions as well as during on-line discussion. I also gave the students bi-weekly surveys about issues that they felt were important, and I triangulated all of this data with a 90-minute exit interview at the end of term.

Use of Computing for Learning

The class met once per week for a three-hour seminar. Computer conferencing allowed students to communicate between classes if they chose to. During the first half of the semester, the students used the system daily, only stopping when the system was unavailable. They credited the conferencing system with helping them become acquainted at the start of term, and they found that the mutual exchange of ideas benefited their learning. They cited being much better prepared for classes after discussion during the week, and their professor remarked that he had never had such intense discussions in class. The students also felt that they learned a great deal from seeing each others' working method, which demonstrated ways of thinking that they had not previously considered. They also found others' work to be useful working models, and felt that its very visibility held up a standard to strive for. The professor noted that this class produced the finest set of papers he had seen in the past decade.

The World Wide Web hosted the final articles in a student-edited journal. The students found this project enjoyable and worthwhile. All noted that they learned many computing skills that would be valuable for their future, and yet this was not an explicit part of the course. Their concentration on such an ancillary skill is reminiscent of the concept of "stolen knowledge" (Brown & Duguid 1996) while their devotion of large amounts of time to their journal because of their enjoyment in creating it seems clearly related to the concept of "flow" (Csikszentmihalyi 1990). While web pages are fairly simple computer technology, they were critical to the success of the design. The mere existence of the journal on the web allowed its availability to a large proportion of "real-world" members of the academic community, and this in turn made the experience more real to the students. All students reported working much more carefully than on a "standard term paper" since this was their introduction to the professional community. The concept of the community of practice being "academics publishing in music analysis and criticism" came from the students, contradicting the professor's initial notion that their audience be "fellow graduate students."

Educational Evaluation

The success of the class was the result of the students' engagement with the concept of starting their own careers by introducing themselves to their professional communities via the journal, and most worked long hours on the design and editing. Student enthusiasm for their own particular career and learning interests led to their synthesis of other work with the subject matter of this course, resulting in much richer and more interesting papers. The students were encouraged to contribute ideas, and many were implemented by the professor. As Lincoln (1995) has pointed out, there is surprisingly little research on learning from the perspective of the student, and this study suggests that there is a great deal of value to be learned from following the experience of students over an entire semester, or longer.

Merrill (2000) has identified five common traits of effective educational systems, which neatly sum up the experience of this course. Key to the experiment was that it was problem-based, rooted in the problem of the students starting their own career while still working toward their degree. To do this, we had to activate the students' prior knowledge, challenging them to use all of their skills to write effectively. In teaching the new skills, the professor demonstrated how he wrote and critiqued, and the students had opportunity to write for each other and critique this writing, in a safe, supportive environment. This application of skills began with short, simple articles and led to the final one; the critiques increased in complexity at the same rate. Finally, all of the work of the course was integrated in the final journal article. The goal of the class had by this time become a personal goal of each of the students.

The class will be offered by the same professor in essentially the same way this year. Changes will include a more stable conferencing system and more tutorial assistance with computing. Also, although feedback from the professional community about the journal was extremely positive, this came after the semester had ended, and we are hoping to have an external reviewer to give the students feedback while the class is still in session.

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Design and Implementation of a LoD[1] System for Multimedia-Supported Learning for Medical Students

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Abstract: New technologies, like Multimedia Database Management Systems (MMDBMS), enable new possibilities for education. In the OMODIS-LoD project, we have developed a Lecture-on-Demand (LoD) prototype that is based on the Object-Oriented Database System ObjectStore and a new data model for multimedia data, called TOOMM. The prototype manages teaching material that has been originally used for CD-ROM based distance education of medical students at the University of Oslo. This paper describes the original CD-ROM based legacy application and the LoD system, as well as the experiences with the process of extracting teaching material from the legacy application and converting and integrating it into the LoD system.

1. Introduction and Motivation

There is a strong tradition to use new technologies for education. The development of multimedia technologies has enabled efforts in distance learning, both synchronous and asynchronous. Synchronous systems may be playout only, for example, a scheduled multicast of a recorded lesson, or live, with a student audience and a lecturer who manually controls presentation of slides and multimedia data. An example of a live synchronous system is the electronic classroom system[2] (Plagemann et al. 1999) that has been used between the University of Oslo and the Center for Technology at Kjeller for live distance teaching in graduate courses since 1994.

Asynchronous systems are implicitly Lecture on Demand (LoD) systems, where multimedia data are used for unscheduled playback (on demand). They tend to be interactive in the sense that the student controls the presentation sequence of different data elements, including following hypertext links and using "VCR-like" controls for play-rewind-reverse-forward. Asynchronous systems may differ as to how they handle questions and feedback, whether it is supported by the system or done offline (e.g., by email). Current asynchronous systems can be CD-ROM based or media server based. In a CD-ROM based system, (e.g., the Computer-Supported Learning Project[3]), each student has his own copy of the read-only CD, so questions and answers must be handled offline through email or other mechanisms. An example of a media server based system that does not provide feedback mechanisms is the Cornell project (Mukhanpodhyay et al. 1999). Our project investigates moving from the static data of a CD-ROM to dynamic data of a Multimedia Database Management System

[1] This work has been funded by the Norwegian Research Council in the Distributed IT Systems (DITS) program.
[2] See "Lærer'n på TV" ComputerWorld Norge 21B, 10 Jun 1994, pp. 6-7. (Norwegian).
[3] See Computer-Supported Learning (Datastøttet Læring) Project, The National Hospital of Norway Library for Medicine and Health. Internet: http://www.ub.uio.no/umed/prdl/progr am.htm#Egenprodusert (Norwegian).

(MMDBMS), where content and questions are captured interactively, stored and updated online, and presented on demand. Additional reasons for the use of an online MMDBMS instead of CD-ROMs are data reuse as well as easy update and adaptation of learning material.

The OMODIS-LoD Project[1] is working on a MMDBMS-based LoD prototype. The prototype is being done in the context of education for medical students on practical medical procedures[2]. We have conducted a requirements elicitation (Ecklund et al. 2001) for this context that also included more general telemedicine[3] and other distance learning requirements. We found requirements for five functional areas: Element Production, Lecture Production, Question, View, and Core (select, setup environment, play). The Question functionality includes Ask Question, Answer Question, Notify (the teacher of new questions, the student of a new answer) and View (Question or Answer). Questions and Answers are themselves required to be supported as general multimedia data. The scope of interaction required by these applications (interactions such as interactive questions and answers, mentoring, and consultation) is best supported by an MMDBMS. We report our experiences with our first MMDBMS-based LoD prototype supporting learning of practical medical procedures.

2. The Legacy Learning System

The Multimedia-Supported Learning of Practical Procedures Project at the Medical Faculty of the University of Oslo developed, in cooperation with two university hospitals (National Hospital of Norway and Ullevål University Hospital) a CD-based set of teaching materials. The long-term project goal is "to capture actual procedures (e.g., surgery or diagnostic procedures) in the hospital and produce interactive multimedia lessons, delivered over the internet, that enable medical students to reinforce their learning of medical procedures" (Ecklund et al. 2001). The CD-based system was the first step in achieving this goal. This legacy system will be replaced with a new interactive multimedia database system based on our prototype.

In the legacy system, each lesson covers one procedure, such as lumbar puncture, arterial blood sampling, pleural drainage, venous cannulation etc. Each procedure may contain one or more captured actual procedure video/audio sequences which are stored in RPZA-coded QuickTime Movie[4] format. In addition to the captured video/audio clips, text, sound, pictures and animations are also used to illustrate each procedure.

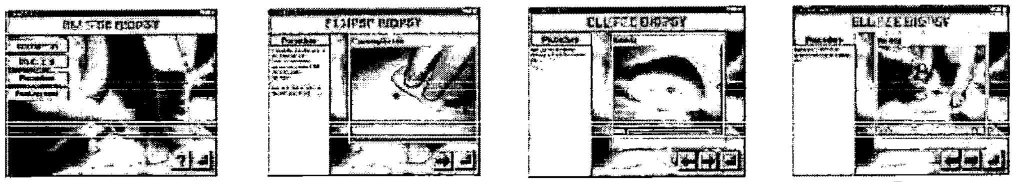
For the legacy system, Macromedia Authorware[5] was used to create an executable presentation program based on the above data materials. The executable integrates simple media data types such as text and images, and captured QuickTime movies are stored in separate files on the CD. At presentation time, the executable runs an external QuickTime player, which loads movie files and presents them in a specified area on the user's screen. Macromedia provides built-in mechanisms that work together with the QuickTime Player to support synchronized playback. The executable enables users to navigate the lesson in a stepwise way by providing users with *Next*, *Previous*, and *Return* button operations. Within each step, the executable recognizes the timing and spatial relationships among different media data associated with this step, and presents them in a synchronized way.

In the legacy system, each lesson is stored on a separate CD-ROM. A lesson includes the final executable and all associated movie files. The following section describes the Ellipse Biopsy lesson as presented by the legacy system.

An Example Demonstration

[1] See The OMODIS Project, UniK-Center for Technology at Kjeller, SINTEF, University of Oslo. Internet: http://www.unik.no/~plageman/ omodis.html
[2] See Multimedia-Supported Learning of Practical Procedures Project, University of Oslo Medical School. Internet: http://www.uio.no/~stenl/ sluttrapp-p10.html (Norwegian).
[3] For example, see The National Centre Of Telemedicine, The Regional Hospital of Tromsø. Internet: http://www.telemed.rito.no
[4] See QuickTime home page, Apple Computer Inc., Internet: http://www.apple.com/quicktime/
[5] See Macromedia Authorware, Macromedia Inc., Internet: http://www.macromedia.com/software/ authorware/

When the executable, Ellipse_Biopsy, is started, it brings up the main window shown in (Figure 1-A). The user can select among the option buttons: *Introduction*, *Equipment*, *Procedure* and *Post-op care*, to view different subtopics.



A B C D

Figure 1: Ellipse Biopsy: An interactive lecture session

Suppose the user now clicks the *Procedure* button. The initial *Procedure* window is displayed as shown in (Figure 1-B). The window consists of a text area and an image and displays them simultaneously. The text serves to be a description or literal explanation of the image. The *Next* button (in right arrow shape) enables the user to go a step further into this section, while the *Return* button (in return key shape) will bring the user back to the main window.

Suppose the user presses the *Next* button now. The next window will come up with a text area and a movie panel shown in (Figure 1-C). The movie panel is ready for play back. The first frame of the video is initially displayed. The user clicks the *Play* button at the left-bottom corner of the movie panel to start playback. (Figure 1-D) is a snapshot of movie playback. An audio track explaining the video contents is played out in synchronization with the video. The *Step Forward* and *Step Backward* buttons at the right-bottom corner of the video panel allow the user to step through the video, if desired.

At anytime during the presentation, the user is allowed to return to the main window shown in Figure 1-A by pressing the *Return* button.

System Evaluation

The CD-based system did not meet the medical project goal of support for interactive questions and answers, online update of learning materials, and network-based or internet-based access to learning materials. Distribution of CDs and ensuring that students have the most recent version of learning materials was another undesirable side effect of the CD-based system. Pedagogically, the user-interface of the CD-based system was deemed to be sound. Hence, we have chosen to retain the look and feel of the legacy system interface.

The second-generation learning system, utilizing a multimedia database, enables support for interactive questions and answers, online update of learning materials, and flexible and consistent distribution of learning materials. Also the MMDBMS and its multimedia data model are extensible, allowing easy development of new user-visible features and services. We describe the multimedia database prototype in the following sections.

3. The LoD System

In this section, we take a closer look at how our LoD system is constructed. We start with a presentation of the overall architecture, then give in more detail a description of the two basic components in the architecture, the data model TOOMM and the database management system ObjectStore.

Overall Architecture

Figure 2 shows the general architecture of the LoD system. The architecture is based on a client-server model. The application on the client side interacts with users via a graphic user interface (GUI), interpreting user inputs, retrieving multimedia data from the server if necessary, and presenting it to the user in a synchronized way. The client might also enable user to use flexible multimedia data queries, e.g., retrieving a particular video clip of a particular lecture. On the server side, a multimedia database management system (MMDBMS) is responsible for the management of all the multimedia data pertaining to the lecture, such as storing lecture data to or retrieving it from the database. The MMDBMS consists of a data model and a database management system (DBMS). The data model serves to facilitate the access to the multimedia data objects managed by the underlying database management system.

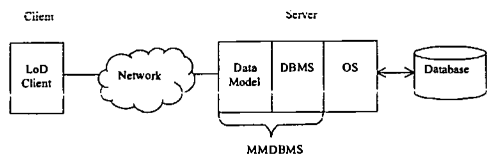


Figure 2: Overall architecture of our LoD system

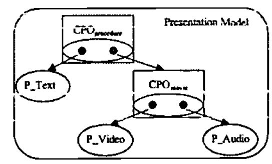


Figure 3: The Procedure CPO graph

In our first prototype LoD system, we have used commercial off-the-shelf technology largely. On the server side, we use ObjectStore (Lamb et al. 1991) as the DBS, while on the client side, we use Java applet to handle both the interactions with the user and with the server. We have also designed a new data model called TOOMM (Temporal Object-Oriented MultiMedia data model) (Goebel et al. 1999).

The TOOMM Data Model

TOOMM (Goebel et al. 1999) is a novel data model that integrates temporal concepts into an object-oriented multimedia data model. The three main elements of TOOMM are *logical data model*, *presentation model* and *play time*. Objects containing multimedia data are instances of object types from the logical data model. Objects instantiated from the presentation model specify how multimedia data should be presented. The play time places *logical data units* (LDUs), such as video frames or audio samples, into a temporal structure for multimedia presentations.

The logical data model differentiates between three main categories of object types: (1) play time dependent multimedia data types (PTD_MMDTs), (2) play time independent multimedia data types (PTI_MMDTs), and (3) components of PTD_MMDTs. The presentation model differentiates between two object types: APO (atomic presentation object) types and CPO (composite presentation object) types.

The OODBS: ObjectStore

ObjectStore is an object-oriented database management system (Lamb et al. 1991). It allows users to persistently store data, access data in the same format in which it exists in the application, and create and modify objects instead of tables, columns, rows, and tuples by using the ObjectStore C++, Java or ActiveX interfaces. In our LoD prototype, TOOMM data are stored and managed on the ObjectStore server machine. Multiple Java applets run on client systems and use the TOOMM model when retrieving and presenting multimedia presentations to an end user. Clients communicate with the server via the ObjectStore Java Interface (i.e., a set of Java classes and interfaces) for retrieving data and presenting data locally.

4. Conversion and Integration of Learning Material

In this section, we introduce the approach how we obtain from the original learning materials the data suitable for TOOMM and how we incorporate them into our LoD system.

Conversion of the Learning Material

The first step in populating the database is to extract the needed data from the medical learning material and store it as logical data objects in ObjectStore databases. By examining the original presentations created with Macromedia, we observed that the PTI_MMDT type data, such as texts, images or graphics, are small in size, and are therefore able to be copied either manually (for text) or by screen-shots (for images and graphics).

The movie data cannot be employed directly by the TOOMM data model, because both the Video and Audio objects implemented in TOOMM must be decomposed into LDU components Frame and Sample. Therefore, it is necessary to extract individual video frames and audio samples from the movie. We implemented a small extraction tool to recognize QuickTime RPZA format, and extract and convert each frame to either JPEG or GIF representation, which are codecs supported by Java. For our implementation, we use the JPEG codec. We did not extract individual audio samples because Java does not support fragmented audio playback. Hence, we extended the TOOMM Audio class to enable the playback of the audio clip as a whole.

Creating a Presentation

After the basic multimedia data elements were extracted from the medical data source and loaded into the ObjectStore database, we created our own LoD presentations using the extracted data and modeled it with the TOOMM data model. This phase includes: (1) creating a CPO graph, (2) defining temporal and spatial relationships, and (3) running the presentation as a Java applet.

Creating a CPO Graph : A large presentation usually can be partitioned into APOs and smaller CPOs which in turn might recursively contain other APOs and CPOs. In an example session of the interactive medical lesson shown in (Figure 1-A), when the user presses the *Procedure* button in the main window, a new interface is brought up where some text and a movie panel are displayed, as shown in (Figure 1-B). In turn, when the *Play* button under the movie panel is pressed, the movie which contains a video clip and an audio clip will be played in place, as shown in (Figure 1-C and Figure 1-D). It is natural to group all the presentation objects which are displayed in one interface (a window, for example) into one CPO. Therefore, the Procedure CPO object in this example can be regarded as being logically composed of a Text APO object and a Movie CPO object, and the Movie CPO object is further composed of a Video APO object and an Audio APO object. We can then create a CPO graph rooted from the Procedure CPO object as shown in (Figure 3).

Defining Temporal and Spatial Relationships: After the above CPO graph has been configured, part of the timing relationships between CPOs and their component APOs or sub-CPOs can be determined. For instance, in (Figure 3), Object P_Text will be displayed the same time as the $CPO_{procedure}$ is activated (i.e., the *Procedure* button is pressed). However, we cannot calculate the play time of the CPO_{movie} until the user presses the *Play* button in the movie panel. Therefore, the presentation must support a dynamic global start time setting for APOs and CPOs. Spatial relationships such as the position of the movie panel within the whole presentation region will also be determined in this stage of data construction.

Running the Presentation as a Java Applet: The final presentation is carried out in a Java applet running on the client system. The applet runs two threads concurrently. One thread is responsible for retrieving TOOMM objects from the ObjectStore server. The other thread captures user input and renders the retrieved multimedia data onto the GUI according to the specifications of their temporal and spatial constraints.

5. Experience and Lessons Learned

The current prototype of the Medical LoD system has been proved to be able to enable the stepwise interactive presentation to the end users. During the project we learned several significant lessons. First, data extraction and data loading is a time-consuming process and must be carefully planned. Second, selection of client software and server software is critical. We have two issues with client and server software.

1) There are restrictions on which Java-supplied classes can be made persistent, in particular Image and ImageIcon classes that we use cannot be persistent. An Image or ImageIcon object must be obtained for each frame before the frame can be displayed on the GUI, but the creation of Image or ImageIcon object can be very

time-consuming. An obvious solution is to create these Image or ImageIcon objects in advance and store them into ObjectStore for faster retrieval later by the presentation. However, the fact that Image/ImageIcon classes cannot be made persistent has made us to seek other non-efficient workarounds.

2) The Java image drawing process is a major bottleneck. An individual image drawing would require a delay of about 100ms in a Sun Ultra 10 Station with 128M memory, much longer than the acceptable frame duration 33~40ms. Image strip and multithread image loading techniques have been tried to solve this problem, but they have not been entirely effective.

Our current work is concerned with performance improvements of the LoD prototype. In the long term, we aim to support user needs and requirements that are stated as Quality-of-Services specifications in the entire LoD-system.

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Scouting Internet Resources for Teachers Using Technology

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Abstract: For teachers using Internet resources, weeding through a morass of Web sites, separating relevant from irrelevant, and ultimately locating useful resources that they can integrate in their instruction were such a daunting and time-consuming task. The need to minimize frivolous tasks in resource seeking and the demand for immediate access to relevant instructional resources gave rise to a new venture entitled "eThemes" - the Internet resource scouting service. To start with, three graduate assistants with library and education backgrounds were hired to staff the scout team. In addition, a database application was developed for managing and distributing Internet resources requested by teachers. Both the scout team and the database were perceived invaluable to teachers for saving their time and effort in finding appropriate Internet resources that can be quickly integrated in their instruction.

Introduction

The Panel on Educational Technology of the President's Committee of Advisors on Science and Technology (1997) reported "the real promise of technology in education lies in its potential to facilitate fundamental, qualitative changes in the nature of teaching and learning" (p. 13). Studies (Becker & Ravitz, 1999; Sandholtz, Ringstaff & Dwyer, 1997; Wilson, Teslow, Cyr, & Hamilton, 1994) affirmed that computer and Internet uses have positive impacts on teachers' pedagogical practices. Among these impacts is the shift of designing instructional systems from teaching to learning and from instructional objectives to facilitative environments. This also reflects the willingness of teachers to relinquish their authority in dictating the learning process and content in favor of giving students greater choice in learning tasks and resources.

To help Missouri teachers use technology to enhance teaching and learning, the School of Information Science and Learning Technologies (SISLT) at University of Missouri - Columbia began a project entitled "eThemes" (http://emints.more.net/ethemes/) in 1999. The goal of this project has been to support Missouri teachers in integrating valuable Internet resources in their instruction to create an active learning environment. This paper traces the background of the project and explores issues related to locating Internet resources that need to be addressed. The project is presented as a solution to explicate how these issues can be resolved. Project results are discussed while further improvements are proposed.

Background

To improve student performance as measured by the Missouri Assessment Program (MAP), teachers are learning new and different teaching and learning strategies with the addition of technology in their classrooms. One of the most successful state initiatives promoting this changes has been the MINTs (Multimedia Interactive Networked Technologies) project, which began with 13 teachers in six St. Louis schools in 1997. The MINTs project was designed to transform the teaching styles and techniques of teachers in an effort to improve student performance and enhance life skills preparation through the infusion of technology. By placing state-of-the-art technology in the hands of teachers and students with full technical support and training and by eliminating the technology barriers traditionally experienced by schools, this project has encouraged a new way of instruction – a way that engages students in their learning by making resources available in a learning environment that fosters cooperation, collaboration, problem solving and higher order thinking skills. The results of this project were so successful that it prompted the Missouri Commissioner of Education to launch a statewide initiative to change the way Missouri is educating its K-12 students. This new initiative is the enhancing Missouri's Instructional Networked Teaching Strategies (eMINTS) Project. The eMINTS project has spread across the state to include188 teachers in 88 school districts throughout Missouri.

Issues

After placing technology in eMINTS teachers' hands, a logical next step was for those teachers to integrate Internet resources in their instruction. However, providing teachers with the infrastructure for tapping into Internet resources has not proven to be a panacea. While teachers may be aware of the richness of content and resources on the Internet for teaching and learning, they are often hindered by lack of time and possibly the skills needed to locate these resources. In other words, teachers may know what resources they want but may have difficulty in finding them. Several issues contribute to this impediment.

First, the Internet is like a school library, only much more extensive. Internet resources are similar to all books in the library but not shelved and sorted in a familiar way. Accessing Internet resources becomes much more difficult because numerous Internet search engines utilize different cataloging and indexing systems. Each has its own underlying algorithm and requires a different searching technique. Without mastering such techniques, the user often gets unexpected or inconsistent searching results. This is why use of effective searching techniques is so important. Unfortunately, many teachers have not been trained in Internet searching. As a result, searching for Internet resources can be a frustrating task.

Second, the growth of Internet resources continues at a speed that no one can image. Searching for a resource can be like looking for a needle in a haystack. For example, a keyword search of "Missouri History" on the Yahoo site returned 19 matched categories and 204 matched sites. These numbers will significantly increase when this article goes to the print. While search engines are helpful, none is perfect. Users still have to sift through numerous search results to locate what they want. It can be a time-consuming task that most teachers are too busy to carry out.

Third, the hypermedia nature of the Internet keeps the location of Internet resources in flux. As authors and servers of Internet resources move, the links to these resources often become disconnected. Broken links become a dreary issue for many users. In fact, according to a Web user survey conducted by the Georgia Institute of Technology (1998), Web users ranked broken links as the second most frequently cited problem on the Web. This is particularly problematic for teachers who rely on Internet resources for instruction. Usually, they are not informed about the problem of broken links until they need to use these links. Instructional quality can suffer when students are struggling to figure out what is wrong. Even though teachers know this may be a problem, , they do not necessarily have the time or energy to fix these broken links. Therefore, administering Internet resources can be a laborious task for teachers.

Fourth, the process of finding and maintaining Internet resources is often conducted by individual teachers. Those teachers who identify valuable resources may not know other teachers who may benefit from these resources or how to share the resources they have found. Consequently, teachers' efforts are often duplicated in locating common Internet resources.

The Solution : Internet Resource Scouting Service

For teachers using Internet resources, sifting through a morass of Web sites, separating relevant from irrelevant, and ultimately locating useful resources that can be integrated in their instruction can be a daunting and time-consuming task. The need to minimize frivolous tasks in resource seeking and the demand for immediate access to relevant instructional resources has given rise to a new venture - the Internet resource scouting service. This service for eMINTS teachers began in May 2000 when three SISLT graduate assistants with library and education backgrounds were hired to staff the service team. In addition, a database application entitled "eThemes" was developed by SISLT for managing and distributing Internet resources requested by teachers.

eThemes service

Figure 1 depicts the fundamental process flow of using eThemes to create and manage Internet resources. The process starts with a request by an eMINTS teacher. Once the service team receives a request, a resource scout is assigned to search Web sites that match the criteria of the request. Then, a resource record that contains the information of matched Internet resources is created and published in the eThemes database. Meanwhile, an e-mail notification is sent to the requester who then uses the resource in his/her instruction. Also, the requester can provide feedback for the resource scout to revise the resource. Once a resource is published, other teachers can use the database and search for archived resources that can be used in their instruction.

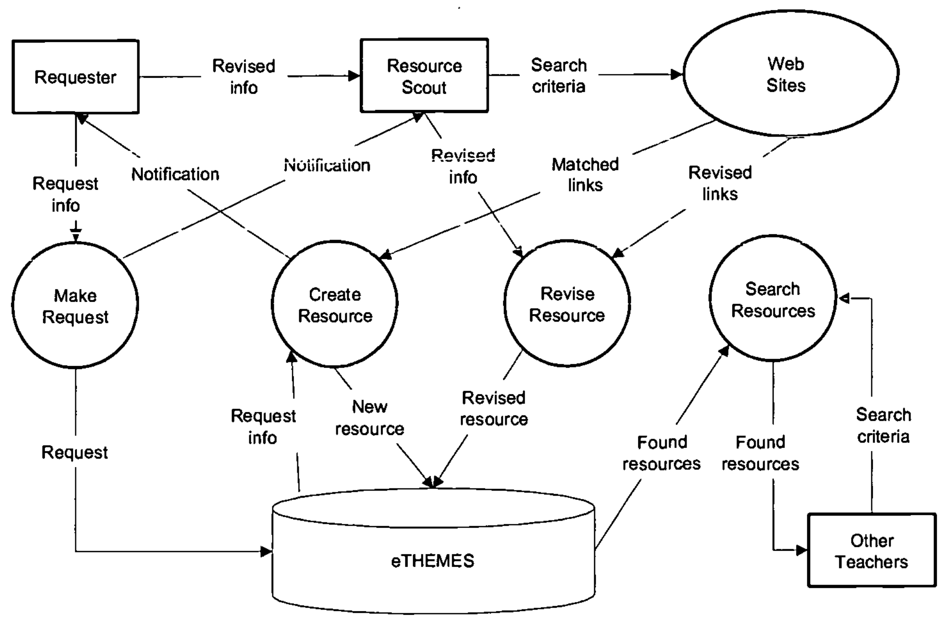

Figure 1: Process flow of the eThemes service

eThemes database

eThemes is a Web-based database system that helps the service team to fill requests from teachers and provide them the needed functions to search and use Internet resources. It allows the service team to build a collection of Web sites with current, relevant content which are aligned with Missouri education standards. It also enables teachers to share their instructional resources using technology.

There are three primary modules in eThemes -- Request Fulfillment, Resource Search, and Resource Administration (see Figure 2 for the main menu). The Request Fulfillment module keeps track of the requests that eMINTS teachers make for resource scouting services. A request contains the information about the content and format of Web sites the requester wants. A resource is composed of a collection of resource links and associated information. A resource link contains the URL, title, and description of a Web site. The Resource Search module allows a teacher to use keywords, names, grade levels, and Missouri education standards to help teachers quickly find the resources they want. The search results can be sorted by their relevance to the search query or by alphabetical order. The Resource Administration module is the place where the service team manages its services. This module contains the functions for a scout to create and revise a resource based on a request. It tells which requests are new, which requests are assigned to whom, and which requests have been filled. In addition, it has a link validation utility that checks broken links on a regular basis with an automatic mechanism to inform the service team and the link users. Also, a monthly usage report is generated for the management to track the eThemes services.

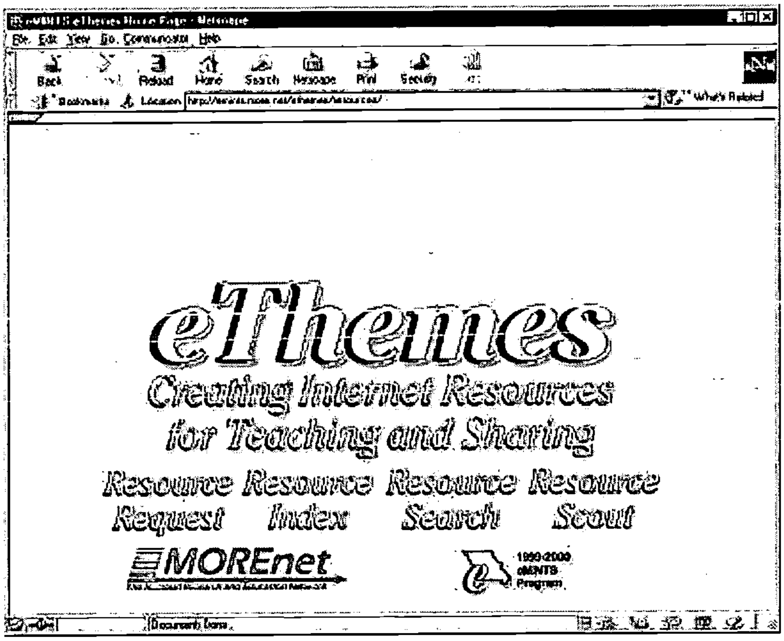

Figure 2: The main menu of eThemes

Results

The eThemes service was formally launched in May 2000. Between May and September 2000, more than 200 resources and 1500 resource links were created. To evaluate the effects of the eThemes service, nine focus group interviews with 27 participating eMINTS teachers were conducted by the Office of Social and Economic Data Analysis at University of Missouri in the summer of 2000.

Value of the eThemes service

The most common benefit stated during the focus group interviews was that the eThemes service was a time saver. One participant described searching for information on China, a search "that would have taken me days or weeks." Instead this teacher used eThemes and saved considerable time. Another participant commented that a teacher could spend hours trying to find graphics. While the evaluation team was present, this participant checked her e-mail to see if the eThemes had answered her request for a moving wagon graphic. It was there and she was delighted with the results.

Virtually all of the participants had positive things to say about the usefulness of the materials that they received. The participants reported receiving multiple sites that could be used in their lessons, and many reported receiving more materials than they expected. In one school teachers were able to construct a school-wide Millennium project using sites collected from an eThemes request. Most of the participants who have not yet used this service acknowledged that they would establish a connection with this service.

Value of the Resource Scouts

Central to the value of the eThemes service are the activities of the resource scouts. The scouts have been perceived as an important resource for teachers, especially as teachers develop new lessons using Internet resources. Many participants have commented on the friendliness and helpfulness of the scouts. Several participants have been impressed by the responsiveness of the scouts and have appreciated their efforts to provide useful and appropriate Internet resources for their students. By and large participants have been satisfied with the turn-around-time for resources. The following comment is typical: "Anytime I've requested anything from them,

Possible Areas for Improvement

First, the participants' opinions about access to the eThemes archive vary widely. Some participants thought that the archive is easy to understand and use. These participants went to the Search module first because chances are that whatever they were looking for had already been collected. Another participant commented that she had to stumble on to the archive to find a resource; and at least one participant said that she didn't know about the archive and had thus never accessed it.

Second, while most participants agreed that the subject matter of the received sites was appropriate for their students, some maintained that the sites need to be thoroughly researched for appropriate content. This includes materials that, while topically appropriate, may not be appropriate for an elementary school audience.

Third, several participants thought that access to lists of sites used by other teachers would be valuable. They have requested that "hot lists" i.e. lists of Internet resources used by individual teachers in their lessons be posted on the eThemes site. The participants had confidence in the sites that their fellow teachers used and recommended. Although eThemes was referred to as an excellent resource, the participants said they still had to figure out the links and decide what was appropriate. But if another teacher used the site, they felt more assured that the site was classroom ready.

Conclusion

As the Internet becomes a more pervasive instructional tool, a resource scouting service such as eThemes is creating a valuable niche for itself. The purpose of this service is to minimize teachers' non-value added efforts on searching resources while maximizing sharing among teachers in order to free them to concentrate on what they do best - instructional design and teaching. The eThemes project is an ongoing effort. While we strive to perfect the technical aspects of eThemes, the experience of this project has affirmed our belief that "any technology design has to reflect its human value." The real benefits from technology cannot be achieved unless the "human touch" is in place beforehand. The most frequent and serious mistake made is to implement technology for the sake of technology and to neglect human components of the technology. A fair assessment of eThemes is that it is not merely about the quality of the resources relayed to the teachers. The quality of the interaction between the teachers and the scouts is more significant to the teachers. Indeed, eThemes appears to be about building relationships of credibility between the scouts and the teachers. Scouts have been and need to continue to be perceived as helpful and responsive. Thus, scouts may value the confirmation that *how* they serve is nearly as important as *what* they serve—in short, being "customer centered." This is true not only for eThemes but for any technology project.

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NEW STRAND OF MEDIA TECHNOLOGY IN ARCHITECTS' FORMING CURRICULUM AND CAREER

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Abstract: Architects devise the space that shapes our human life. The rise of Information Technology gives birth to the liaison of artistic architecture design and pioneering technology. Making state-of-art visualisation by means of varied environmental configurations, any humble design can attract wider attention from a variety of audiences. This research aims to establish new methods of space creation techniques that can be introduced into architects forming curriculum. The technology, such as virtual reality, remote sensor techniques, and photo/video manipulation skills will be investigated in the research. The research is also seeking the possibility to create a study opportunity for architecture discipline with particular reference in innovating proficient media technology of interests.

Introduction

Through the prevalence of computers and increase of IT (Information Technology) literacy in Taiwan, computer technology has been adopted as part of fundamental knowledge. Nonetheless, the IT education in this level does not intend to cultivate perfect genius of computer scientists in the future, but in a way that more confident and well-accessed to modern form of IT can become part of their future life. However, the concept of integration various media into each school curriculum is moving slow and has not yet growth to the stages of how to teach, what to teach, or why to teach. Enhancing the IT literacy is getting government's attention. However, the stagnant education revision system in this country makes the improvement hardly to take effect. Lack of expertise is another challenge to magnify more strength from teacher forming institutions where the application proficiency of IT is also considerably low. Meanwhile, education practice is conducted by fixed form of teacher-to-student one way instructional scheme which is entirely obstruct to IT's idea of free form of development. Through the increase of the information exchange and good wealth of information presentation formats (Mitchell, 1992), the multimedia is formed and the demand for highly efficient data exchange is intensive. On-line nature of architecture visualisation has indirectly transformed the conventional service-to-client relationship of conventional architectural design project that existed in the past (Morgan & Zampi, 1995). Instead, the realm for potential clients is indefinite and the style of transaction in architecture-related projects are getting out of fence of paper-based drafts and labouring documentations.

Procedures and Findings

In this research, the author first few phases focused on the examining those new technologies and constructing the relationship of the discussed media technologies in architecture related subjects. The goal during this stage was to enhance the students' proficiency in applying new for of media technology in resolving problem that comes in the real-life situation. The later phases will extend the concerns of applying more media technology in architect's professional and create opportunity for further collaboration between IT and Architecture expertise. The goal of later one was to create Architect's profession with significant reference to the media technology. The research also expected the creation of media technology was a result of architecture demand-driven technology and the technologies have become essential to architecture study, not a plus to the architecture design capability. For instances, to identify new demands of IT in architects' career; to devise new demands; to construct of media technology laboratory for architecture design; compose "optional course" for media technology in the strand of current architecture design; open joint degree for it and architecture with particular reference to media technology; a position of projects coordinator who will deal with the acquisition, surveying of tangible, architecture-related projects; course/modules lecturers for instructing and supervising projects for graduate students (Yanik & Hewett, 2000; Fisher, 2000).

To emerging Media Technology for Architecture Design Curriculum can be placed by the following technologies.

Virtual Reality: From earliest helmet-assisted viewing generation of virtual and environment-interactive sensation to the growing number of Internet •s VR technology of virtual models is a generic term for forming spatial sensation and visualization. VR can both accomplish non-existed environment and distant, rare places with high difficulty of reaching. VR technologies have efficiently evolved into acceptance in ordinary people with less knowledge in programming as that is pretty much required in computer scientists. More and more convenient toolkits not only make flying through space easier but also making space creation a simple job. Internet also allows models to be posted on-line to gain public attraction and improve the quality of appearance, speed of playing with models and maximal capacities of number of players/viewers.

Photo/Video Manipulation VR: While VR is gaining higher and higher acceptance of space modelling, another trend of space/object creation, or space/object re-creation, technique is on the move to attract the conventional VR users along the sinking price of photo/video capturing devices. Photo/Video VR manipulated technology is a visualization application by taking a snapshot of the targeting space or object or recording a video of desired space through walking around. Subsequent changes made in the process and fit into the devised model or reconstructed models can eventually make it appeals more realistic. Broad-band technology in data transmission is a major contributor to make it happen as video clip demands very high data transmission within invisible motion picture frame delay.

Remote Sensor techniques: Measuring the dimension of space always complies the problem of reconstruction. GIS(Geographical Information System) and GPS(Global Positioning System) assist to identify distance of interested space. Remote sensor technology can even help to "scan" the dimension of remote objects. Then the acquired digital data can be helped to rebuild the space/object and make changes to them if needed. Architects and archaeologists can even rely on this approach to even reduce the space forming process. With remote sensor skill by devices, any good examples of architectural masterpieces can be reconstructed, resized, re-orientated, re-located, re-layout and re-fabricated by all kind of varieties. VR technology is also supplemented by both Photo/Video manipulation technique and remote Sensor's co-ordinates mapping techniques to allow for a higher precision of desired conceptual or re-constructed models. New media technology gives rise to higher acceptance of deploying computer at home user end and speed up the springing of computer-generated conceptual environment. As the technology moves in fast speed, people can immerse sooner in the totally computer generated environment easily anywhere by connecting to the desired host place. Architects' then turn their profession in satisfying the cyberspace's architectural environment where the interaction is constructed in a virtual venue. The way of training up architect in this direction is taking shape since more and more tools are available for authoring and the Internet has become the most favoured showing ground for illustrative models and ideas for future style and way of life.

Suggestions

The idea of this article is to re-think the IT education under the higher education level by developing curriculum strategies that are closely associated with the students' proficiency in deploying IT as well as data exchange technology.

1. Te Research center of Media Technology with reference in Architecture discipline:
   The research was to establish a research center to deal with the increasing needs of media technology in architecture related subjects.
2. Architecture Design Curriculum:
   Near Term Plan:(1). Compose one media-based project modules;(2). These "new" projects are the option course for both graduate students and under-graduation students;
   Intermediate Plan: Compose Joint Degree for IT and Architecture for Graduate levels
   Long Term Plan: Compose Joint Degree for IT and Architecture for Under-graduate level.

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Self-regulated learning as a strategy for enhancing the effectiveness of adult online learning

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Abstract

Self-based leaning is recommended as an effective style for adult distance learning. Adults also conduct online learning mainly distantly and independently. It reveals therefore that self-based learning would be significant and helpful for adult online learning. When the market of online learning is growing rapidly with the facilitation of information and communication technologies, it is becoming significant to explore how adults can learn effectively and successfully via online to achieve the vision of establishing a learning society. Self-regulated learning (SRL) is self-based and has been researched popularly in the field of traditional Educational Psychology but less discussed in adult learning. The author utilizes the literature review linking to his practical experiences to examine issues such as the feasibility of SRL and how to enrich the literacy of SRL for effective adult online learning in this paper. Concrete strategies for conducting SRL are also raised to be recommendations.

SRL for effective adult online learning

Briefly, SRL means the extent of how a learner actively regulates his/her learning in the dimensions of metacognition, cognition, affection and behavior. The key concepts of SRL are focused on how a learner begins, changes and maintains the process of learning and on the learning transferring (Boekaerts, 1999; Dharmadasa and Gorrell, 1996; Gilliam, 1990). When conducting SRL, learner plays the main role in the process actively and independently rather than passively and dependently. Comparatively speaking, self-directed learning (SDL) instead of SRL has received more discussions in adult learning. SDL is defined that adults learn according to their personal conditions such as goal setting, reading speed, and accessible courses. Malcolm S. Knowles and Steven Brookfield are all representative researchers on adult SDL. Accordingly, there is some overlapping between SDL and SRL. As Areglado, Bradley and Lane (1996) argue, one of the meanings of SRL is learners self-directing to learning. It implies there is a closed relationship between SDL and SRL and both are self-based and flexible. However, there is potential difference between these two learning styles. Adult learners require more capabilities in regulating and managing their learning in SRL. Their cognition and metacognition and other self-skills are more demanding in SRL. For the subject, SRL has been introduced and utilized for younger school learners but SDL is mostly recommended for adult learners. In online learning environment, since multiple media are used and there are abundant and diverse databases in the Internet, adult learners need more skills to select feasible information by themselves. Therefore, more complex capabilities covering the domains of metacognition, cognition, affection and behavior on which SRL comparatively focuses are required.

Referring to the definition of SRL, we know that a successful self-regulated learner needs to control the process of learning possibly in the domains of his/her cognition, affection or behavior. For adults who are mature in physical and psychological conditions have a greater demand on autonomy for independent learning. Besides, self-based learning is especially suitable to part-time adult learners. It seems that adults would have more advantages to employ SRL in distance online learning. In the context of online learning, which has its own specific and particular characteristics, how adults conduct SRL to achieve a satisfactory learning effectiveness?

Becoming a successful self-regulated adult online learner

Adult learners have to learn how to make full use of learning resources carried and set up by electronic media on line. If the entering competences and prerequisites are not ready, adult learners may directly suffer negative effects such as anxiety to computer and lost in the abundant Internet data and information before get positive attainment. This is what Gary (1999) concerns that the Internet may result in alienation for learners. Martinez and Bunderson point out that learning skills such as complex-problem solving and self-managed learning are demanding and challenging to learners and recommend to develop constructs, adequately integrated with conative, affective, social and cognitive factors, to improve the instruction (Martinez and Bunderson, 2000). These ideas are similar to Zimmerman's arguments in SRL (Zimmerman, 1986, 1989, 1999).

Adult learner has to be the master in online learning environment. Oren, Nachmias, Mioduser, and Lahav (2000) also raise similar points. They suggest that personal interests, willingness to participate and motivation to interact with peers, teachers and other knowledge sources are all significant conditions for successful learning in the Web. As mentioned before, these personal factors are also foundation and crucial elements of SRL. It shows that for adult online learners, return to self-based learning would be significant and beneficial. For becoming a self-regulated adult online learner, the following potential strategies are formulated according to conditions for effective online learning and corresponding four domains of SRL ie cognition, affection, behavior and metacognition.

1. Domain 1: Cognition

1.1 Conditions for effective online learning

A. Understanding learning courses

B. Being able to filter data resources

C. Realizing his/her own advantages and disadvantages of learning conditions

1.2 Strategies for successful self-regulated adult online learner

A. Rating entering behaviors and prerequisite knowledge to be the reference framework for selecting online learning courses.

B. Improving the capabilities of independent judgement to clarify the significance priority of data.

C. Referring to standardized psychological measures and practical experiences to have more self-understanding

2. Domain 2: Affection

2.1 Conditions for effective adult online learning

A. Cultivating positive emotion to computer and other electronic facilities.

B. Developing strong motivation to continue online learning

C. Being independent and active even facing learning barriers such as suddenly losing typed documents

2.2 Strategies for successful self-regulated adult online learners

A. Recognizing electronic facilities as instruments and intending to learn how to use them successfully

B. Learning to apply self-motivation as rewards to reinforce self

C. Making learning peers and groups and having collaborative learning to obtain more social supports

3. Domain 3: Behavior

3.1 Conditions for effective adult online learning

A. Operating electronic facilities familiarly for learning purposes

B. Applying multiple updated techniques to conduct learning and have continuing learning

C. Resolving handy mechanic problems to clear out obstacles alone

3.2 Strategies for successful self-regulated adult online learners

A. Enriching fundamental literacy of information and communication from primary school

B. Preparing many practical and working know-how manus and continuing to upgrade

C. Asking other people for help and sharing their operative skills to enrich his/her competency to resolve faced learning barriers

4. Domain 4: Metacognition

4.1 Conditions for effective adult online learning

A. Being able to evaluate the whole procedure of online learning and have self-correction and critical thinking
B. Being able to revise learning purposes according to the results of self-correction and self-feedback
C. Being able to arrange a helpful online learning environment by modifying advantageous and disadvantageous conditions

4.2 Strategies for successful self-regulated adult online learners

A. Learning skills for self-evaluation and self-correction from the beginning to the end of online learning
B. Examining the gap between learning purposes and resources available continuingly and making feedback to adjust goal-setting
C. Managing a suitable online learning environment and controlling the potential influential factors to meet personal learning needs

Further researches needed

The new millionaire is a new era of distance learning and online learning would be playing a critical role in distance learning. Adults are the majority population of a society. When information and communication technologies have brought abundant facilities available for creating online learning resources, it is vital to explore how to enhance the effectiveness of adult distance online learning. Effective online learning depends on many conditions encompassing hardware and software factors. Self-based learning is a principal style in distance learning as well as in online learning. A comparatively new concept in the field of adult learning, SRL, is discussed insufficiently. SRL is not a panacea but is beneficial to adult online learning. The application of SRL in adult online learning calls for further researches.

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ROBOTS OF ARCHITECTURAL SKELETON

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Abstract: This research aims to explore the digital knowledge and human space creation. A large number of papers have examined and investigated how to apply Computer-Assisted Design technique to implement pre-constructional, in-construction and post-construction visualization and simulation. Digital Architecture in this context takes another perspective to re-think how to improve the digital environment in this early stage has a significant impact upon how the expertise of future architecture-related practitioners is formed. This research will in turn investigate how the arrival of Digital Architecture Era affects future ways of living and people's relationship with environment and building construction materials and technology. In addition, how the future architects curriculum react to this trends that new forms of technology applications become essentials to the modern livings will also be examined by means of studying how to best achieve this idea.

Introduction

This research aims to explore the joint strength of modern electronic and IT (Information Technology) applications in devising new forms of prospect architecture and housing prototypes. A wide range of applications can be found in IA (Information Applications) that comprises of computer-like consumer products that people reply on closely for living (Aish, 1992; Mark, 1992). However, they are still treated separately from buildings and not yet brought into the building skeleton itself. The research will investigate how Digital Architecture can make use of modern IA/IT technology in establishing mutually affected relationship of Architecture and IA/IT from building's designing phase to post-construction catering phase. This new type of future architecture must have a virtually identical capability of sensation processing as much as of human beings (Hendrics & Neuckermans, 1999). In other words, a robot of architecture that can communicate with people, deal with information received and give proper response to it. This architecture will also have a higher ability to self-regulate ventilation, energy circulation and also change its physical conditions upon environmental changes.

Procedures and Findings

This research breaks down the whole course curriculum into components and in each component, a study was to be examined to how best adopt new strand of digital technology in various fields and equip student with essential IT deployment capabilities.

In each group, the research examined the feature of the course and inaugurates digital technology in extending architect's capability in new Information Technology age. Architect in this age has diverse applications and the jobs for architects are not to be confined into constructing houses only. Technology enables architects with thorough IT expertise getting in touch more advance, technology related career, such as film animation for virtual environment, taking part in cross professional projects, etc. In the above strands, architect can also be specialized in specific curriculum.

1. Idea Inspiration: For centuries, the architects also play a role in creating the ideal environment for Human beings, though is not always limited to. Architects in each generation have to break through the restriction of structural/material/technical shortcoming and improve human settlement by creating innovative space that people are looking fór. Devising space is an essential job that architect should perform and copying of space is infamous for architects in practice. The goal of Idea Inspiration strand is that student in this profession are always aware of in-depth technology that shape our life and its movement in the future. Computer or media assisted illustration and visualization, Internet-based information exchange and information acquisition are vital in this IT application.
2. Drafting: Most architects have received intensive training on how to best a good drafter that is a common and

an essential life in each generation of architect profession. Modern CAD technology has far penetrated into physical working environment and education ground. The goal that drives the research of this research in this strand is not simply to train student become even an advance drafter but an idea of adopting pattern formulation techniques.

3. Modelling: Elaborate models can always please prospect customers in gaining a higher perception of how architecture is dimensioned and layout. CAD tools for constructing three-dimensional models are getting common and supplying advance environmental setting and materials can give models a virtually realistic view. Modelling also has a significant meaning in reconstructing architecture that of structural or historical significance. *Virtual Reality* visualization is one of the pioneering technologies in constructing and navigating models in additional to CAD. The research of this Modelling strand will further examine how to add more interesting environmental setting, such as animated models, robotic models for architectures for simulation.

4. Statistics related Subjects: Architects must command a wide spectrum of information that is related to how a specific architect can be constructed and proper function. Internet allows for fast and efficient information gathering and exchanging. Courses in this strand are designed to encourage students to participate *on-line Web-based discussion forum* and join the various communities of Internet society and in fact a multi-laterals study. Internet and *broadband communication* infrastructure provide an ideal setting for obtaining and sharing information of interest.

5. Media and Presentation: New forms of Media authoring technology and home-site, customisable application can virtually create film-like presentation in a professional standard. In addition to drafting on desk, architects have to prepare works in an elaborate and customer-pleasing manner. Through advanced software and broadband technology, such as *Video on-demand* and *Video's teleconference*, posting publicly models and ideas can be a much easier job than ever.

6. Site and Environment Cognition: Site survey is essential to understanding of physical construction environment. Modern surveys can work through equipments that can help to obtain environmental data, such as distance, dimensions, climate, botanical data, the nature of land, terrain, demographics, etc. *Remote communication* in Digital architecture research is to pose a window to construct the *virtual environment* based on gathered information and student can thus carry out study virtually at every place.

7. Engineering Courses: Complicated structures in physical engineering cases are best examples of teaching innovation in space arrangement and a demonstration of human desire of resolving engineering difficulties. Studying these structural examples or specific teachings materials on theory in Physics and Mechanics can be achieved through illustrative and interactive computer-generated models and animations. This strand can be incorporated with design /navigation /visualisation of models and virtual environment as well as historical studies.

8. Cross disciplines Studies: The future career of architect is not a single career for constructing houses. Cross discipline studies is of urgent priority can single architect professional are unable to resolve cross-functional problems. Future way of life is also highly IT dominated. The function of architecture is gaining complicated and also specialized. This strand of Digital Architecture is to stress the advantages the collaboration with other professionals.

Suggestions

The research explored each division's connectivity to digital application of architectural skeleton and hope to bring a close relation in future training of architect profession. Future architectures are mostly in uncertain forms. Through joint strength with IT, robotics and other professionals that come together, the digital architecture curriculum emphasis the future forms of buildings that possibly have to grow to unanticipated and unimaginable and re-think the current architect education approach that the explicit gap between fast changing technology is getting larger. Deploying IT and robotics human-interaction in architecture in this research was to allow architects immersed at the IT professions, making architect career be part of IT specialists and IT professionals be part of architect career.

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Enhancing Student Performance on State Mathematics Proficiency Tests: Using Multimedia Collaborative Web-based Lesson Plans and Practice Tests

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Abstract: This study will explore the use of multimedia and hypermedia via telecommunications to improve student performance in a critical area: that of mathematics competency for urban middle school students. The article describes research into the process of preparing sixth graders in urban school districts for the Ohio state math proficiency tests with Web-based lesson plans, as well as using Web-based practice tests to predict their performance on these tests. Results from this prototype will be used initially with other state math proficiency tests, and will ultimately be expanded to the additional proficiency test areas of science, citizenship, reading, and writing.

Introduction and Problem Statement

With rapid increases in the educational use of the Internet, more students are learning collaboratively and K-12 educators are sharing their instructional ideas on the Web globally (see, for example, the PEN-DOR project in Fullerton, Greenberg, McClure, Rasmussen, & Stewart, 1999). The Web can bridge the gaps between urban and rural schools as well as between wealthy and disadvantaged districts by providing common, equally accessible resources to all.

In December of 2000, the state of Ohio released preliminary report card scores for school systems for the 1999-2000 school year based on proficiency test scores, attendance and graduation rates. Urban school districts were particularly notable for their poor performance on these measures, with one of the largest problem areas being performance on the mathematics proficiency tests. This study will explore the use of multimedia and hypermedia via telecommunications to improve student performance in a critical area: that of mathematics competency for urban middle school students.

Research Questions

This study will investigate five questions. (1) Can sixth graders' math proficiency test scores be accurately predicted by the scores in Web-based practice tests? (2) Can free access to Web-based lesson plans and practice tests help university pre-service teachers to better understand and design math curricula which prepare students well for state proficiency tests? (3) Can free access to Web-based lesson plans and practice tests help current urban school teachers to prepare better math curricula which prepare students well for state proficiency tests? (4) Can free access to Web-based lesson plans and practice tests help parents/guardians to better understand and thus help their children prepare for proficiency tests? (5) Can free access to a common Website and a shared initiative to identify, screen, select, generate and share proficiency-aligned math lesson plans help build beneficial relationships between pre-service and in-service teachers and improve student performance?

The Study

Content is key in Web-based education. Design and development of math lesson plans and practice tests will focus on aligning with state education standards and sixth grade proficiency test mathematics learning outcomes. Approximately 30 sets of lesson plans and practice tests will be categorized into different math topics covered in the 4th and 5th grade levels. Series of math lesson plans and practice tests will be designed, developed, and collected by (1) enrolled College of Education graduate students who are currently working as math teachers; (2) a collaborating lead teacher among the representative educators from the urban school collaboration districts, and (3) other resources developed by other math experts.

Lesson plans will be freely accessible and/or downloadable by pre-service teachers, in-service teachers, students, parents, and interested associates. Access to practice tests will be reserved and will later be made available in accordance with the experiment schedule. All practice tests will be freely accessible by all participants at the end of the experiment. Hypermedia elements such as images, animation, sound, and digital video will be embedded into the lesson plans and practice tests as necessary. A CD-ROM with the collection of lesson plans and practice tests will be burned as requested by users.

All practice tests will be taken online. For practice tests in multiple-choice format, students will receive score reports online immediately after their submissions and the correct answer will be provided for any questions answered incorrectly. For practice tests in open-ended format, recommended sample answers with explanations will be provided to the students for self-evaluation after their submission. All materials and survey data, including information sent and received, will be hosted in a central server (see Wang, 2001).

All content, lesson plans, practice tests, and navigations will be extensively field-tested before Web page delivery. Team members, content creators, pre-service teachers, and urban class students will be invited for beta test and recommendation input. Other interested district educators, administrators, Web masters, and associates are also welcome to join. Based on significant feedback, revision will be conducted.

Sample subjects will be sixth graders in five urban school districts. Subjects will be asked to go over the Web-based lesson plans by following along with teachers in class. Follow-up Web-based practice tests will be administered immediately after each lesson plan is conducted. The proposed experiment schedule is approximately two times a week for fifteen weeks. Thereafter, subjects are welcome to review all lesson plans and/or practice tests at their convenience individually or supervised by teachers or parents/guardians.

Scores in the practice tests following the Web-based lesson plans will be used as the independent variable for research question #1 described above. A set of attitude surveys will be designed as well to measure the other four research questions.

All the experimental material delivery, survey, and data collection will be online. A regression model will be developed to determine the degree to which Web-based math practice tests can predict sixth graders' state math proficiency test gain scores. Other attitude survey data will be used to analyze research questions 2 to 5 addressed above.

Discussion

A positive regression equation is expected to develop for the final research findings. If so, the quantity and quality of the collection of lesson plans and practice tests will be expanded and enhanced. Further research can be conducted on the impact of aligned lesson plans with other grade levels. If the majority of math proficiency test scores for each grade can be predicted by the regression equation, the materials will be promoted for use in other urban and/or suburban school districts using multimedia collaborative Web-based lesson plans and practice tests in the other core proficiency areas of science, citizenship, reading, and writing.

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Communicative Collaboration: Four CSCL Students' Online Group Collaborative Learning Perceptions and Experiences

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Abstract: This paper reports a study exploring four Computer Supported Collaborative Learning (CSCL) 2000 class students' (from diverse ethnic backgrounds) perceptions of and experiences in knowledge construction and group collaboration. Communication and interpersonal relationships emerged as major areas of concern in this Naturalistic inquiry study. Findings indicated that individual and group successes are interconnected in the online collaborative learning environment. Group success lies upon successful negotiation and construction of shared knowledge among members of the group. However, many verbal and nonverbal communication cues are largely missing or limited in the highly technologically-reliant environment. Educators who are interested in designing online courses for students of diverse backgrounds should consider the social and cultural aspects of communication. Future studies should focus on exploring effective cross-cultural communication, challenges, successes, and strategies.

Introduction

Technological advances have allowed global communication. The Internet has created opportunities for widespread electronic delivery of news, information, and curriculum and has altered the way we communicate, share knowledge, deliver education, and conduct business. It provided the possibility to erase geographic and interpersonal boundaries among people of diverse backgrounds.

The Internet population has exploded globally from 3 million users in 1994 to 119 million users in 1998; Internet traffic is said to double every 100 days. (Joo, Jae-Eun, 1999) Driving this rapid growth is the Internet's ability to "bring close what is far away" (Holmes, 1997, p. 28) by enhancing communication, its promise of collaborative opportunities in an array of areas, and our need for connection and interaction. The strengths of communicating on the Internet derive from its accessibility, interconnectivity, immediacy, interactivity, mobility, and flexibility.

However, amidst the hype of new technology, human communication strategies often lag in their adoption of and adaptation to rapid technological advancements, much like any other species caught in a rapid alteration of its ecosystem. In order to understand how learners adapt themselves to the technological environment and what their needs and concerns are, an exploratory study regarding students' perceptions of and experiences in an online CSCL course was conducted.

This paper briefly describes the method, context, participants, and findings of the study. Findings suggest that educators who are interested in designing online courses for students of diverse backgrounds should take into account the social and cultural communication aspects of interaction. Future studies should focus on exploring effective cross-cultural communication, challenges, successes, and strategies.

The Study

Conducted within the constructivist paradigm, this research focused on four students' perceptions and experiences in a computer-supported collaborative learning class where a major aspect of the course design was based on constructivist theory. Naturalistic inquiry was used as the research strategy for this study. As described by Erlandson et al.(1993), naturalistic paradigm assumes that there are "multiple realities;" affirms the "mutual influence that researcher and respondents have on each other;" and assumes that "total generalization is never possible."

The context being studied was a CSCL 2000 course that was designed to assist learners in understanding, creating, and reflecting through engagement in six course modules. A variety of group projects were embedded where learners engaged in collaborative team building, learning, decision-making, problem-solving, knowledge construction, information inquiry, project construction and evaluation, and critical analysis. To accomplish project objectives, online socialization and communication were essential. Hence, course success, in the classic sense of learning accountability, resided on the students' success in collaboration.

This study focused on four female graduate students enrolled in a CSCL (Computer Supported Collaborative Learning) graduate course offered in 2000: a 47-year-old Caucasian, a 24-year-old Asian, a 32-year-old Mexican-American, and a 29-year-old Indian. Each individual participated in two interviews and e-mail communications with the researcher from mid-October to mid-December, 2000.

Findings

Study participants reported that misunderstandings often occurred from divergent expectations, worldviews, and values. Interpersonal relationships were perceived as superficial due to distrust in technological tools, concerns about privacy in cyberspace, and uncertainties of the collaborative process.

Participants reported that many communication methods available in face-to-face interactions were either missing or limited in the cyberspace. For example, during the synchronous chat, collaborators were unable to distinguish voice tones and emotions. In online communication, communicators were objectified as names or pictures rather than as humans, and it was difficult to drag a person aside and whisper in the midst of group chats. During video conferencing, limitations of the camera necessitated either long shots that lost details or close-ups that focused solely on the speaker, whereas in face-to-face meetings communicators control and select their focus.

Due to the nature of collaboration and the need to negotiate toward shared meanings, online collaborators reported spending a considerable amount of time attempting to understand, check, confirm, coordinate, negotiate, and discuss with group members. Participants reported that feelings of uncertainty, isolation, frustration, or anomie may occur because of technological failure, limitations in tools, interpersonal interaction, and group relationships.

Participants suggested that in order to make the group decision-making process easier and results more meaningful, individuals should clearly state their expectations, be cognizant of the various cultural and individual notions of time and responsibility, be sensitive to the perspectives and needs of others, and communicate frequently with group members to resolve conflicts.

Conclusions

The study concluded that group success lies upon achieving commonly shared ideas of success and commitment; a clear understanding of problems to be solved; mutual respect and understanding; flexibility; a positive attitude; and openness to new ideas and suggestions. In the online collaborative learning environment, learners were responsible for their own learning as well as achieving group goals. Constant negotiation was required to develop mutually shared meanings. Through communication and collaboration, individuals came to understand their reality as well the reality of others. Through constructive feedback, learners constructed, modified, and reconstructed their knowledge.

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Education Support Paradigm as Knowledge Management

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Education can be looked upon as a kind of knowledge management for students. Also, various education styles, which have been traditionally performed in the universities, schools and homes, support individual knowledge-handling phases from different situations independently. For example, we can categorize education styles into 4 classes globally, and observe these styles in our environment easily: 1) Knowledge transfer from text-books or existing materials, 2) Knowledge transfer with other students, 3) Knowledge transfer from teacher with one-way-based lecture, and 4) Knowledge transfer with tutor/adviser with synchronized interactions. Figure 1 illustrates the conceptual framework for these 4 education styles. The arrows show the interaction for student, who acquires knowledge newly, refines the acquired knowledge by itself, integrates the refined knowledge into the already systemized knowledge, and applies the integrated knowledge to various problems. Of course, these knowledge-handling processes can be supported successfully in each domain in Figure 1. In Figure 1, each domain is distinguished clearly by the constructive relationship between teacher (or tutor) and students: (x:y) represents the number of teacher ("0" or "1") for "x" and the number of students ("1" or "n" (n> 1)) for "y". For example, (1:n) means that the number of teacher is "1" and the number of students is "n". These education styles have possibly been implemented by means of the corresponding education support systems: (0:1)-style is by CAL (Computer Aided Learning), (0:n)-style is by CSCL (Computer Support Collaborative Learning), (1:n)-style is by CAI (Computer Aided Instruction), and (1:1)-style is by ITS (Intelligent Tutoring System).

The knowledge-handling process in the education can be corresponded analytically to phases in the knowledge management. SECI model which was initially proposed by I. Nonaka, et al.[1] makes it possible to explain a knowledge-based activity for human beings or productive organizations effectively and systemizes the intelligent activities from a viewpoint of knowledge management. SECI model is composed of 4 concept domains, as illustrated in Figure 2: Socialization, Externalization, Combination and Internalization. These 4 types of knowledge-handling activities are related in the spiral form. These 4 concept domains are defined through the interactive relationship among individuals, groups and organization, and also are interpretatively explained as a knowledge transformation/reproduction process: the socialization from implied intellect to implied intellect is to acquire the knowledge by self-activity; the externalization from implied intellect to formalized intellect is to refine the knowledge by group activity; the combination from formalized intellect to formalized intellect is to integrate the knowledge by organization activity; and the internalization from formalized intellect to implied intellect is to expand the knowledge by interrelated activity. Figure 3 illustrates the adaptation of education styles in Figure 1 in accordance with the framework of Figure 2. Of course, in our real world these 4 types of educational activities are not always performed practically in the spiral form, but are often organized independently in the learning environment or learning motivation for/of students. Additionally, the education environment, which can provide sufficiently such a spiral process among related educational activities, has been not yet implemented in our real world.

However, we can organize such a spiral process with mutually related educational activities as a typical architecture of education support system. Figure 4 illustrates various composite modules, derived from elements and their relationships in Figure 3, and also shows 4 types of education support systems, related organically to the composite modules. These composite modules are well-known ones which have been generally investigated in the current education support systems, except for the private learning field. The private learning field is a functional interface for student. The self-learning supports the socialization mechanism, the group learning covers the externalization mechanism, the lecture corresponds to the combination mechanism and the private lesson provides the internalization mechanism. Namely, these 4 types of educational activities are successfully achieved by architectural framework in Figure 4. Especially, the system integrated from ITS for the private lesson and CSCL for the group learning can contain all necessary educational modules, and takes a basic role of managing the learning process successfully. Thus, the unified framework of education support system can be organized on the basis of those of ITS and CSCL. Of course, individual composite modules must be controlled effectively with a view to attaining different learning situations independently.

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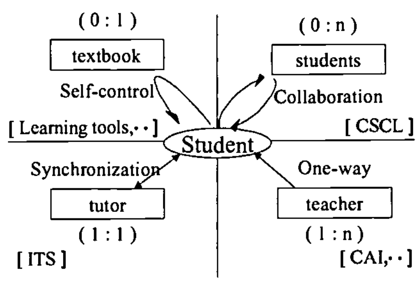

Figure1 Education Styles

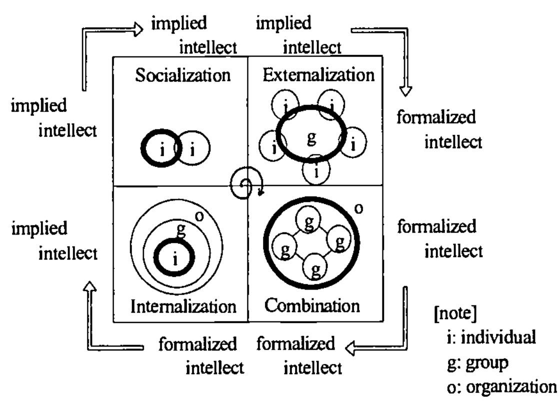

Figure2 Knowledge management process (by I.Nonaka)

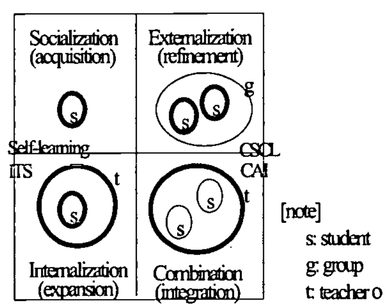

Figure3 Education support model

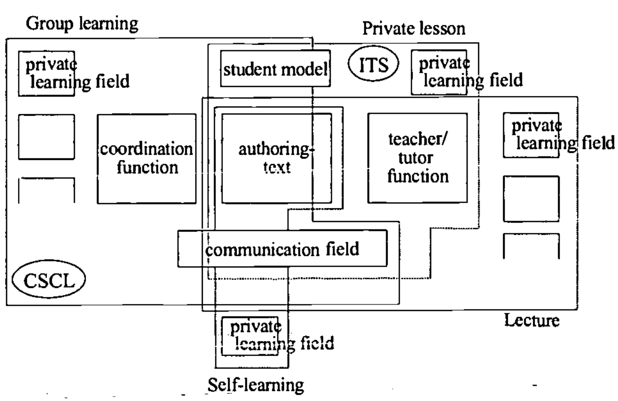

Figure4 Education support environment

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Evolution of a Student Model Building Program Designed to Assist Understanding of Biological Control Systems

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Abstract: Tertiary students in graduate and undergraduate medical and biomedical science courses have increasingly diverse backgrounds in prior academic achievements and culture. This presents problems for teachers assisting students to understand complex biological control systems. Our approach is to have students work in small groups to construct their own simple model of such a control system. This model then provides the basis for a structural framework for them to add further complexity without losing overall perspective, and allows exploration of deeper issues. Our interactive model-building program is suitable for many disciplines and student backgrounds, and provides a visual representation of a difficult concept, aiding in memory retention and providing a basis to ground further knowledge.. Audit trail data have been analyzed to identify and resolve areas of student difficulty, and extensive surveys and observations on students' use of the program over three years in several courses have been used to improve and test its effectiveness.

1. Introduction

This article reports on the development of a multimedia module (first described in Weaver et al, 1999) in which students are asked to construct and explore their own model of a complex biological control system and then use that model for further investigations. The long term continuous formative evaluation and adjustment has now led to the international distribution of this program on CD (Weaver et al, 2000).

Teaching Complex Control Processes in Biological and Medical Sciences

Our new approach is to introduce a qualitative conceptual framework for a model that is suitable for introducing complex control systems to students in biological and physical sciences, economics and engineering. In other words we facilitate the students' building of the 'big picture' of a complex system before going into the details. Such an approach has also been taken to bring teaching into alignment with practices in new curricula that increasingly rely on problem-based learning, problem-solving, student-centred learning, and self-paced learning.

Biological science was previously regarded as a soft learning option, but the growth in biological knowledge has meant that concepts have become increasingly difficult to understand as systems are elaborated through research. It is always a challenge to teach difficult concepts in an engaging manner. This project is a direct response to student and staff difficulties with the teaching of biological feedback control. This approach might equally well apply to fiscal modelling in economics or to a complex engineering principle.

2. Program Design and Evaluation

Pedagogical Issues:

We use the computer program effectively as an expert system that assists students' construction and testing of their model by providing construction tools, simple animations of their model operating, feedback screens indicating success or failure of their model and hints on possible changes they might make. Students may find deficiencies in their model, a need to adjust misconceptions, suggest modifications in the expert model for future implementations, or exhibit misunderstandings in common with other students. On completion of the model, students are given tasks with a strong element of reflection in their use of the tutorial as they try 'What if?' scenarios and elaborate on the knowledge into new areas.

Software Design Principles
The essential feature of the program is to present the information in a simple qualitative manner that could be used to give a global view of the control system. This conceptual framework can then be used by students to add specific details of the mechanisms or indeed to better understand a mathematical simulation of the system at a later time, such as would be appropriate for engineers. Teaching programs are always based on either explicit or implicit assumptions about learners and learning and the desired cognitive outcomes. Some issues we have tried to address are described in Weaver et al, 1999.

Model-Building as a Series of Cognitive Steps
Students are required to create and position components of an electrical (neural) circuit to create a control system that will allow a person to maintain the blood supply to the brain when they change posture. Students are then expected to select components consisting of receptors (signal detectors), input (afferent) neurones, processors (interneurones), and output (efferent) neurones

Our educational approach is to provide feedback at every stage, and this is in the form of a simple animation of the system working (ie. electrical impulses moving around the connected components of the system), followed by textual feedback. The textual feedback is always in the format of a positive statement (what is correct so far), followed by a statement about what is not yet correct, and a hint about what to consider next.

Evaluation:
The first version of this computer aided learning (CAL) program was tested by electronic audit trails and questionnaires. An example of the information obtained was the requirement to separate the model building exercises from the use of tools and symbols, leading to the introduction of 'practice' screens.

The program was finally evaluated with three groups of 2nd Year students at the University of Melbourne: Medical Students in a curriculum with emphasis on Problem-Based Learning, 2nd Year students in a new Biomedical Science Degree and 2nd Year Science Physiology students. Approaches to evaluation included questionnaires, computer audit trails, pre- and post-CAL tests and analysis of exam results for misconceptions. The program has been distributed nationally and internationally to about 12 Universities who have trialled the program with their students and have provided useful feedback incorporated into the final program.

Overall, the students enjoyed the 'hands-on' nature of the model-building exercise immensely, and gave the program a very positive rating. They judged their own understanding as having increased from 2.23 (Biomedical Science) and 2.35 (Science) to 3.72 and 3.54 respectively, after using the program. Pre- and Post-CAL tests showed a similar significant improvement in understanding (Wilcoxon Matched-Pairs Ranks Test, $p<0.005$ for whole test score)

3. Discussion

Our approach to help students to learn about control systems by fostering the development of phenomenological understanding has been successful. It has overcome the difficulties our students had previously with a simulation or mathematically oriented approach that we deliberately avoided in our introductory program. The goal was to establish a level of qualitative fundamental understanding that can be overlaid later, where appropriate, with quantitative transfer functions when these are known. Thus our approach is usable in a wide variety of contexts, including those in which mathematical constructs are inaccessible.

This program is also more linear in model construction than others we have developed for modelling epithelial cells and it is difficult to provide specific feedback if students continue to place multiple elements all over the screen without much forethought, since the number of permutations and combinations becomes enormous. Once students start the construction appropriately, their construction problems are largely resolved.

The emphasis is to encourage student hypothesis formulation and visual testing as the continuity between control system input and output components is represented graphically. This approach lends itself to the description of control systems for which real components can be identified (ie receptors, neurones, blood vessels) rather than systems in which the components are conceptual. The use of task sheets as thought extension exercises provides the opportunity for students to both test and generalize their new-found understanding, and has proved useful in provoking discussion among groups of students. This opportunity was exercised in most classes and students liked to test their ideas extensively with the tutors.

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Educational Administrator Technology Competencies and Training

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Abstract: The educational administrator is a key player in technology integration in the schools. Yet, many school administrators are not prepared to provide the leadership necessary to provide a vision of, plan for, or implement a technology integration plan. In order to prepare them for the challenges they will face in promoting technology integration, a model for administrator technology training, based on professionally articulated and agreed upon competencies, was developed and delivered to a cohort of 84 doctoral students at Arizona State University. The competencies were those developed by the Arizona Technology in Education Alliance (AzTEA). This paper describes the AzTEA competencies and the model training program designed to address the competencies.

A Model for Administrator Technology Training

School administrators play a critical role in the implementation of technology in pre-12 education. Yet many administrators do not possess the technological competencies requires to provide effective leadership in the implementation of technology. In fact, many do not possess the competencies and skills necessary to maximize the use of technology in their own work environment or improve their job performance.

Recognizing the training needs of school administrators with respect to technology, individual school districts, professional organizations, and institutions of higher education have offered a variety of learning opportunities. However, (in most cases) this training has not been based upon any established, agreed-upon technology competencies for school administrators. Such competencies have not yet been established at the national level in the United States as they have for teachers and students. (An initiative to develop national competencies is currently underway under the leadership of The Collaborative for Technology Standards for School Administrators. The Collaborative will involve numerous individuals and professional organizations, including the major administrator organizations and the Inter4national Society for Technology in Education (ISTE), in a year-long project to develop a set of "foundation" technology standards for all preK-12 administrators, as well as specific standards for building-level administrators, the superintendent, and other district-level administrators.)

A model for administrator technology training based on professionally articulated and agreed-upon competencies has been developed by faculty of the Division of Educational Leadership and Policy Studies at Arizona State University, the third largest university in the United States. The development of a competency-based program was made possible by the fact that the Arizona Technology in Education Alliance (AzTEA), an ISTE affiliate, had in 1998 developed and adopted a set of "Educational Administrator Technology Competencies." An abridgement is presented in the following section.

Educational Administrator Technology Competencies
The Educational Leader should be able to:

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1. demonstrate functional knowledge of terminology associated with computing, telecommunication and technology
2. identify and use the skills of planning and policy development as the relate to the infusion of technology into the educational environment, including, but not limited to:
   2.1 group process
   2.2 dealing with the rate and character of change
   2.3 community /constituency involvement
   2.4 policy, regulation and procedures as developmental and foundational activities
   2.5 research on effective schools, school improvement and student impact as related to technology
   2.6 authentic assessment as a tool about and using technology
3. identify and use the tools of technology.
4. operate a computer system and utilize software.
5. use a computer network independently. This includes the ability to:
   5.1 implement the policies, procedures, and practices of the district's Network Agreement
   5.2 navigate confidently throughout the network.
   5.3 Maintain security measures to both passwords and hardware.
   5.4 troubleshoot simple network problems
6. use basic troubleshooting skills and simple maintenance techniques as related to hardware and software.
7. utilize productivity/information tools for problem solving, data collection, information management, communications, and presentations.
8. model appropriate behaviors toward technology that includes equity, ethical (intellectual property/copyright), legal and human issues (including voice mail protocol) of computing and technology use as the relate to society.
9. enhance technology professional development including the ability to:
   9.1 network with peers
   9.2 attend technology conferences (in person and via distance technologies)
   9.3 consult with patrons and parents
   9.4 subscribe to technology print resources (journals, magazines, and newsletters)
   9.5 use on-line manuals and help features
10. demonstrate an understanding of staff support including training and maintenance
11. identify funding sources and costs involved in technology implementations such as:
    11.1maintenance costs including personnel and supplies
    11.2infrastructure construction, maintenance and operational fees
    11.3excess utilities, override bonds, E-rate, etc.

Technology Training

In the Spring of 1999 these competencies served as the core for the development of a course in technology for school administrators which was then taught to three classes of doctoral students (total enrollment 84), all enrolled in a newly designed "DELTA Doctoral Program." The majority of the students were practicing (both at the district and school level) school administrators. Four held administrative positions in higher education. The course was designed to be the first course in their program of studies. All classes were conducted off-campus: two in school district offices, one in an on-campus location owned by the university. The class included on-line learning experiences where most of the course readings, handouts, and collaborative learning took place on the Internet. Students participated in on-line discussion groups and collaborated on-line to complete a major project devoted to school technology planning. Pre-and post assessments of students' technology competencies were conducted. The results of the pre-assessment were used by the instructor to design learning experiences for students based on their competency level.

Developing Modular and Adaptable Courseware Using TeachML

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Abstract: In this paper we present the use of an XML grammar for two complementing projects - CHAMELEON and EIT. Areas of application are modular courseware documents and the collaborative authoring process of didactical units. A number of requirements for a suitable document format will be identified. After comparing existing solutions we introduce TeachML, our XML based document format for adaptable courseware documents and reusable didactical units. We describe how courseware documents can be adapted to the learner' s previous knowledge, aims and infrastructure. Then the process of creating different output documents from a TeachML source will be explained. We continue with considerations about the development process of learning material within a professional publishing environment, leading to the necessity of a virtual repository for storing courseware documents and media assets.

Introduction

In an information society ongoing learning and knowledge updating is crucial, especially in the rapidly growing field of new technologies. Access to online-information from everywhere at any time becomes more and more important, for both private and professional users.

However, it is quite difficult for specialists or educationists to create interactive, multimedia courseware documents because in most cases they lack the necessary skills in the fields of design or programming. Regarding this situation we initiated two projects: EIT (Enabling Informal Teamwork) [1] deals with the informal teamwork processes during the development of courseware documents. CHAMELEON (Cooperative Hypermedia Adaptive MultimEdia LEarning Objects) [2], [3] investigates document formats for modular and adaptable courseware documents. These projects aim at the development of media independent courseware documents for autonomous and tutor-supported learning.

For the description of documents consisting of reusable and adaptable didactical units and pre-structured document templates for frequent teaching situations we started to develop the XML grammar "TeachML" in 1998. The use of XML allows the dynamic generation of output documents in different formats and styles (e.g. XHTML - Extensible Hypertext Markup Language - or TeX) adapted to the user' s knowledge, preferences, aims and computing infrastructure.

Both projects imply a scenario focused on the development of didactical units by professionals who fulfil a certain role in this process (e.g. author, editor, expert of a certain subject, software developer, designer, ..). Therefore the main objective of EIT is to understand how the co-operation of these people can be supported by a web-enabled groupware system and which features are essential for a suitable electronic working environment. For that purpose we will design and implement the prototype of a virtual repository for didactical units and multimedia documents using insights and experiences acquired by converting different kinds of conventional learning material - like on- and offline-media, books and comple-men-tary material - to TeachML. The editor, tutor or teacher can select didactical units from the repository which fit his specific target group or learning situation best to create adapted output documents.

In the next chapter we will provide an introduction to the TeachML document format. Chapter three describes how we are approaching the challenges of the professional authoring process for didactical units in a team-oriented environment.

The TeachML Document Format for Courseware Documents

Analysis of existing courseware material for web-based learning systems reveals that there are primarily two common approaches. The first way is the use of HTML documents, to benefit from the advantages of an open standard (or more precisely a W3C recommendation) to achieve platform independency. Moreover there already exist many authoring tools and export filters for creating HTML documents and it is possible to integrate multimedia elements and interactive behavior using scripting languages, plug-ins, Java applets or SMIL (Synchronized Multimedia Integration Language). However, there are also a number of limitations: Structuring HTML documents whilst preserving adaptability and extensibility is quite difficult. Furthermore HTML is a web-format and not very well suited for creating different output documents – e.g. printed versions or multimedia presentations. Dynamic HTML is very useful for similar looking pages like product presentations, but not for courseware documents.
The second way to create courseware documents is the use of special authoring tools (e.g. Idea [4], Authorware [5]) or universal multimedia authoring tools (e.g. Director [6], Flash [7] or Toolbook [8]). With these tools it becomes easier to develop interactive and media-enriched courseware documents, but the main problem persists: Structuring the documents into reusable didactical units is not supported. Another disadvantage of these tools is the use of proprietary formats which leads to non-interoperable results, making reuse, adaptation and combination of existing courseware modules difficult to impossible.

Requirements for a Courseware Document Format

Considering the problems mentioned above some requirements the document format is to meet in order to structure courseware documents will be specified.

- System- and platform-independency must be guaranteed or the necessary tools and interfaces (APIs) have to be available for most platforms.
- The document format has to be extensible in order to integrate custom structures and future technologies.
- Mechanisms for associating the course-structures with all necessary metadata elements have to be provided.
- The format must not enforce the use of specific output formats or presentation platforms.

To meet these requirements we decided to use XML for the development of a document format for courseware documents. XML covers all of the points above: It is independent from a specific platform and operating system and provides the DOM (Document Object Model) as a platform- and programming language-independent API for the development of the necessary tools. XML grammars can be constructed in a way that they easily can be extended by new or alternate elements. There already exists a metadata scheme for teaching resources – IMS (former Instructional Management Systems, now IMS Global Learning Consortium, Inc.) [9] derived from the IEEE LOM (Learning Object Metadata) [10] metadata scheme. Though the IMS scheme itself is independent from a specific document format there is an XML binding that can be used easily.
In the next section we compare two existing markup languages for courseware documents. Afterwards the TeachML document format itself will be introduced. Finally we describe, how TeachML documents can be used to create modular and adaptable courseware documents.

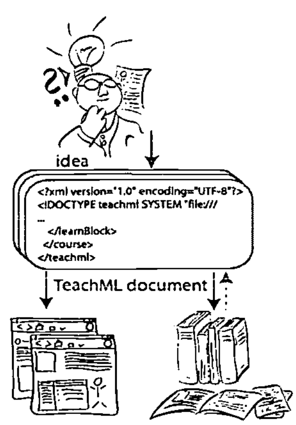

Figure 1: Achieving Media-Independency

Existing Markup Languages for Courseware Documents

In the context of the PaKMaS project (Passauer Knowledge Management System) [12] which deals with web-based adaptive hypermedia information systems the document format LMML (Learning Material Markup Language) [11] has been developed. LMML itself is divided into two parts: LMML-structure and LMML-content. The former can be used for structuring courseware content into several units which can be subdivided in basic modules and sections. The latter provides means for representing the real content components. Metadata elements can be integrated into LMML documents using predefined attributes. Thus, there is not much overhead when using metadata. However, integrating a new metadata element requires changes to the LMML DTD. LMML does not allow the definition of different routes through the course and provides no means for modeling dependencies between learner and courseware content.

The TARGETEAM project (TArgeted Reuse and GEneration of TEAching Materials) [13] focuses on supporting the different usage-processes in the lifecycle of courseware material. An XML-based format for courseware documents has been developed recently, called TeachML [14] too. The courseware documents are stored in pools containing modules assembling reusable units. Modules can be structured by nested issue-elements containing text content, tables, links, images and image animations. TARGETEAM-TeachML does not enable the author to create different routes trough or views of the content. Several content elements are defined but there is no way to structure the material in a didactical way. An open question is, why the sub-languages for content elements re-define existing structures for tables (HTML), links (HTML, Xlink) or image animations (SMIL). Java based processors for creating HTML- or TeX-output are used whilst XSLT and CSS should suffice and would be a more open and adaptable approach.

The TeachML Document Format

TeachML has been developed in the context of the CHAMELEON project. Our goals were to give authors the possibility to create reusable didactical units and to enable tutors to select, customize and combine such didactical units to target group specific courseware material.

Each TeachML courseware document is divided into four levels of elements. On the lower level there are *media objects* like text, images, audio, video, formula, reference, but also interactive Java applets, animations, or 3D-scenes. The mediaObject-element hides media-specific properties, e.g. whether an animation is realized with Shockwave or SMIL.

On the second level there are *content units*. Content units group media objects which belong together to transmit their message to the learner, e.g. a figure and its title or a proof which can consist of several formulas, texts and references.

The third level are *didactical units*. They consist of several content units. Didactical units are the primary units of reuse, e.g. example, figure with explanation or different types of exercises.

On the upper level there are so called *didactical structures*. They are used to create real courseware structures. Possible types of didactical structures are course, chapter, chain of arguments, examinations containing several exercises, a overview path or a detailed path. Didactical structure is the only recursive element because high-level structures like a course can consist of lower-level structures like chapters.

Since all relations between media object, content units, didactical units and didactical structures are references all elements must have a unique ID. This ID is also used for another purpose: Every didactical unit can contain an optional list of references to other didactical units which represent didactical preconditions for its use. With TeachML we do not try to build a semantic network - in our opinion this is too costly and in most cases unnecessary effort. However, in difficult and very detailed courses it can help the learner to find the right entry point.

Information about learners can be represented in a compact learner' s model. It contains administrative information but is also tightly coupled with the courseware itself. In order to adapt the presented TeachML course to a certain learner it is possible to specify information about previous knowledge, aims and actual learning success. The previous knowledge and aims of the learner are represented by references to didactical units. For example an aim could be a reference to a set of exercises the learner wants to (or has to) solve at the end of the course in order to get a certificate. The actual learning progress is represented in two ways. The first is a history list with references to the visited didactical units. If some of these didactical units are exercises, information about their solutions will be stored as well. The second way is by using the variables *level of detail* and *level of difficulty*. With this information the appropriate didactical structure (e.g. a path with a matching difficulty) for the learner can be selected.

For assigning metadata to TeachML elements an XML binding for the IMS metadata scheme based on the IEEE LOM scheme is used. IMS defines a core of frequently used metadata elements and a so called standard extension library for other elements. The scheme defines nine categories (e.g. general or educational) and a number of elements inside each category. Every element is optional and can be used in any number and order. However, for an author the great variety of available metadata elements can be quite confusing. Therefore a so called metadata mapping is being defined in TeachML, mapping each TeachML element to the relevant IMS metadata elements along with information about whether the metadata element is mandatory or not. If different types of TeachML courseware documents require different metadata elements it is very convenient to have to update the mapping information only. Some extensions to the IMS scheme became necessary, e.g. for the types of example and argumentation chain. As an equivalent to the existing metadata element difficulty in the educational category the new element detail has been added to this category. All new elements were easily integrated using the extension mechanism of the IMS scheme.
Together with the Cornelsen Verlag [15] we are analyzing how existing courseware material e.g. from schoolbooks can be converted to a TeachML equivalent. This experiment will help us to evaluate the TeachML format in order to find missing types of didactical units and to update or extend existing ones.

CHAMELEON System Architecture

In this chapter we show how TeachML documents can be integrated into the context of the CHAMELEON project. Additionally we describe our current work in this project.
To take advantage of the power of the TeachML document format there is a need for some additional tools. In the last chapter we described, how basic information for adapting a course to the learner' s previous knowledge and aims can be represented in a learner' s model. This model can be updated by using information about the interactions between learner and didactical units. Most information is provided by exercises, because they indicate if the learner understood the contents of the course. Exercises should denote a level of difficulty, so this information can be used to make an assumption about the appropriate difficulty for the next courseware documents to be presented.
Exercises are usually interactive components. Thus it is difficult to convert the TeachML based exercise description into an interactive presentation on the learner' s side. One possibility is to use HTML forms, but this is applicable to multiple choice and completion tests only. So we decided to develop a set of Java applets for exercises. The TeachML document fragment containing the exercise information (e.g. question, true and false answers, feedback information and help topics) is used to initialize the applet. Then the applet dynamically constructs the visual presentation of the exercise, manages the interactions with the learner and returns the learner' s solutions (and the way he found them).
So far we introduced the TeachML format in order to represent courseware documents, but how can these be presented at the learner' s computer? Our solution is to use stylesheets to transform the TeachML document into the appropriate output format. This is a quite complex task to perform, because of the large number of different types of content, didactical units and additional information (e.g. from the user model or about the system configuration) which must be taken into account. Currently we are using a combination of XSLT and CSS stylesheets for transforming TeachML documents into an XHTML representation for a web course. In order to provide a printed version of the TeachML document XSL Formatting Objects are used to create PDF documents. In addition an attempt has been made to develop guidelines and stylesheets for adapting TeachML documents to the needs of visually impaired learners based on the W3C recommendation about Web Accessibility Guidelines [16].
The first TeachML based courseware documents were developed using a plain XML editor. Because of the large number of additional information (e.g. IDs, paths and metadata elements) this proved to be a very time-consuming task. Therefore the next step will be the development of a modular authoring tool for TeachML documents and didactical units targeting two main objectives. At first it will simplify the process of structuring the TeachML document as a whole by visualizing dependencies between didactical units and didactical structures. Secondly it will enable the integration of plugin components for creating and adapting didactical units. The main advantage of this approach is that there will be no need for changing the tool framework when the TeachML document format is being extended by new didactical units or existing ones are being changed. That way we will be able to extend the capabilities of the editor by simply adding a reference to the new or changed editor component.
In the next section the authoring process of didactical units themselves will be described in greater detail.

Enabling Informal Teamwork

EIT is a research project in cooperation with Cornelsen-Online and is supported by the German Federal Ministry of Education and Research (bmb+f) as part of the project WEP in the Global Info program [17]. EIT aims at the development of a web-based environment for producing and maintaining courseware documents and learning materials (CD/LM) for various media. The project divides into three parts:

- Unitizing learning material to improve reusability.
- Conceptual design of a virtual repository for web-based multimedia documents and of document management tools.
- Extending these concepts by groupware capabilities with the emphasis on organizing informal collaboration.

Professional Publishing

Publishing companies employ various external and internal specialist for the production of CD/LM. An editor acts as a central role in this process by structuring and coordinating subtasks while authors investigate and create texts, sketches or scripts for multimedia applications. These are transformed into different media by designers, graphic artists, software developers and many others. Coordination of the individual tasks requires additional manual work from the editor who manages the exchange of raw-data and semi-finished materials between the different experts. In this process some disadvantages can be observed:

- The interrelation between tasks, media-assets and meta-information is lost.
- Assets are used in heterogeneous and often incompatible environments. Therefore conversion, systematization and archiving causes additional expenses.
- Reuse and maintenance are impeded by lack oft meta-information about the individual assets.
- Coordination of sub-tasks causes additional work.
- Project status and individual workload are hard to estimate. Bottlenecks are discovered very late, flexible reorganisation of subtasks is difficult.

The vision of an electronic working environment supports modular creation of adaptable and reusable CD/LM for books, on-/offline-media and semi-finished materials. A distributed virtual repository stores media-assets and components for CD/LM together with the associated metadata. Thus an efficient management of the stored information in each stage of its lifecycle becomes possible. Access is provided by a distributed middleware ensuring availability and consistency of the stored data, even if a continuous network connection can not be guaranteed. Different role-specific views of the repository will be provided allowing an easy migration from conventional methods of working and supporting group-aware collaboration.

Research Issues

Currently we are examining professional CD/LM provided by the project partner to improve and validate TeachML. By rewriting these documents we try to find out which processes occur and which metadata have to be filed during the production and maintenance of CD/LM. Simultaneously a modular editor for TeachML documents is designed and implemented. This editor features a plug-in architecture, allowing to extend its functionality to handle special XML sub-structures (e.g. formulas, tables, etc.).

The next step will be the transfer of those development tools and procedures into the authoring process of the Cornelsen Verlag to gather further information about workflows and boundary conditions within a professional publishing process.

The knowledge obtained will be used for the design of a virtual distributed repository for storing TeachML-data and media assets along with the necessary metadata.

Summary

In an information based society knowledge needs to be extended or updated in ever shorter time-spans. Therefore the efficiency of storing information and making it available to the human mind becomes crucial to keep up with this development. Creating modular, adaptable, extendable and reusable courseware materials can be one milestone on the way to meet this challenge. We presented TeachML, an XML based document format for such a class of courseware documents. TeachML enables the courseware author to structure learning material both in respect of content and didactics. Therefore TeachML offers two main concepts: didactical units as units of reuse and combination and didactical structures for creating different views of and routes through the course. A number of didactical units, called atoms, could be identified. Didactical structuress and a compact user model enables us to adapt courses to the learner' s previous knowledge, aims and infrastructure. Because TeachML documents are free of presentation aspects it is possible to create different output documents e.g. an XHTML document for a web presentation and a printable version. The EIT project extends this approach by validating TeachML in a professional publishing environment and by designing a virtual repository for multimedia documents, media assets and associated metadata.

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Countermeasures against Security Breaches in Web-based Training Environments

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Abstract: Today, as e-commerce is becoming a major issue for companies, security flaws are rapidly gaining public attention. Both corporate and private users consider security to be the decisive factor for Web-based business in future. At the same time the Web is used for distance learning and various platforms for Web-based training (WBT) have emerged. However, none of these platforms focuses on security issues and therefore security is designed and integrated only as an additional feature. In this paper we elaborate on the fundamental security concerns that users of WBT software have and show how existing flaws can be eliminated. Basically we rely on well-established security concepts. However, as these concepts have not been designed for Web-based applications, we have adapted them. Our solution is to use encryption algorithms with keys unknown to the Web server. Therefore our approach is compatible with all available Web servers.

1 Introduction

During the last years the Internet experienced an enormous growth. The Web with its appealing hyperlink navigation has enabled easy access for a variety of users who had not had the chance to use the older Internet services like ftp or telnet. The increasing number of users has given rise to new Web applications and companies are increasingly beginning to think about e-commerce.

The Web with its worldwide access to information is what was needed for efficient computer-based distance learning. There has been distance learning for many years already. It started with correspondence-based learning where the students received studying material and assignments by mail. As technology advanced teaching and learning was enriched by multimedia. Students received video or audiotapes and one- or two-way communication was established via TV and radio. Companies focused on producing teaching aids and could be sure that their investments could not easily be stolen. Despite the fact that videotapes can be copied, the quality decreases as copies of copies are being made. Furthermore it is necessary that the copying process is performed in one place, i.e. the video cannot be transferred to a friend who lives in another continent. The only way to achieve this, is to send the copy by mail - which obviously means additional time and cost for copying.

Digital content, however, can be copied easily. The quality does not decrease with copying and digital content can easily be sent around the world at very low cost. For example, Napster and Gnutella are two programs that are very popular for sharing digital music via the Internet - most of the songs are copied illegally.

Copyright protection alone is not enough as it can be difficult and very expensive to trace copies once they have been made. Although Digital Watermarks can help to clarify who holds the copyright, all current techniques have drawbacks (Yeung 1998). Large companies in the music industry may have the resources to enforce protecting their digital assets but smaller companies or university institutes will never be able to prohibit illegal copying using legal measure only.

We know for a fact that many potential creators of multimedia Web-based training content refrain from their initial plans due to these security problems. Belanger (2000) estimates that developing a premium quality WBT course that is equivalent to a 54 hour in-class course requires approx. 28000 hours. Famous distance learning institutes like the Open University in the UK or the German Fernuniversität Hagen have enough students so that the average cost per student is low enough for such expensive digital content to be created.

Despite the threat of illegal distribution of multimedia course content, very little has been done to integrate security concepts into WBT software. The following section will give an indicative overview over how security threats can be dealt with. Section 3 starts by evaluating existing WBT programs with a focus on the theoretical security flaws previously identified. We then demonstrate how some flaws can be avoided using a WBT platform called Coimbra and we present an outlook on our current project Alcatraz.

2 Countermeasures

In this section we elaborate on how security issues that are relevant in the context of WBT can be adequately addressed. Throughout this paper we focus on security for general WBT systems and not on security for Web-based information distribution of sensitive information. We assume that the system is safe from attacks if the required effort to break the system exceeds that of creating a multimedia course. The information of university WBT course is not secret as it can be found in textbooks. It is the effort of adapting this publicly available information to a multimedia platform that represents the real value.

2.1 Protection against Theft of Digital Content

The first step to avoid illegal copying is to define a security policy. Digital watermarking techniques obviously cannot solve the problem of illegal distribution. As the recent spread of illegally shared MP3 music files showed, copyright alone is not an adequate protection. For most songs digital watermarks would have little effect as the holder of the copyright is often well known. Personalizing digital watermarks means that digital content is market for the buyer, so that he or she can later be traced as the first who illegally copied a CD. This could be an approach but the organizational overhead seems too large.

Many lecturers are not willing to devote any effort to the development of sophisticated WBT aids and they even refrain from allowing students to download the lecture's slides. Requiring a username and password for http-access can help to keep non-students, i.e. potential thefts, away from the course material.

One problem, however, still remains. Students and all people who are allowed to access the course can easily copy the whole hypertext structure - even if you only permit them to access the course for a very short time. These illegal copies can then spread through the Web and if the teaching material is of high quality, the probability of illegal 'reuse' is very high.

The approach that we propose is to encrypt the content. Unlike encryption standards (e.g. SSL) incorporated in standard Web browsers, we propose a system that stores the content in encrypted form on the server. The Web server does not have the key to decrypt the content because we agree with Wilkinson (1999) who wrote: "If sensitive information is to be included in a shared web, access controls will be required. However, the complex software needed to provide a web service is prone to failure. To provide access control without relying on such software, encryption can be used." We implemented these concepts in the Coimbra system (Coimbra 2001) using a client-viewer that decrypts the files only for viewing, which implies that they also stay encrypted in the client's disk cache.

2.2 Guarantees concerning Evaluation

Similar to counting how many students attend each lecture, WBT software can log how many people use the software and for how long. In order to be able to trust the evaluation results, two 'attacks' have to be made difficult. First, one has to make sure that the displayed data gives a correct impression. This requires the identification of users who rarely learn with a WBT course, those who use two or more accounts, as well as those who share an account. Second, one must not have the chance to tamper with the auditing records.

Detecting usage patterns that differ from regular usage is a common task in intrusion detection. Pfleeger (1996) briefly discusses some approaches but admits that only simple forms of intrusion can be detected automatically.

Automatically detecting usage patterns would be useful to discover if two or more students share the same account. However, we found that user profiling is especially difficult for students who explore the content of a WBT system. When studying, there is nothing like a routine task and page accesses do not follow any systematic rules. One might be lead to believe that students start reading basic pages first and continue, with detailed information later on, but this is not true. When learning for oral exams a student may focus on overview knowledge but the same student may need in-depth knowledge one day later for her home assignments. This example illustrates why only simple forms of sharing an account (e.g. two different IP addresses using the same account simultaneously) can be detected automatically.

The best way to guarantee that every single user registers, is to require the registration for the exam. Obviously, students will enter their real names and addresses. Course registration should be free or at least very cheap so that there is no incentive for students to share one account. Encrypting the log files ensures that they cannot be tampered with. By combining a count of page views with measurements of how much time is spent on each page, a rather reliable indicator of usage can be derived.

2.3 Prohibiting Cheating

Computers can be used for in-class tests. This testing situation is the easiest to handle, as it is very similar to traditional exams. The teacher can check student IDs and can ensure that students do not talk to each other or exchange information by other means. For many tests it is necessary to make sure that students cannot use any other application than the testing program. For example in Windows systems it is feasible to prohibit switching to other applications. Teach/Me (Lohninger 1999), WBT software for chemistry students, implements this security feature in its testing modules.

As an option students may not want to take exams at the teacher's university. Test centers can be authorized to provide the exams. The computer-based TOEFL (Test of English as a Foreign Language) is a perfect example for this kind of exam. Compared to the first scenario where the exam takes place in a class organized by the course's teacher, additional security problems occur. First, exams have to be distributed so that no one can 'open and re-close' them before the actual exam starts. Second, the results have to be evaluated either at the test center or centrally. Answers to multiple choice questions can be evaluated automatically but text answers have to be reviewed by humans. These answers should only be accessible for the student and for the examiner. Public key cryptography can be used to achieve the required security.

If WBT is used for distance education it is convenient for students if they do not have to travel to test centers. This third and most demanding option in regards of security means allowing students to take the exam on any computer. The main problem is to authenticate the user and to make sure that no one else enters the answers after authentication and that no one provides illegal help by e.g. hiding in the room and talking to the student. Using teleconferencing software for oral exams can be considered a quite safe way. The conversation takes place synchronously in real time and thus others cannot easily give answers to the student, as the examiner will notice pauses in the conversation. An alternative to oral exams is take-home exams. These exams – being more popular in the US than in Europe – are specially designed so that cheating is difficult by merely using a textbook. Web technology does not offer additional cheating options that could not be exploited for 'traditional' take-home exams.

2.4 Privacy for Users

The easiest and yet most reliable way to avoid that people misuse auditing information is to give them no direct access to the data. Professors, for example, may not access the logs of every individual student but only summary information derived from the logs. As the topic of security in statistical databases is extensively covered by literature, it is beyond this paper's scope to go into details. Castano (1995) gives a comprehensive overview and discusses recent research results.

3 From Coimbra to Alcatraz

Several years ago, we wanted to use the Web to distribute learning aids and to automate testing. We analyzed existing software and found that we missed some features. Therefore, we decided to start developing our own platform called Teach/Me (Lohninger 1999). Having gained experience with Teach/Me, we then fundamentally redesigned the system's architecture. This was the beginning of Coimbra (2001). Today, as the first versions are available to the public, we continue to move on to Alcatraz, a prototype that incorporates role-based access control. Before we present the Alcatraz architecture, let us have a brief look at some major WBT platforms.

3.1 Related Commercial Systems

We briefly want to point to drawbacks that were common to all WBT and CBT products: (1) no intelligent caching and (2) no encryption. Detailed information about the products can be found on the Web sites (see Table 1).
As most products use standard Web browsers as client software, the client cannot influence caching. In our opinion this is a major drawback. What we wanted is a client program with a browser-like user interface and the option to control the caching. During installation students usually do not mind if large files (like indices, table of contents, etc.) are transferred via a slow connection but they do mind if this happens while learning.
As already mentioned, teachers often refrain from publishing their course material on the Web because they fear theft and usage by others without proper citation of the original source. To avoid copying caching could be prevented but the tradeoff concerning speed is too high. A better solution is to store data in the cache in an encrypted way. The client can then require online authorization every time the program is started. As only a small amount of data has to be transmitted to perform this authorization, the software can easily be used with a modem connection.

Software solution	URL for detailed information
Allen Communication	http://www.allencomm.com
Macromedia	http://www.macromedia.com/learning
Micromedium	http://www.micromedium.com
WBT Systems	http://www.wbtsystems.com
Docent	http://www.docent.com
Asmetrix	http://www.asymetrix.com

Table 1: Major WBT software vendors.

There are, however, other products that focus on providing control over the content using encryption. The advantage is that the content can be safely chached on the local file system. IBM's cryptolope objects are an "envelope" to securely distribute digital content. It is nothing more than a Java Archive file. The self-contained cryptolope package always includes the cryptographic keys that unlock the encrypted content. For security reasons, these keys are themselves encrypted with a key that only a third party can unlock. Therefore this third party, also called a key server, does not have to store all keys of all the cryptolope objects but only the access keys. IBM is not the only company that offers this kind of protection for digital content. Infraworks (www.infraworks.com), QVTech (www.qvtech.com) and Authentica (www.authentica.com) claim to have similar products.

3.2 Coimbra

The Coimbra software system has been developed to create teaching and learning material. Coimbra is an open system based on Internet standards enabling the teacher to provide students with additional material via the web.
Coimbra can be used to publish both on CDROM and over the Internet. Unlike with most WBT platforms, distribution via CDROM is very easy with Coimbra. All files that would normally be found on the Web server have to be copied to a CDROM - everything else remains unchanged. When starting the client the user just selects the CD drive instead of typing in a URL and everything works like via the Web only faster. It is one of the key benefits of Coimbra that it offers the possibility to shift a database from one medium to another without effort. Coimbra allows developing any material locally on the disk and then moving the entire database to a Web server and also distributing it via CDROM. Similar to IBM cryptolope, wherever the data is stored, the files are encrypted, making it difficult to steal the textbook or to alter the auditing information in the log files.

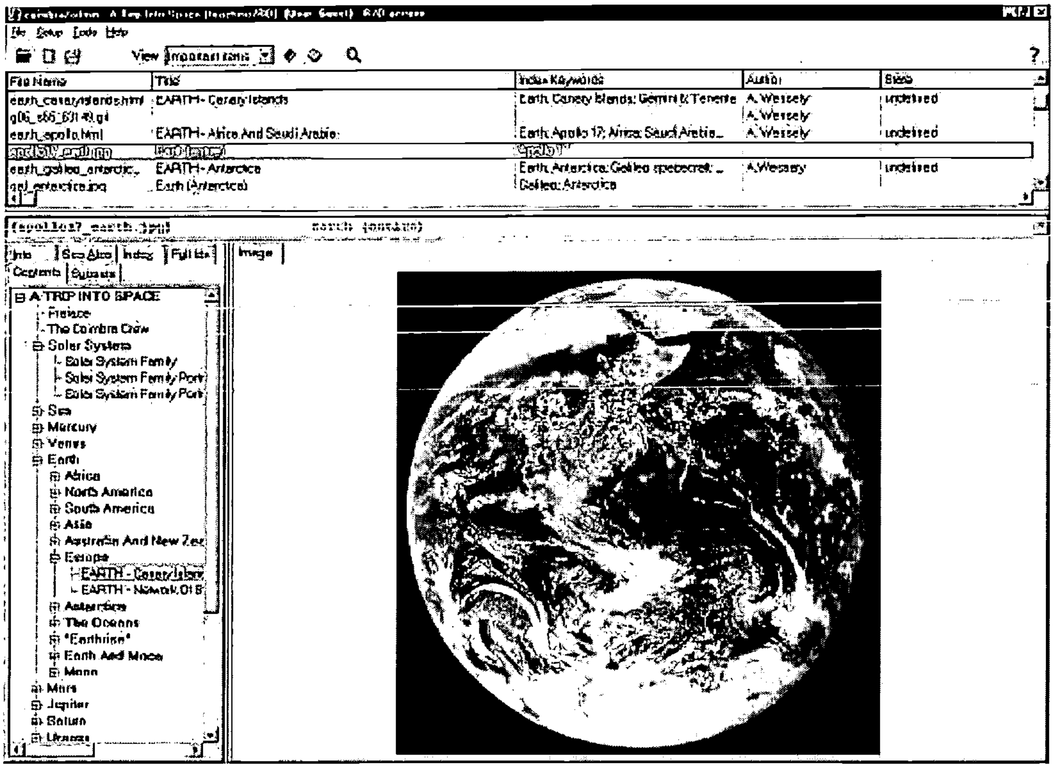

Figure 1: The Administration tools are used to create, maintain and distribute WBT courses.

It is important to note that the index works even with the encrypted files as the client software - having the keys - updates it when necessary. Standard Web server indexing engines do not work as the Web servers store the encrypted files without having the keys to decrypt them.

3.3 Alcatraz

Coimbra's security system is based on assigning access rights to users or to groups of users, i.e. discretionary access control. There is, however, a more flexible security model that is commonly used in database systems: role-based access control (RBAC)

A typical RBAC system assigns privileges to users in two consecutive steps. In the first stage a user is assigned one or more roles. This assignment can be either static or dynamic. Dynamic assignment allows for users changing their roles depending on the tasks they perform. In the second step the roles' authorizations are checked against the operation requested by the user.

The obvious advantage of RBAC systems is that the identical roles can quickly be assigned to different people. Moreover, this streamlining eliminates security breaches caused by assigning incorrect access rights.

As students take different courses every term, access rights have to be updated frequently. To ensure security throughout a university, it is advantageous to allow teachers and students only access data required to complete their course. RBAC systems should be used to specify for which task (i.e. an application role) one needs access to a specific document. These application roles are then assigned to user roles. Finally, individual users are one or more user roles (see Figure 2)

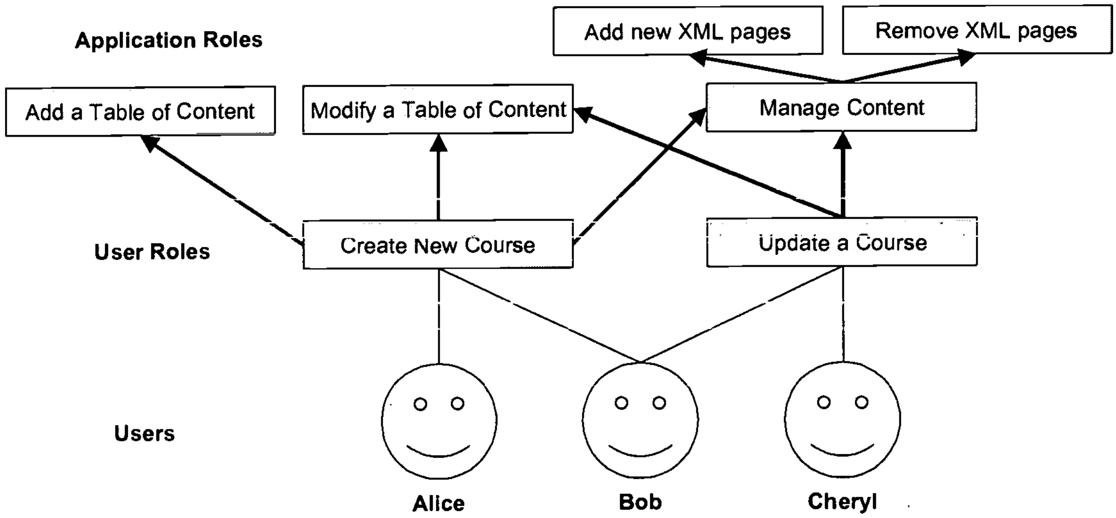

Figure 2: A multilevel hierarchy of roles can be used to define access control to WBT content.

4 Conclusion

In our work we have explored security issues that users consider relevant for Web-based training. The results of our analysis have lead to theoretical concepts how these issues could be addressed best. Finally, after completing a first version of our Web-based training platform, Teach/Me, we have developed a second platform called Coimbra (www.coimbra.at). Existing weaknesses in managing security policies are addressed by Alcatraz, our current project. It focuses on integrating role-based access mechanisms into WBT software allow flexible assignment of access rights.

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Abstract: Coimbra is document database that was specially designed for developing and deploying Web-based Training. Beside usual Meta information teachers can specify browse sequences for different courses, keep track of students accessing pages and cooperatively develop and share content to build various courses (e.g. calculus for computer science, calculus for chemistry, etc.). All information is encrypted using state-of-the-art secret key cryptography to prevent theft of intellectual property. The innovative approach is highlighted by Teach/Me (Lohninger 1999) which is based on Coimbra and has recently been awarded German Award for Educational Software digita 2001.

Managing Web-based Training Content

One of the important issues in creating teaching materials is to organize thousands of basic documents (texts, diagrams, Web pages, scanned images, photos, video, ...) and the corresponding meta information so that (1) all documents can be easily found, (2) teaching materials are fed from a common pool of shared documents, (3) relationships between individual documents are maintained, and (4) new applications can be derived from existing materials by adding new ones or by reorganizing existing ones. In addition to these prerequisites, the document management system should contain a suite of tools specifically tailored to the creation of teaching material.

Coimbra is an authoring system for network based multimedia teaching materials. It is based on common Internet standards, which allow to deploy the materials over the Internet as well over in-house LANs and on CD-ROMs. The content managed by Coimbra is encrypted (Blowfish (Schneier 1994)) to prohibit theft of intellectual property. A freely available viewer supports many additional navigational functions and allows to create easy to install packages which can be passed on to students.

Document Database

On a technical level, Coimbra is a document database system which helps to file documents of different kinds and formats (photographs, videos, sound, written texts etc.) and from different sources (local computer, internet etc.) in one single system thus offering easy access to these documents and enabling the user to combine different types of documents in a single application. Each document is stored unaltered in the database and is accompanied by a list of meta information tags, which provide information about the contents of the particular document. The meta information comprises title, author, references, index keywords, various dates, access rights, links to related documents, and several more technical tags.

The user interface of Coimbra consists of four different channels (see Figure 1): (1) direct access to the database, (2) a preview function, (3) a set of navigational tools, and (4) a document selector which helps to narrow down the number of visible documents in large databases. Besides these basic access channels Coimbra offers a wide variety of tools to manage the documents (i.e. extraction tools for meta information, analysis of indexes, a visual layout editor, search and replace functions, subset editors, basic image processing, etc).

Due to length limitations, we will just give a brief overview of the most important features in Figure 1.

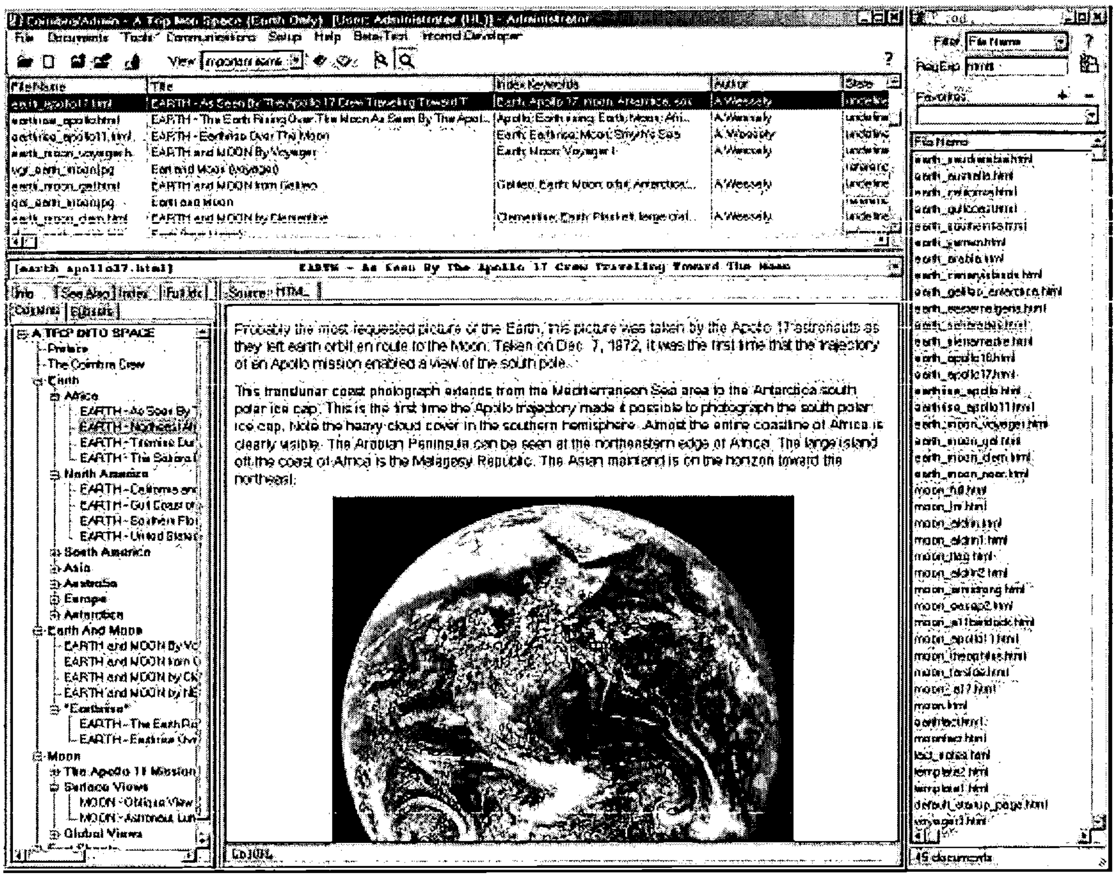

Figure 1: The Administrator's UI supports (1) direct access to the database (top pane), (2) a preview function (lower middle pane), (3) a set of navigational tools (lower left pane), and (4) a document selector (right pane) to narrow down the number of documents visible in the top pane (1).

support of cooperative authoring	powerful document management
teaching materials can be deployed via CD-ROM or network	large number of supported formats
a rich set of built-in navigational tools (TOC, indexes, browse sequences, "see also" links, subsets, courses)	course editor and self-configuring courses
integrated user administration	integrated indexing engine (including a full text index)
support of network based examinations	copy protection by encryption
communication facilities (e-mail, bulletin boards, chat, ...)	annotation of materials
tracking of document states	integrated HTML editor
interface to external editors (e.g. for pictures)	interactive slide shows

Table 1: A list of Coimbra's key features.

Coimbra forms the basis of several interactive electronic textbooks, of which one (Lohninger 1999) has recently been awarded the "Deutschen Bildungssoftwarepreis digita 2001" (German Award for Educational Software digita 2001 - http://www.ibi.tu-berlin.de/projekte/digita/digi2001/d_2001.htm).

The Coimbra system has been built for IBM-compatible personal computers running under Windows 98/NT/2000. More information on Coimbra can be found on the following Web site: http://www.coimbra.at/

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Initial Design of an Interactive Learning Environment for Statistics

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Abstract: This paper describes the initial analysis and design phase of a research project with the goal of creating an interactive, web-based environment for learning statistics. General design principals were drawn from existing research on constructivist learning. More detailed system requirements were obtained via the use of "empathic design", a participatory system design approach. Empathic design is a methodology for capturing the unarticulated needs of the user via direct observation, and then translating these needs into system/product features. Reported here are preliminary results of an analysis of observations of students solving basic descriptive statistics problems.

Introduction

This paper describes the initial analysis and design phase of a research project with the goal of creating an interactive, web-based environment for learning statistics. The domain of statistics was chosen for a variety of reasons: 1) statistics is a common (and typically required) course across many disciplines and levels, 2) it's a difficult (and unpleasant) subject for many people, and 3) it requires a variety of skills, both conceptual as well as procedural. Moreover there appears to be a large general interest in the teaching of statistics as evidenced by the multitude of resources on the web, including demonstration applets, case studies, data sets and repositories of relevant newspaper articles (see http://it.stlawu.edu/~rlock/ for example).

Analysis and Design

While there are many approaches for building well-designed software, determining user requirements is always a critical first step (Kendall and Kendall, 1999). This research takes two approaches for determining user requirements. The first is a practical notion of constructivism (see for example, Wilson, 1996); Perkins (1992) suggests a framework for a technology-based learning environment.

Though these principles provide general guidance, more detailed design specifications are clearly needed. What in particular do students have difficulties doing/understanding? How are these problems manifested? What might some approaches be for preventing or rectifying mistakes?

Leonard and Rayport (1997) suggest that the best way to fully capture user requirements is to observe users in action. Observing users provides much richer feedback than such approaches as questionnaires, protocol analysis, feedback on existing products, or talking to the users.

The Experiment

Two students were (individually) videotaped "talking out loud" as they worked on some half-dozen basic descriptive statistics problems in a standard textbook (Levine, Berenson and Stephan, 1998). Each session took about 90 minutes. Successful completion of the assigned problems required 1) the ability to recognize and calculate the desired quantities and 2) an understanding of the concepts behind their usage.

Observations

1. When working the problems the students constantly needed to refer back to previous pages for definitions and examples.
2. In doing calculations neither student started by writing down the appropriate expression, then filling in the values, and then proceeding with the calculations. Rather, they just immediately started doing the calculations with the data at hand. This "scratch pad" approach seemed to lead to mathematical mistakes; further they then had difficulty finding values they had already calculated when they were needed for later problems.
3. One student didn't order the data in determining the median – from my experience 10-20% of students make this error on exams.
4. Problems understanding fundamental concepts. For example, generally the notion of which measure of central tendency to use when seemed elusive. Neither student could successfully answer questions that required a fundamental understanding of the concept of variance/standard deviation, though one student could do the calculations fairly straightforwardly.

How This Translates To Design

In this section I propose relevant design responses to the user requirements specified above. (The numbers here correspond to the numbered user requirements in the previous section.)

1. Provide a glossary, with definitions and examples, "one click away".
2. Have the system structure student problem solving at the outset using step-by-step templates: start with the expression, find the known values for the variables in the expression, calculate additional values needed for calculations, substitute the values in the expression, and do calculations.
3. a) Have the system force a step-by-step approach until the user gets the idea.
   b) The system could graphically demonstrate the determination of the median via an animated ordering of the numbers (and then determining the observation at place $(n+1)/2$).
   c) The system could be designed with "intelligence" so that when the student provides the answer that indicates non-ordered data, the system "knows" how to correct the student.
4. a) Build a coherent set of visual representations (i.e., Java applets) to demonstrate concepts. For example, demonstrate visually the effect on the mean, median, and variance of adding/removing data points.
   b) Provide mechanisms to engender conceptual understanding through knowledge construction via simulations, realistic exercises and collaborative work with other students.

These design criteria mesh directly with Perkins' (1996) five facets of a learning environment: information banks, symbol pads, construction kits, "phenomenaria" (i.e., simulation environments), and task managers.

Conclusions, Caveats, Further Research

User input is generally understood to be a prerequisite for the creation of well-designed, useful software. The literature on instructional technology seems remarkably bereft of any mention of design issues in this sense. This work has applied an empathic design approach for capturing user needs. Although these are only initial results, a number of interesting observations and related design suggestions have emerged. The ultimate goal is to expand topics to cover the standard MBA one-semester course curriculum.

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New Concepts for the Usage of Groupware in Software Engineering Education

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Abstract: In this paper we present an innovative Tool for distributed software engineering, which is particularly suitable for the use in software engineering labs in higher education. Tools that are used to support distributed teams run under the term groupware and the respective field of research is summarized in the term Computer Supported Cooperative Work (CSCW). Many publications state the work field software engineering as an example for possible groupware support (see Gibbs 1989). Although many approaches to support software engineering teams exist (Gorton & Motwani 1996, Dewan & Riedl 1993), only few work deal with the development of special groupware for educational purposes in the field of software engineering (one of these approaches is described in Zitterbart et al. 1999).

Software Engineering and Groupware Support

Only in exceptional cases will an individual developer control the entire life cycle of a software system. Modern software engineering in any case signifies team work. The world-wide extension of the data networks and the continuing globalization add another component to software engineering: the development in worldwide distributed teams. Our experiences with software engineering projects showed, that the teams cooperate in different ways in the separate development phases. Different requirements on the computer support result from this. Earlier stages of the development require numerous group meetings with a high proportion of cooperative work. Videoconference systems and group editors can serve these computer supported face-to-face meetings. In addition to that, special software engineering CASE-tools are necessary to support the design phase. Coding during the implementation phase mainly employs individual work and does not require special support because of its strong individual work character. An exception from this can be found in big software companies with development departments all over the world and in different time zones. In this case, the use of special tools can enable a 24-hour software production (see Gorton & Motwani 1996).

Software Engineering Syllabus at GMU

In our degree course, software engineering is an one semester course that consists of two hours lecture and six hours of lab per week (see Hunger 1998). During the lab, the students work in teams on a close-to-reality task that is chosen in such a way that it can not be solved by an individual. Therefore, the students are forced to divide it into subtasks

Student survey (GMU 2000)

Since 1997 we examined the practical training several times. One of our goals was to find out which phases of the software life cycle are best suited to be supported by a Groupware. Students were asked to fill in a questionnaire every time when they reached one of the following milestones during the lab:

a) requirement specifications,
b) context diagram and data dictionary,
c) transformation diagrams,
d) behavioral models,

e) implementation models,
f) specifications and work programs for implementation,
g) compiled procedures,
h) executable programs and
i) documentations.

For the evaluation we combined the related milestones a), b), c), d) to "Essential Model" and f), g), h) to "Coding". The questionnaire consists of 17 questions and every questionnaire contains the same questions. It was organized in five sections concerning Group work, Work mode, Organization of the group, the role of the tutor and own role within the group. The average number of questionnaires we received at every milestone was 80. Within the questionnaires we introduce three possible work modes as they are originally defined by Borghoff & Schlichter 2000:

- Individual work: each member individually solves the subtask and the group declares the best solution as the groups solution.
- Collaborative work: each member solves parts of the subtask on his own, which contributes to reaching the goals of the group. The personal goals rank higher than the goals of the group. More asynchronous than synchronous sessions are needed.
- Cooperative work: the subtask are solved by the entire group. The goals of the group rank higher than personal goals.

Most students described the most common overall work mode as "Cooperative Work". A closer look has shown that the portion of individual work increases from phase to phase. On the other hand the portion of cooperative work decreases from phase to phase. It also can be seen from figure 1 that during the requirement specification and the modeling phases cooperative work was the most common work mode. Collaborative work was named as the common work mode in all phases by nearly 30% of the students, except coding. This peak can be explained in that way, that most of the students are not very much into programming. Therefore they work together, but the main goal was to complete the own program module.

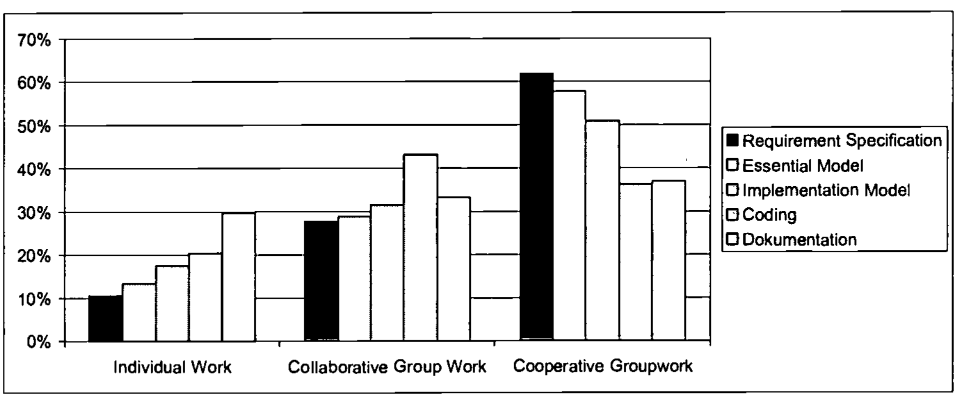

Figure 1. Work modes in relation to the phases of the Software Life Cycle

The evaluation shows that the early phases in the Software Life Cycle like requirement specification and also modeling seem to be best suited for a Groupware support. In the later phases like coding and documentation the individual goals dominate the chosen work mode and lead to a high portion of individual work and collaborative work. Therefore they seem not as well suited for a Groupware support as the early phases.

Results and Resulting Predefinitions

Tools to support the early design phased are required for asynchronous and synchronous sessions. Several investigations (Brereton et al. 1998, Sarjoughian et al. 1999) deal with public available tools like Microsoft

Netmeeting or SeeUSeeme but these tools drop out because of the different requirements for use in the educational field. The tools for synchronous work need to have more functions than publicly available tools like

- a better support for discussions,
- the setup of partners images and relationship aspects,
- mechanisms for preventing communication breakdowns and
- support for the students in their cooperative actions.

Looking at commercial systems shows that they drop out according to their high costs (license fees, connection costs in case of ISDN-based systems, asset costs). These results are gained from investigations published in (Sarjoughian et al. 1999). Beyond that, the application of Software Engineering CASE-tools requires additional time of the students that depends on the tool complexity (Boloix & Robillard 1998). In case of Software Engineering CASE-tools it has to be taken into account that modern tools such as e.g. Prosa or Rational Rose perform consistency checks at model transitions from one level to another. But especially this work is supposed to be carried out by. From the design process view, this reduces the needed tool to a simple drawing tool with a special object library. Altogether, these arguments suggest the development of a individual Groupware that should contains:

- a synchronous communication tool,
- a floor control to support discussions and also to handle access to the commonly used resources and
- a Software Engineering CASE-tool for common modeling and document processing.

From a technical point of view a session management to control the network communication and a protocol stack to support the required network services are also needed.

Tool Concept

In the first section we discussed arguments for using groupware to support software development teams in their cooperative actions. These arguments are not as valid for students because of the different experiences, the different group processes and also the disadvantages of the existing technology and tools. The researches undertaken in Duisburg sustained the thesis that these differences and disadvantages can be avoided by making according steps for the tool development. This section describes suitable methods and mechanisms as well as their implementation. The system architecture and the implemented protocol stack will be introduced in the next section, details are given in (Hunger et al. 1999). Afterwards, the prototype of the implemented clients will be presented. The floor control and the user interface will be discussed in detail. Additional tools to support the lectures are described in (Hunger & Werner 1998b).

System Architecture

The above described tools require also mechanisms for multimedia data exchange in order to make efficient working over a computer network possible. Our tool concept sees windows-based systems as its target platform and the global internet as its transport medium. This concept is realised as a client/server architecture and several methods of data transfer have been implemented: unicast connections for client/server-communications and multicast connections for interclient-communications. Client/Server connections require reliable services for the transmission of document data, login data and control data. On the other hand, interclient connections only require unreliable services, but a guaranteed bandwidth and delay for the transmission of video- and audio-data. For the realisation of the above described architecture, a suitable protocol stack has to be developed. In a first step only implementations of standardised protocols which are currently available, or which will become available in the near future are used (IPv6, RSVP, RTP, ICMP..).

Floor Control

The floor control is implemented on the server side and handles the access to the public window and the shared resources. Furthermore it coordinates the course of communication through an administration of different kinds of permissions, e.g. permissions to speak, permissions to alter the documents. Floor control approaches usually are mainly technically or social oriented. Our approach differs from those methods in that way, that it combines the advantages of technical and social floor passing methods. An essential part of our floor-control implementation is the permission list. This list can have three possible entries. The actual spokesperson is followed by the next two clients who requested to speak. Each demand of the permissions and each passing of the permissions results in updating this list. Important is that the list never shows two equal entries. Thus two members cannot exclude the third person from the discussion. Further more a tutor can be called by any user at any time. Therefore the model serves all of the above formulated requirements.

The Client User Interface

Working in a team, dividing up the given task into subtasks, discussing provisional results and integrating first results afterwards, already require discipline of the students without using groupware. The usage of videoconference techniques also requires that students work in a completely new scenario. Thus interface design obtains an outstanding meaning. Our client user interface contains video screens of each member and a CASE-tool in a public window for the common process on the outline documents. Figure2 shows the user interface of the client software. Each member has the same view of the window according to the WYSIWIS-principle, but only one of them can alter the document at a certain time. A telepointer serves to elucidate and to present facts. Each member is also equipped with a private working window for trying out ideas. A chat window was implemented so the conference can be ended simultaneously in case of bad transfer circumstances.

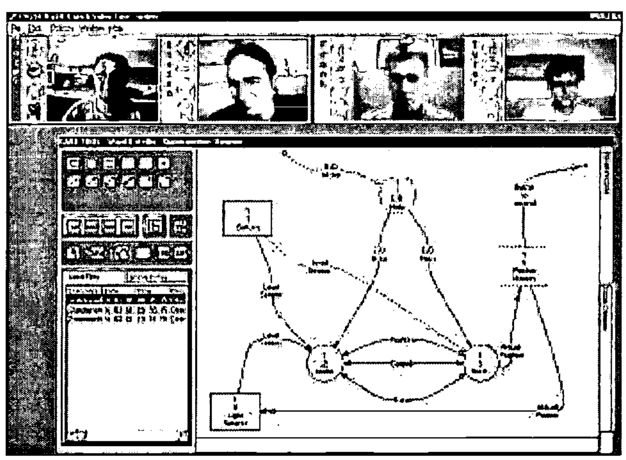

Figure 2. Client User Interface

Other features of the user interface result from the above mentioned demands,

(a) of setting up and promoting partner images and relationship aspects and
(b) of supporting group awareness.

These requirements are taken into account by the following design and implementation steps:

- each member is represented in an individual video screen (a),
- the members are always shown in the same video screen (a),
- the video screens can not be changed in either size or position (a),
- none of the video screens can be covered up by another window (a),
- the video screen of the person who has access to the shared resources is always highlighted (b),
- the entries of the permission list can be fetched and visualized (b) and
- the CASE-tool contains a global and local history of changes (b).

Evaluation

In summer term 2000 the first evaluation of our Tool named the Passenger Case & Video Tool (PCVT) took place. It was a small evaluation that follows the aims:

- get a first feedback on the implemented functions and features,
- gain experience in the usage of the PCVT,
- prepare for a bigger evaluation that will take place in summer semester 2001.

The evaluation uses questionnaires and also log files that have been recorded during the sessions. These log files contain information on the communication behavior of every student.
The environment consists of the PCVT communication component and the Habanero Whiteboard (see http://havefun.ncsa.uiuc.edu/habanero/Docs/index.html) as a CASE-Tool substitute because we haven't finished our CASE-Tool implementation yet. Therefore the evaluation focussed on the PCVT communication component.
The implemented features to enable group awareness seem to be suitable because 56% of the students have always been aware of the conference situation and 44% most of the time. The implemented floor control to enable a discussion control was not rated as good as expected. Nobody rated it very good but 78 % rated it as good but also 22% rated it as medium. The most named reasons for this are that it is not possible to pull back the *ask for permissions* after the application for it. A second drawback seems to be, that it is not possible to address questions to a special participant.
During their experiments most of the students worked on modeling tasks (Context diagram, transformation diagrams and behavioral model). Therefore the following evaluation focuses only on the design phases. One question addresses the effectiveness of the PCVT for communication purposes in comparision to natural face to face discussions like in the practical training in Software-Engineering. It can be seen that the students rated this higher from phase to phase, what means at least from week to week. Because the used functions are quite the same and also the course of work, this must be a result of the learning effect.

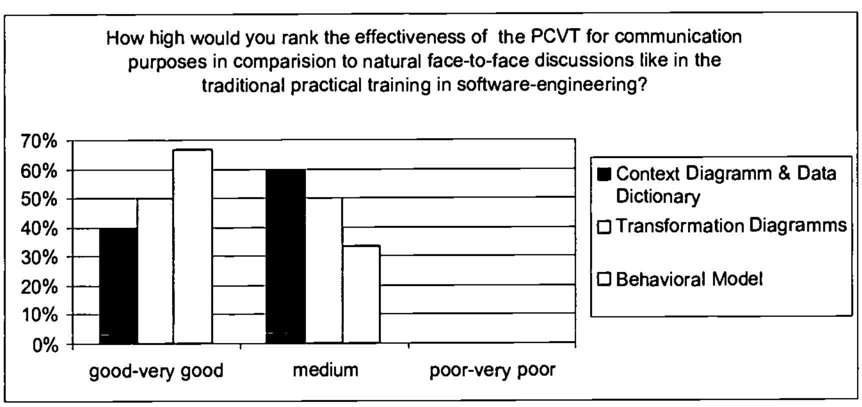

Figure 3. Learning effects

Although the number of participants was much too small for a quantitative evaluation, the trends resulting from the above mentioned evaluation seem to be unambiguous. Because this is not true for the other questions, their evaluation will not yet be discussed.

Summary and outlook

This presentation discussed the use of groupware in a practical training for software engineering students. We presented the result of our investigations of a traditional practical training and a tool concept to support the early software life cycle phases. Three essential differences of our tool compared to publicly available solutions can be specified:

- the floor control to support discussions and to avoid communication breakdowns,
- the described user interface to support the setup of partner images and relationship aspects and
- the measures to enable group awareness.

The function of the tool could so far be verified in an IPv4 based intranet. A first small evaluation took place in the summer term 2000. The final evaluation is scheduled to summer term 2001. Future work will provide the improvement of floor control, so that individual members can be approached specifically. Furthermore, the integration of additional CASE-tools is planed.

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The Learning Net – An Interactive Representation of Shared Knowledge

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Abstract: It is assumed that cooperative learning continuously constructs and extends the shared knowledge of a group of learners with respect to a specific learning domain. Experiences with Computer-Supported Collaborative/Cooperative Learning (CSCL) environments indicate that an explicit representation of the shared knowledge is helpful with regard to two aspects: First, it can preserve (intermediate) results of the cooperative learning process. Second, it can also improve the process itself by providing the context and means for learners' orientation and navigation in the learning domain, awareness of the learning process, and the construction and negotiation of knowledge. In this paper, we introduce the *Learning Net* as an interactive representation of shared knowledge and sketch how it can be integrated and used in a CSCL environment.

1. Introduction

Computer-Supported Collaborative/Cooperative Learning (CSCL) is regarded as an emerging paradigm in educational technology (Koschmann 1996). It is based on cooperative learning methods (Slavin 1995) and on constructivist viewpoints of learning as (1) active construction of knowledge, (2) bound to a complex situation, and (3) a social process. CSCL environments respond to these views by providing (1) authoring facilities to create and modify artifacts within the CSCL environment, (2) means to represent complex, authentic, context-rich information using hypermedia technology, and (3) communication and cooperation facilities in various ways such as e-mail, chat, audio/video conferencing, or shared whiteboards.

In the course of a (successful) cooperative learning process, information provided by a teacher, by peer-learners, or from other sources is jointly processed by a group of learners. The result of the cooperative learning process is a jointly structured information base as well as the learners' shared knowledge of this domain. As material is continuously added, learners need an easy way to access the material, and they have to organize and manage this knowledge and uphold an overview.

Problems known from hypertext, especially the loss of orientation in hyper-documents ("lost-in-hyperspace") and cognitive overload caused by navigation in the document, are amplified in hypermedia-based CSCL environments: Documents may be changed anytime by peer-learners working on the same document, and coordination with peer-learners is needed in order to maintain a common understanding.

In face-to-face situations non-verbal cues provide helpful information to cope with these problems, e.g. a learner can show disagreement with gestures or facial expressions upon a statement and thereby initiate a discussion. Reduced communication channels in distributed CSCL settings render the construction of shared knowledge more difficult. Learners must make non-verbal signals such as gestures or facial expressions explicit in order to communicate the to their peer learners. In our research, we aim at supporting learning groups by providing an interactive representation of the shared knowledge, the so-called *Learning Net* (LN). In the remainder of this paper we present how knowledge is represented in learning nets and how leraning nets can be used to support navigation in the shared knowledge, awareness of the shared knowledge, communication and cooperation in the learning group.

2. Knowledge Representation with the Learning Net

A common assumption in cognitive science is that most declarative knowledge can be represented according to the metaphor of a "net", or, more formally, as a directed graph (Churcher 1989; Sowa, 1998). In cognitive psychology, various types of nets are used to represent structural knowledge, i.e., the pattern of connections among concepts in memory, and nets are often used in educational settings to convey knowledge (Jonassen et al. 1993). Also, in the CSCL field net-like representations are used to visualize relations between concepts, statements, data, or hypotheses , e.g., in the Belvedere software environment (Suthers, 1999). Here, we aim at representing the essential structure of socially shared knowledge as it is dynamically constructed during the cooperative learning process in a more active way by linking documents and persons with the net.

A LN scheme is defined by the types of nodes, the type of relations between nodes, and the type of links to documents and persons. With respect to the types of nodes and relations between nodes empirical studies lead to the hypothesis that variation in these types can significantly affect the learning process and outcomes (Suthers, 1999). Therefore in our approach, the LN scheme can be user-defined, e.g., by the teacher, according to the kind of learning situation. An appropriate LN scheme then can be selected for each instance of the LN by the teacher or the learners. Specific LN schemes have been developed and implemented for the domain of problem-based learning (Miao et al., 2000). In the remainder we use a simple general-purpose LN scheme consisting of goals, topics, definitions etc. and focus on the connection of the LN to documents and persons.

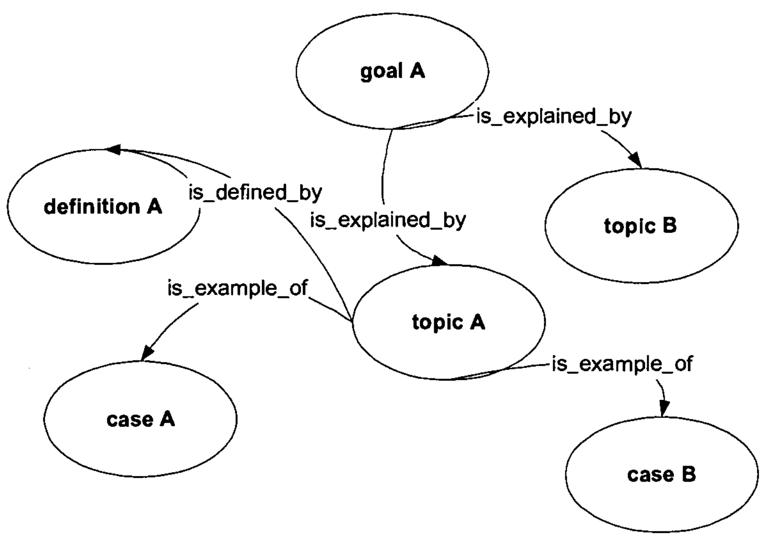

Figure 1: An example of concepts and relations in a Learning Net

Using the general-purpose scheme the LN is structured in the following way: A learning goal is the central node of the LN. To achieve the goal, several topics need to be tackled; a topic can be any concept, principle, or problem. To understand a topic, special cases can be presented as examples or analogies; e.g., a case-study on phobia treatment can serve as an example for the concept of behavior therapy; similarly, a topic can be introduced just by definition.

3. Usage of the Learning Net

3.1 The Outcome Perspective

From the outcome perspective, the LN should provide a common frame of reference and represent the current state of shared knowledge in a CSCL environment.

In cooperative learning it is (mostly) unclear a priori what the exact boundaries of the learning domain are. This problem becomes more severe when the learning process evolves over time. Here, the LN provides a frame of reference, i.e., a structure that denotes what is part of the domain of concern and what is not. It is a kind of index all participants agreed upon. It is not fixed, since it dynamically changes during learning; changes, however, are not arbitrary, since they presuppose some kind of consensus among the participants. A LN supports various situations, e.g., informing a new person joining the group about what the learning process is about, or let a group continue where it left the learning process previously. The problems associated with the concept of shared knowledge (e.g., Nickerson 1993), especially how to measure it in a CSCL environment, are discussed in Pfister et al. (1999).

3.2 The Process Perspective

Besides the static viewpoint of the LN presented above, there is also an important dynamic aspect: The construction of a LN is a cooperative process during which knowledge is negotiated, different perspectives are integrated, and conflicts are made explicit. The degree of agreement (Pfister et al., 1999) on each element of the LN is reflected on the user interface, e.g. by different colors of nodes or links. This visualization provides an easy overview with respect to the "hot spots" of the group, e.g., conflicting concepts of group members. These hot spots can help to decide on the next steps in the learning process.

The construction of a LN can proceed *optimistically* or *pessimistically*. In the optimistic case, whenever a participant creates a new element, it is assumed that consensus is above a certain threshold. Anybody who thinks this element should not be part of the LN must actively object; a participant who does not object is assumed to agree. Hence, as long as nobody objects, the construction can proceed very smoothly by participants synchronously or asynchronously adding or deleting elements. To enforce active learning, a possibility is to proceed pessimistically, i.e., each element introduced in the LN by some person has to be explicitly accepted by everyone else, or by a majority defined by the consensus threshold. We assume the latter to be more time consuming but that it leads to more elaborated and deeper knowledge, both on the individual as well as on the group level. Anyway, the mode of the LN construction has to fit to the collaboration mode of the group. The mode should be determined in consideration of the group size, productivity, synchronicity etc. For example, in an asynchroneous collaboration of a large and productive group, the pessimistical construction hampers the progression of the LN: Each learner has to wait till the other learners agree before his or her contribution is included in the LN.

4. Realization

We distinguish the "document level" and the "conceptual level" in CSCL environments. The (hypermedia) document level comprises all basic documents created and imported, i.e., texts, graphics, etc. These documents are all related to concepts, i.e., the basic issues and topics the learning process is about. On the conceptual level, all concepts can be linked by semantic relations, e.g., "is example of", "is definition of". By defining the relation types users can model a wide range of domains and learning strategies. The LN is a representation of the conceptual level. It contains the concepts and relations between these concepts. Figure 2 shows a screenshot of the current implementation of a LN for problem-based learning (Miao et al., 2000).

4.1 Supporting Navigation: Connecting LN and Documents

In addition to the relations within the LN, there are links between the LN and the document space, i.e., each node refers to one or more specific documents, which provide detailed information relating to that node (e.g., a text, a diagram, etc.). Thus, by looking at the LN representation, learners are able to orient themselves and gain an overall and common understanding of the domain, but may then "dive" into the document space by following a link from a node of the LN to an associated document.

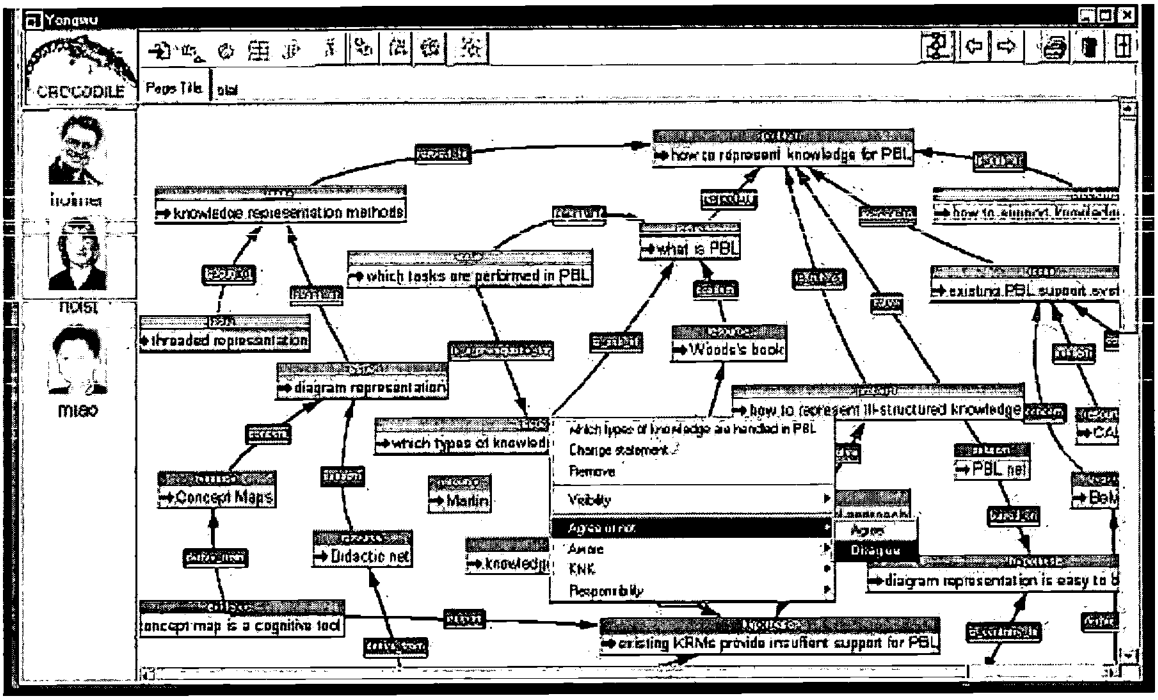

Figure 2: A screenshot of the current implementation of the Learning Net for problem-based learning

4.2 Supporting Awareness: Visualizing the Group State and Progress

The LN provides a color bar for each node and relation on the user interface (a line at the bottom of each node and relation in figure 2). Using a context-sensitive mouse menu (see figure 2) a learner can express her or his oppinion with repsect to a number of scales, e.g. whether he or she agrees or disagrees with a certain node or relation, whether he or she has knowledge about the topic of a certain node. The color bar visualizes the percentage of learners which agrees/disagrees, which has knowledge about this topic. Thus, the LN can be used to get a quick overview of the state of the learning group as a whole, e.g. with respect to the consensus in the group or the progress of a group with acquiring a certain knowledge domain.

4.3 Promoting Cooperation (1): Connecting LN and Persons

More generally, persons, who are also a knowledge resource - especially, in the context of cooperative learning, are represented in the same way as documents. Thus, persons can also be linked to concepts, for example, an expert in spreadsheets can be linked to the concept "Table creation" with a link labeled "is expert of".

4.4 Promoting Cooperation (2): The Construction of the LN

Access to the LN is available from everywhere in the CSCL environment. When a user opens the LN, a collaborative LN editor starts for the user and all other users in the same group. There are two ways to construct the LN. Nodes, relations, and anchors can be generated directly, or they can be the output of a system-controlled cooperative learning method, a so-called learning protocol (Wessner et al., 1999). In addition, some modifications could be initiated automatically according to the system's knowledge about the learning process, e.g., enforcing specific nodes according to the learning strategy.

For direct construction and modification the collaborative LN editor contains separate functions to construct and modify the LN, especially to create, edit, and delete nodes, relations, and anchors to documents or persons. Node types and relation types are fixed, so the direct construction is more or less the same as working with a graphical editor. However, the LN must not be independent of documents and participants, i.e. in general, each node should reference at least one information resource. Thus, there are smooth transitions between the LN, the documents, and the participants in the CSCL environment: From each node in the LN, one can navigate to the associated resources.

Learning protocols systematically support a special kind of communication or cooperation activity in a group of learners. For example, the explanation protocol controls a dyadic explanation process by systematically switching roles (explainer and explainee), providing a specialized interface to enter explanations and questions. If both agree, the dialogue can be stored for future use or further discussions, and the information (x is an explanation dialogue concerning topic y) can be incorporated appropriately into the LN. While in this example the modification of the LN is a side-effect of the learning protocol, there are other learning protocols specially designed to modify the LN.

5. Summary and Open Questions

We have proposed the Learning Net (LN) as an interactive representation of shared knowledge for cooperative learning. The learning net is a socially constructed, dynamic meta-level above the hypermedia learning artifacts, (1) providing orientation and navigation in the learning domain and (2) supporting cooperation between learners. The LN is part of a learning environment called CROCODILE, developed in the internal research project CLear at GMD-IPSI (Pfister et al., 1998; Miao et al. 2000). For further information on the CLear project and downloads see http://www.darmstadt.gmd.de/concert/projects/clear.

Preliminary evaluation results at GMD-IPSI indicate that the learning net can be used in various ways, e.g.,

- Tool for scaffolding: A teacher builds a LN as a skeleton for the intended learning process. The students take this LN as a starting point for their learning, "fill" it step-by-step with related documents, extend and modify the LN as the learning proceeds.
- Tool for summarizing and reflecting: The group starts with an empty LN. After each learning phase the group summarizes what they have collected and discussed by creating and extending the LN. They use the LN to reflect on the last learning phase.
- Inductive vs. deductive learning: The learners can start with examples or cases and proceed towards more general concepts and rules and vice versa.

Some problems we encountered and which we plan to investige in the future are:

- Participation of absent learners: How can and must absent learners be involved in the maintenance of the LN? Should absent learners block changes in the LN?
- Reducing the cognitive load: Can we reduce the additional cognitive load for maintaining the LN by prompting learner(s) to update the LN under certain conditions, e.g., at the end of a session or after creating a certain number of new documents?
- Scalability: Preliminary evaluation results indicate that the usability decreases rapidly in groups with more than three or four members. How can we improve the usability in larger groups?

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Developing and Deploying Online Courses with JCourse

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Abstract: JCourse, created at Carnegie Mellon University, is a Java- and XML-based system for developing and deploying web-based courses. On the development side, JCourse allows content providers to work more independently of web designers than has been previously possible. On the deployment side, JCourse provides basic (albeit incomplete) support for the IMS Question and Test Interoperability v1.0 specification (www.imsproject.org), which allows questions and tests from one compliant system to be reused in other compliant systems. Because Java and XML are platform-independent, JCourse runs on Windows and Unix (including Linux). JCourse was used to create a web-based course on Causal and Statistical Reasoning (www.phil.cmu.edu/projects/csr) that has been successfully used by about 150 students at the University of California, San Diego, the University of Pittsburgh, and Carnegie Mellon University.

JCourse supports the development and deployment of web-based courses. Development support includes instructional and assessment pages. Deployment support includes an assessment engine, a user interface for student and instructor access to student performance data, and security-related access control.

Without JCourse, instructional content for online courses is typically created as HTML web pages by the content author. The instructor uses his or her favorite text or HTML editor to create the HTML file, and then FTPs it to a web server so the students can access it.

This approach works well when instructional materials do not require professional design from a visual design perspective, but otherwise it falters. (Consider, for example, an online course intended to be packaged and distributed as a commercial product.) Because content authors are subject experts, not visual designers, the course development effort requires a separate visual designer role.

HTML presents several major problems in such a situation. First, since HTML encodes both content and presentation, content authors and visual designers cannot work independently, which reduces the number of design iterations. Second, content authors produce non-HTML versions of the content (e.g., Microsoft Word), which leads to synchronization issues. Third, HTML does not provide a mechanism for keeping multiple pages consistent in appearance. Finally, the course developers may want to give the course a completely new look from time to time. For large courses this is difficult with HTML, as each page must be individually updated.

JCourse solves the above by separating content and presentation into different files. The content files use a simple XML (eXtensible Markup Language) format appropriate for the content author. The presentation files, or stylesheets, are based on XSL (eXtensible Stylesheet Language), a sophisticated language that visual designers can use to define page appearance. The XSL stylesheets are applied to the XML content files to obtain web-ready HTML files, which can then be viewed using any web browser without special plug-ins. The transformation process is called XSLT (XSL Transformations). XML, XSL, and XSLT are all W3C technologies (www.w3c.org). Using JCourse, authors and designers can work more independently, allowing rapid design-test-revise iterations. Since the content format is simple, there is no need for the multiple copies that become out of sync. Having a stylesheet enforces a consistent look across pages. Finally, changing the look of the entire site is simply a matter of changing the stylesheet (or small number of stylesheets) responsible for that look.

For assessment development, JCourse provides basic support for the IMS QTI specification, which defines a portable XML-based format for the creation of questions and tests. As the format is complex, JCourse includes an assessment authoring application, implemented using Java Swing. The interface allows the author to create IMS-compliant questions and tests, including single- or multiple-response choice questions, and fill-in-the-blank questions. JCourse also provides extension functionality not directly supported by the IMS QTI specification, including support for tables and Shockwave movies. Questions and tests created in JCourse can be used in any IMS-compliant system, as long as they use only nonextension functionality. Similarly, questions and tests created in IMS-compliant systems can be used in JCourse.

JCourse can also be used for course deployment. JCourse includes facilities, in various stages of completion, for course management (e.g., maintaining class rosters), student account management (e.g., viewing one's assessment scores), delivering instructional pages and assessments, tracking student performance, and security-related access control. JCourse runs as a Java web application on any web server that supports the Java 2.2 Servlet web application specification. (This includes most major web servers; see www.java.sun.com.) A single JCourse instance can host multiple courses and multiple instances per course.

The JCourse assessment engine performs three major functions: assessment delivery, response processing, and results storage. The user requests an assessment by clicking on a hyperlink on the web page. The hyperlink points at the URL where the assessment engine resides, and the query string includes an assessment ID so the engine knows which assessment to deliver. The assessment engine then loads the assessment, and generates HTML dynamically for that assessment, using JavaServer Pages (JSP). It sends the HTML back to the client browser, which displays it. At this point the student answers the question, presses the submit button, and sends the results back to the assessment engine. The assessment engine evaluates the results according to the assessment specification as created by the authoring tool. It then writes the performance data to the student performance database, and finally returns feedback to the student.

The JCourse gradebook gives course instructors simple web access to the student performance data. The instructor can view the score for any given student/assessment pair, as well as summary statistics for given students or for given assessments.

Deployment options are flexible. Course instances can be configured to have their own question and test repositories, or they can share them. Sharing saves disk space and simplifies management by avoiding the need to synchronize updates, while having individual repositories allows customization. Similarly, course instances may share student performance repositories, or have their own. In the case of performance repositories, a JDBC-based abstraction layer sits between the repository and the application proper, and allows any JDBC-compliant database (e.g., Access, SQLServer, Oracle, Sybase, mSQL, and MySQL) to be used to persist student data.

JCourse was used to create a web-based course on Causal and Statistical Reasoning (www.phil.cmu.edu/projects/csr) that has been successfully used by about 150 students at the University of California, San Diego, the University of Pittsburgh, and Carnegie Mellon University. Approximately four people, all working part-time on the project, produced the bulk of the course in under a year. The material includes dozens of Shockwave simulations, almost 500 questions tracked and recorded in the JCourse database, and a large virtual laboratory in Java, all delivered in approximately 18 content modules.

Classes at UCSD and at Pitt are delivering the same material to students with traditional lecture/recitation format, and with JCourse. On the first midterm, students using JCourse scored 6 percentage points higher at UCSD, and 3 points higher at Pitt. Although these groups were self-selected, a similar experiment in the spring of 2000 found the selection effect to vary between 2 and 4 percentage points. Students using JCourse to learn the fundamentals of experimental design and causal inference are faring as well as their peers in lecture.

Future directions for JCourse include the following:

- More complete support for the IMS QTI specification, including support for additional question types and support for question selection and sequencing when it is specified.
- Performance-based (as opposed to security-related) access control. For example, students cannot progress to later course sections until they have demonstrated mastery of earlier sections.
- External API to the student performance database so performance data can be collected for exercises implemented as applets, Shockwave movies, etc. We already have several such applets (Causality Lab, Carnegie Proof Tutor, D-Separation Tutor, Set Builder), but currently they provide their own persistence capabilities. We want JCourse to provide at least general support, such as saving scores and timestamps.
- We will investigate the possibility of open sourcing the project.

A Multimedia Tool for the Classroom: A Cross-Curricular Multimedia Knowledge Construction Environment

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Abstract: This paper describes how six constructivist instructional theories were combined and incorporated into the design of a prototype multimedia learning tool. The tool, a multimedia learning environment for high school students, is intended to meet the demand for a cross-curricular knowledge construction system that supports anchored, situated and generative learning, cognitive flexibility, metacognition and rich-interaction that fosters open dialogue and critical thinking. A prototype interface is described.

Background

Our aim with this project was to explore the possibility of combining six key features of constructivist instructional theories into a generic design formula to help develop a prototype instructional tool that is purpose-built for laptop computers[1] and that exploits the attributes of multimedia and the World Wide Web. The instructional needs were to design a knowledge construction environment that (1) *integrates* curriculum subjects so that students can better inter-relate them with respect to context and meaning; (2) Enables unique, engaging, meaningful, memorable, *collaborative experiences* for the students; (3) *Facilitate intellectual growth* beyond the present level of learned skills; (4) Incorporates an *intuitive interface* with little or slight learning curve for both teachers and students; (5) Demonstrates how an effective learning tool can bring learners and teachers together. In this prototype, materials are organized into case studies that engage learners in knowledge construction. Teachers can customize the cases or use cases already embedded in the multimedia tool. Thus, knowledge acquisition and construction are central features of the tool.

A Constructivist Design Model

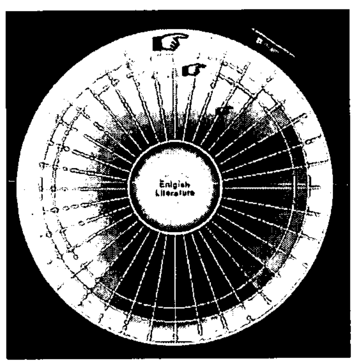
The theoretical models we combined for the design of the prototype draw from the work of constructivists such as Cunningham, Duffy & Knuth (1993), Jonassen & Tessmer (1996/7), as well as Spiro et al. (1988), Wilson, Teslow and Osman-Jouchoux (1995). These models, each highly regarded, were chosen for their individual merits but also because they are widely recognized in the field of instructional design for the elements they include and because they each represent key aspects of constructivist approaches to learning. The integrated constructivist theoretical framework gave us a foundation for the design of the multimedia tool in prototype.

Six theoretical features guided this phase and helped to form the main interface design. The first feature for students using the prototype tool is that they can engage in meaningful *knowledge construction*. Learners, especially in well-structured domains, are often faced with prepackaged materials that minimize generative problem solving or preclude opportunities for learners to create their own complex interpretations. The implication for our design is that a deep resource of 'knowledge objects' can be represented in multiple forms (from 3-d object models, films, texts, illustrations, or VRML spaces, for example) that learners can explore and collect into an integrated notebook or digital scrapbook. Students engaged in knowledge construction exercises would use integrated programs such as a personal scrapbook, multimedia viewer or communication tools to accomplish teacher-defined tasks.

A second feature is to provide for cognitive flexibility with *multiple perspectives* on, and *multiple representations* of the learning materials (Spiro, 1988). A key implication for learners is that they can access, view and navigate a given environment while creating, selecting from and/or editing various biases. A third feature is to *situate learning in relevant contexts*. Students utilizing the multimedia tool ought to be able to search, view and gather information from multimedia elements that relate meaningfully to the 'real-world' problems designed by the teacher. The environment accommodates the creation, editing and navigation of teachers' assignment 'templates'. This helps to foster a fourth feature of the prototype: *generative learning* with ownership of the learning process. Students are able to customize their own portfolios, websites, templates and the workspace interface itself as befits the problem-solution context. The fifth feature of the prototype is to support *social experience* in learning as much as possible. The communication tools in the system support socially negotiated tasks where alternative viewpoints can be explored and shared by students. Thus, Email, Websites that support messaging and Chat, as well as Collaborative Notebooks and shared project spaces.

The final feature of the prototype learning tool is that it can engage the learner at the *metacognitive* level. This requires functionality that emphasizes feedback, rich interactivity, customizability, control over self-assessment, as well as access to the structured assessment of others. This involves tools such as task-adaptive creative workspaces with modular palettes of controls and communication tools where the locus of control rests with the learner. The aim is for the student to arrive at a state of self-awareness through the use of 'cognitive tools' that support the creation and editing of their work. Learners using the multimedia tool can conduct research, analyze reading material, view, create, edit video, illustrations, compose an expository essay, compose multimedia projects, post efforts on a class web page, engage in cooperative learning and peer evaluation, and contribute to the building of a library of resources. The goal of providing the learner with tools to engage in active knowledge construction, explore multiple perspectives, practice generative problem-solving in anchored, relevant contexts, with rich social learning experience and metacognitive interaction support, led to the navigation device described here:

Navigation ColorWheel©



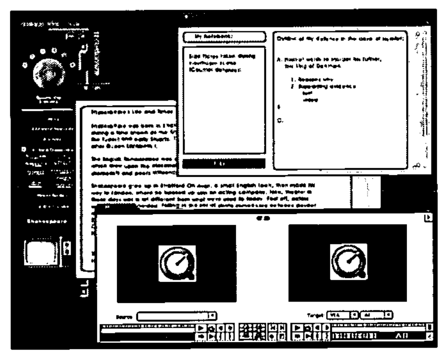


Figure 1. The color wheel is the curriculum navigation device used by students and teachers for navigating across and within curriculum subjects. The wheel's multi-layered **ocular** navigation metaphor provides access to knowledge construction, perspective-seeking, contextualization, problem-generation and orientation. Control functionality is accessed via tool palettes integrated with media resources.

Conclusion

The modular, customizable interface of the prototype incorporates the integrated logic of the constructivist learning environment features in terms of learning resource navigation, communication and control, and supports students' and teachers' knowledge construction needs in an intuitive manner, exploiting the affordances of the Case Study paradigm. Students can access, arrange, create, edit and control their projects and creative material in a customizable portfolio. The challenge in the creation of a tool like this is not only the development of a real platform, but also the design of a library of quality-controlled learning resources and references.

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Improving Web-Based Training Using an XML Content Base

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Abstract: This paper proposes the application of a structured content base to Web-Based Training settings and introduces a workflow using an XML-based file format for educational data. Content is authored in a SGML/XML editor employing a modified DocBook DTD that caters for semantics needed in educational scenarios. Using a Java servlet, this content is formatted according to learners' preferences on-the-fly from XML files deployed on a web server. Additionally, all user requests are logged with their parameters into a database, supporting statistical usage evaluation.

Introduction

Interactive Computer-Based Training (CBT) has experienced a tremendous growth over the last few years. However, the rapidly growing demand for interactive CBT revealed that the traditional content creation workflow has serious shortcomings that make its large-scale application difficult: Reuse and exchange of content modules are hard to implement, because most learning environments use proprietary authoring tools and data formats. It soon turned out that also HTML, *the* common standard on the Internet, lacks much of functionality to fulfill many of the needs of online educators, e.g. no dedicated semantics for online exercises, no support for complex equation rendering, difficult reuse of HTML content in new contexts. This paper presents a workflow that tries to solve some of these problems using an non-proprietary content structure and a web server extension that enables HTML browsers to access the features made possible by XML content.

Why structuring educational content?

Structured educational material decouples style from content. Storing course content in elements that reflect its semantics (e.g. introduction, example, quiz, ...) allows the reuse of data in different situations and formats - adapted to learner preferences, target media or purposes. All groups concerned with the online learning process benefit from the use of structured documents:

Authors

- Authors can concentrate on content not (necessarily) on style and formatting
- Structural integrity can be checked/enforced by an authoring application (e.g. link checking)
- Indexes, summaries, glossaries etc. can be generated automatically
- Content modules can be reused in other contexts (e.g. related courses, in different skill levels)

Publishers / Internet Service Providers

- Content is well machine-processable (i.e. easily stored in databases to facilitate content administration and improvement of retrieval performance)
- Crossmedia publishing is possible from one, single source (e.g. online/offline versions, printed material). The concept of *viewgroups* presented in (Müller & Deponte 1999) addresses this idea.
- Versioning is facilitated.

Learners

- Mandatory structure facilitates navigating the course content.
- Advanced search and retrieval of content components.
- New features like multi-representation content become feasible (e.g. the same content in both visual and textual representation. (Ram et al. 1999) suggests a Presentation Markup Language.)

Researchers / Quality Assurance

- Enhanced possibilities for learner tracking and usage evaluation allow the collection and sharing of comparable data on applicability and effectiveness of the content and help to improve its quality.
- Flexible rendering allows experiments with screen designs, navigation concepts etc.

Current activities employing stuctured content in the educational field

XML (Bray et al. 1998) is, like its predecessor SGML (ISO 1986), a scheme to define new languages. It does not specify what kind of application data is stored in a file by itself but rather provides a framework to define purpose-depended languages that follow one common syntax. This is done in a document type definition (DTD) that describes the overall structure and the components of generic data file. There have been already different suggestions to apply SGML, XML or at least structured documents to educational purposes:
The Tutorial Markup Language (Brickley 1998) provides a language to describe several classes of online exercises like multiple-choice tests, drag & drop puzzles etc. IMS is currently defining a specification for standarized questions and test data formats (IMS 2001). Other structured file formats (Krauße 1999, Arneil et al. 1999) pursue the same goal but currently don't use neither SGML nor XML.
The IEEE Learning Technology Standards Committee proposes a learning object meta-data standard (LOM) (IEEE 2000) to facilitate the retrieval, reuse and exchange of educational content. Learning objects range from small components like a single sentence, a figure or a Java applet up to complete on-line courses. LOM contains information on technical, didactical and legal issues of educational content and provides support for versioning. LOM does not standardize the actual internal data structure of learning content.
The recently released specification for content packaging by the IMS (IMS 2000) has also bindings to an XML file format. There are already commercial applications like Microsoft's LRN project that are strongly influenced by these specifications (Microsoft 2001).

Our implementation

We offer several online courses on computer science topics to our students at our department. This material consists typically of some 200 linked HTML pages per course, enriched with additional interactive elements like Shockwave animations, Flash movies, and Java applets. The courses were created from legacy content in Adobe FrameMaker format as a starting point. Dealing with mathematical and statistical subjects the courses contain over 500 equations. A typical page is shown in (Fig. 1).

Although Adobe FrameMaker ships with HTML/XML export functionality, files generated by the HTML export function needed manual clean-up which took one person about 1-2 days to complete for each new release of a course. Additionally, an evaluation among student users turned out that the poor display quality of equations was a major annoyance to learners. From our previous experience we also could identify two main usage scenarios for our online content: the *tutorial mode*, in which learners tend to navigate through the course linearly and slowly paced and the *script mode*, in which users want to look up small amounts of information like definitions, proofs or concepts quickly. Because both modes are related representations of the same content, we wanted to keep maintaining course content simple and generate both versions from one single data source. Because interface design for WBT is still a young discipline we also realized that there might be a need for additional modes in the future. Ideally, a learning environment would therefore apply formatting and user preferences to the desired content not until the moment of an incoming learner's request.

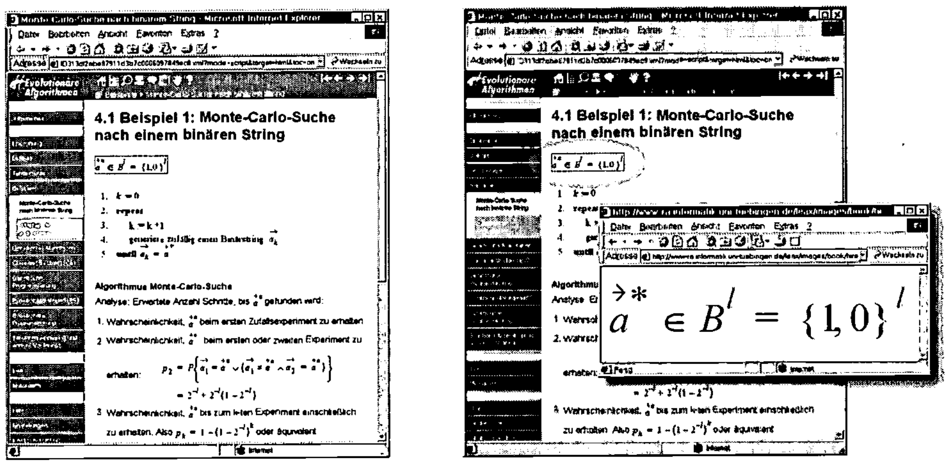

Figure 1: Left: Typical page from online course "Evolutionary Algorithms". Note the high number of equations and symbols in the main content area. Small symbols, especially indices, are hard to read on-screen and do not print very well. Right: Using our improved system, learners can click on any equation to open a high resolution version in a separate windows. An additional print view offers also a high quality hardcopy option.

Our new publishing workflow consists of six steps:

1. Choosing/creating an appropriate document type definition (DTD).
2. Structuring a complete course according to the DTD in an authoring environment.
3. Converting the SGML content into XML and preparing it to be served on the WWW.
4. Creation of HTML page templates and navigational controls.
5. Developing a servlet that converts XML to HTML on-the-fly.
6. Tracking content usage into a relational database.

Document Type Definition (DTD)

We decided to enrich an XML-compliant, light-weight variant of the DocBook DTD (OASIS 1998) used in technical publishing with additional elements and attributes that cater for educational needs, different media types and hyperlink capabilities. We classified the elements inherited from DocBook into the given aggregation levels according to the LOM specification (IEEE 200). All level 0 objects were assigned a 32digit hexadecimal identifier attribute - unique in time and space.

Authoring environment

FrameMaker+SGML was chosen a as XML editor because it combines the ease of use of a modern word processor (especially equation handling) with the structural functionality of an XML editor. To track down learning objects during the following processing steps, each level 0 object was assigned a globally unique identifier. Once the identifiers are assigned, they will be present in FrameMaker+SGML files as well as in exported SGML documents. It is important to note that even though the content is kept in the FrameMaker+SGML file format, this format represents nothing more than a wrapper around a DTD compliant structure.

Converting and preparing XML content

The next step is to export the FrameMaker content into an SGML file using built-in export functionality. Image representations of embedded equations are also generated in this step.

A common problem creating scientific content for the WWW is to display mathematical equations. While some browsers already feature limited MathML rendering capabilities it is common practice to embed equations as bitmap images, e.g. GIF or PNG files. This one-way conversion complicates later-on modifications for the author and results in poor image quality of the content (especially when hardcopied. We decided to keep equations in this format within FrameMaker but to convert them in GIFs during SGML export. By exporting the course content twice with different resolution (72 dpi, 300 dpi), we get two versions of the same equation. This allows features like zooming into equations that are hard to read (Fig. 1) or high quality hardcopy options.

In a final step the *course description*, a hierarchical table-of-contents structure is extracted from the SGML document to serve as website structure. Course description, course content (stored in a set of XML files) and equation images are now copied onto the web server file system, ready to be served.

The complete conversion procedure is depicted in (Fig. 2). Export and equation rendering of a 200 page course on an Athlon 900 MHz Windows PC takes roughly 6 minutes for the 72 dpi version (30 minutes for 300 dpi) and does not require any human interaction.

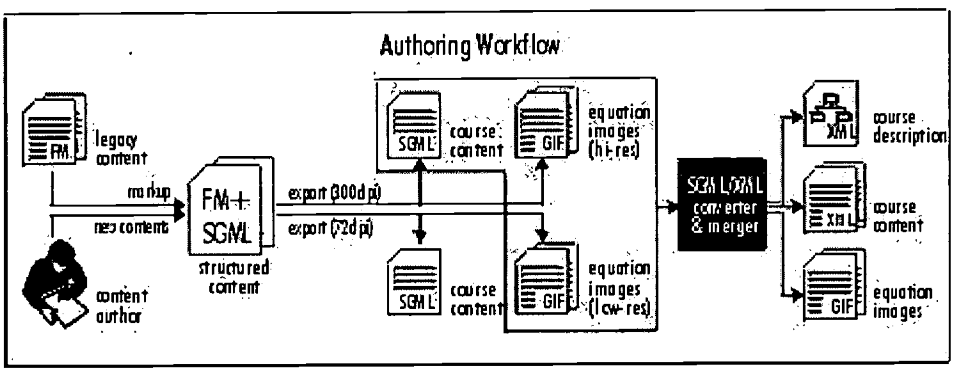

Figure 2: Authoring workflow. Content creation takes place inside the SGML editor (like FrameMaker+SGML). In two passes, SGML versions and two variants of equation graphics are exported. Finally these file get converted to XML and prepared for being served by our servlet-based system.

Page templates and navigational controls

Page templates were designed in an HTML editor, containing placeholders for dynamic content. These placeholders get replaced by applying several XSLT transformations using the open source XSLT formatter Xalan to the requested course content file. XSL style sheets exist for several target media (on-line, print) and usage modes (tutorial and script mode).

The globally unique learning object identifiers are preserved during conversion, allowing web browsers to make use of this information. We have implemented a smart, fine-grained annotation system that works at the subcomponent level within HTML pages and allows learners to tag individual page elements with personal comments. These comments can also be classified by the learner (question, answer, general remark, bug report) and given a restricted visibility to other users.

Serving the content

Because most browsers currently provide only limited XML support, the course content is server-side converted from XML to HTML. Additionally, this allows adaptation of the content to a specific user's learning context (e.g. formatting preferences, target media, usage mode) at this point.
To bridge the gap between web server and XML content, we developed a *S*ervlet *I*nterface for *O*nline *U*ser-adapted *X*ML (SIOUX). Java Servlets are plug-in extensions written in Java that add functionality to a HTTP daemon. To serve a request, SIOUX reads in the requested XML file, applies a XSL transformation to the target medium and mode, inserts the content into a page template, resolves server-side includes and other placeholders, returns the HTML page to the learner's client and logs user id, URL and learning context into a relational database.

Our setup builds on an Apache HTTP daemon and the MySQL RDBMS running on an RS/6000 workstation. Servlet support is provided by the JServ servlet engine, connecting to the SIOUX servlet on a Windows PC (Windows 2000, Athlon 900 MHz, 256 MB, Sun Java Runtime Environment 1.3). The response times vary between 0.2-0.6 seconds per page request depending on complexity of the XSLT style sheets. This is acceptable compared to the 1-5 minutes it takes a learner to work through the page content. (Fig. 4) shows how a request is handled by Apache/SIOUX and which resources are used.

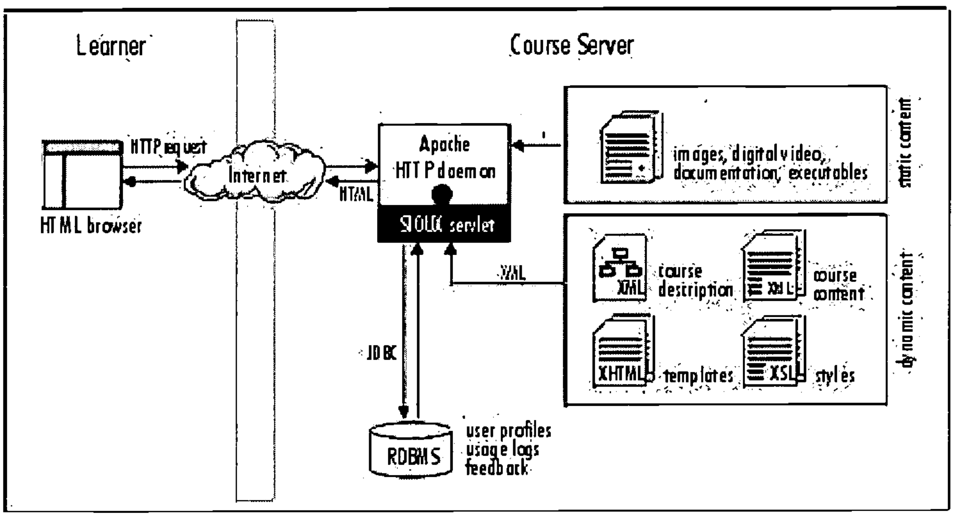

Figure 3: Resources used within the SIOUX architecture. The SIOUX servlet generates dynamic content from XML structure, content, style and template files. Static content is handled by the Apache server without SIOUX intervention.

Tracking content usage

The system contains a learner database that allows restricting access to course content, personalized tracking of content usage and persistent storage of user preferences. After a request has been served, the user's ID, the requested URL and all session parameters (e.g. current mode, target media, individual interface settings, date and time of access, referring URL, agent, ...) are logged into a relational database.

Conclusion

The paper illustrated how structured content supports the online learning process in creating, deploying and using course material. An example has been given, how an existing DTD can be modified to include the dedicated semantics needed in didactical processes while avoiding getting trapped in a proprietary format. Using one single, consistent source which is varied on-thy-fly also avoids complicated and error prone maintenance of several parallel versions. Rendering is acceptable fast for online learning purposes. Several modes (tutorial, script) match the main usage scenarios closer than a single all-purpose version. Preserving learning object identifiers in the resulting HTML pages makes way for applications like fine-grained annotation mechanisms on sub-page detail level.
The flexibility in displaying content in different flavors provides also a test bed for evaluation of different user interfaces or navigation concepts. Equally important is the ability to measure the usage of these experimental variations. While it is obvious that web interface design plays an important role in online education process, it is arguable which is the *best* way. Due to extended tracking possibilities we can offer an approach that helps to collect hard facts. In the likely case we'll learn that there is no single ideal interface for *all* learners, the presented workflow is already powerful enough to serve highly personalized educational content.

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The Impact of Epistemological Beliefs on Middle School Students' Knowledge Acquisition and Problem Solving While Working in a Hypermedia-Supported Problem-based Learning Environment (HALE)

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Hypermedia-supported authentic learning environments (HALE) leverage the characteristics of hypermedia to immerse students in an authentic context while engaging in authentic tasks. Research indicates that students' epistemological beliefs affect performance in traditional learning environments. Yet few studies explore the relationship between epistemological beliefs and performance in hypermedia-supported authentic learning environments. Analyses show a trend of being able to predict performance, though the results were not statistically significant. Though none of the results were statistically significant, the findings may suggest that students with naive epistemological beliefs might be low performers on measures of achievement when learning in hypermedia-supported authentic learning environments.

Analysis of Navigation in a Problem-based Learning Environment

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Abstract: Research has shown the potential of a problem-based approach to enhance students' learning. The interactive nature of hypermedia technology and its ability to deliver information in different media formats can provide unique capabilities for implementing problem-based learning (PBL) environments. Yet, we know little about the types of tools that are effective in supporting learning in hypermedia supported PBL environments. The purpose of this exploratory study is to investigate both the use of tools and design features in a piece of PBL software and their effectiveness on middle school students' learning. Since data gathering has just been completed, there has not been sufficient time to complete the data analysis. Data analysis will be completed and research results and conclusions presented in the conference presentation.

1. Research Framework

1.1 Problem-based Learning

There has been a growing body of research on authentic and situated learning environments utilizing the problem-based approach to learning [Cognition and Technology Group at Vanderbilt, 1992; Pedersen, Williams, 1999]. Problem-based learning (PBL) emphasizes solving authentic problems in authentic contexts. It is an approach where students are given a problem, replete with all the complexities typically found in real world situations, and work collaboratively to develop a solution. Problem-based learning provides students an opportunity to develop skills in problem definition and problem solving, to reflect on their own learning, and develop a deep understanding of the content domain learning [Cognition and Technology Group at Vanderbilt 1994; Jacobson & Spiro, 1995; Lajoie 1993]. This approach was developed in the sixties for medical education, and has since been used in various subject areas, such as business, law, education, architecture, and engineering.

Literature has shown that problem-based learning can facilitate the improvement of student attitude toward the content area learning [Cognition and Technology Group at Vanderbilt, 1992; Williams, 1999]. Explanations offered for this are that students perceive the relevance of the work [Barrows 1986] or compare the task of finding information and developing a solution to solving a mystery [Cognition and Technology Group at Vanderbilt 1992]. Medical students using a PBL curriculum have been shown to be able to pursue learning independently better than their peers receiving a traditional curriculum [Aspy, Aspy, & Quinby 1993], a finding which supports the claim that PBL prepares students to become independent, lifelong learners. High school students in a semester long class which used PBL exclusively showed a significant increase in their spontaneous use of one problem-solving step: problem finding, the ability to identify and formulate problem statements [Gallagher, Stepien, & Rosenthal 1992]. Similarly, students in a PBL curriculum have shown a greater ability than students in traditional classes to break complex problems into their component parts and identify sub-problems which must be solved in order to solve the main problem [Cognition and Technology Group at Vanderbilt 1992; Gallagher & Stepien 1996].

In recent years, there has been a growing interest among educators to use PBL in the K-12 setting. However, the experiences of college level programs and early efforts in K-12 schools have shown PBL to be a particularly demanding instructional approach for both students and teachers [Barrows & Tamblyn, 1980; Cognition and Technology Group at Vanderbilt, 1992]. Students must perform a wide variety of tasks with which they may have had limited prior experience. These include problem finding, hypothesis generation, identification of learning needs, location of resources to meet these learning needs, data collection and organization, and development of a solution plan supported by evidence and reasoning. Teachers, in their role as facilitators, are responsible to provide support for this wide variety of activities to students who may vary greatly in their needs. Because the variability of the classroom teacher's ability to function in this role has a profound effect on the success of PBL [Walton & Matthews 1989], instructional materials that provide some of this support seem warranted.

1.2 Hypermedia and Problem-based Learning

The interactive nature of computers and the ability to deliver information in different media formats provides unique capabilities for the implementation of PBL environments. In particular, the capabilities of hypermedia have much to offer designers of advanced learning environments. Hypermedia is a rich environment containing information in many different forms, including text, graphics, audio, video, and animation. The student is not forced to access the resources in any predetermined order, but can navigate within the environment in a nonlinear fashion [Burton, Moore, & Holmes 1995]. The support of multiple media types and the possibility of nonlinear navigation are particularly useful in the creation of computer-based PBL environments.

The nonlinear nature of hypermedia is consistent with the characteristics of PBL. As students are engaged in PBL, they need to collect data and access resources. This suggests a high degree of control on the part of the learner. Hypermedia can support this by allowing students to access needed resources at the time it is most appropriate. Hypermedia allows students to have more control over their learning. They become actively engaged in decision-making while traversing the environment. Research on learner control versus program control in hypermedia environments suggests that subjects under learner control score higher than those under program control on achievement posttest and have a more positive attitude toward learning [Hannafin & Sullivan 1995].

Though PBL can be implemented with traditional media, hypermedia provides unique capabilities for its implementation. The nonlinear nature of hypermedia allows students to explore the PBL environment accessing resources as the need arises. Hypermedia can also facilitate the development of authenticity in the learning environment. Williams [Williams 1992] suggests that law and medical school curricula could be improved by the use of hypermedia environments to engage students in authentic activities within an authentic context.

1.3 Hypermedia and Cognitive Tools

When working in everyday situations, individuals use tools and resources such as computers, calculators, concepts, and formulas in order to solve problems. Therefore, tools must be considered when creating authentic environments for student learning. A tool does not necessarily have to be a tangible object. For example, an engineer may use a mathematical formula to calculate the area of a cylinder. Different disciplines and professions may use ideas and tools in very different ways.

Many researchers argue that cognitive tools can support and enhance student learning [Lajoie, 1993]. These tools come in many forms and can support students in a variety of tasks they must perform as they engage in problem solving. Hypermedia has the potential to make these tools readily available to students.

As discussed earlier, PBL occurs within a context where knowledge is naturally situated. Tools can be employed to create an authentic context in which students can work. *The Adventures of Jasper Woodsbury* series utilizes video-based scenarios in order to create a context for learning [Cognition and Technology Group at Vanderbilt, 1992]. The video segment provides a focus for the learning activity and may also help students who are poor readers. Hypermedia can also present a scenario, but has the advantage of allowing students to explore the environment in which the scenario is set.

Hypermedia can augment memory and support students in reflecting on their problem-solving process. *Sherlock I*, software that creates an environment in which Air Force technicians practice avionics troubleshooting, includes tools to support cognitive processing [Lajoie, 1993]. Avionics troubleshooting is a complex task requiring the technician to entertain many variables and remember a series of completed tests. *Sherlock I* allows the student to view the steps he or she has taken in troubleshooting a problem. The ability to view the solution path supports students in reflection on the problem solving process without the need for them to rely on their recollection of every step. The software-generated problem solving steps also make explicit student thinking, an essential component in stimulating metacognitive awareness. Likewise, reflective questions can also be effective in promoting metacognitive thinking.

Hypermedia environments can offer a comprehensive set of resources to enable students to meet their learning needs. In order for students to engage in problem solving, they must have access to information. Information can be provided to students in a number of tools. The Lab Design Project (LDP), which allows students to actively take part in sociological research concerning a fictitious biotechnology building, permits students to gather information from such diverse formats as interviews with employees, building plans, letters, and sketches [Honebein 1996].

Hypermedia can provide electronic notebooks, which, in addition to providing space for student note taking, can include advanced features to help support the student in constructing meaning. The notebook in *Bio-world* contains a section that displays the students' previous actions such as database searches and diagnoses for patients [Lajoie 1993]. These features help support the student's memory and metacognitive thinking. Other projects have augmented the traditional notebook with the ability to support multimedia, collaboration among students, and the ability to create links between concepts [Edelson, Pea, Gomez 1996].

Though literature supports the efficacy of problem-based learning, little research exists which investigates the types of tools or features that are effective in supporting students working in PBL environments. PBL software is beginning to find its way into schools. However, the relative effectiveness of the various tools incorporated in these programs has yet to be studied. In order to design an effective computer-supported PBL learning environment, it is important to understand the tools and design features included in the software, and their impact on learning. It is, therefore, the purpose of this study to examine and understand how middle school students use and interact with a piece of recently available computer-supported PBL software.

2 Research Questions

This study investigates the use of tools and design features as employed in a piece of problem-based learning software and their effectiveness on middle school students' learning of science concepts. Specifically, the following research questions formed the focus of the study:

(1) Do any navigational profiles emerge among the student teams, and if so, how do they compare in usage of the tools embedded in the PBL environment?
(2) If navigational profiles exist how do they compare in terms of the external criteria: science aptitude, recall and transfer measures, and attitude toward the environment?
(3) If navigational profiles do not exist, what is the relationship between tool use and student achievement and attitude?

3. Design of Study

3.1 Sample

The participants of the study (N = 100) were students enrolled in sixth grade science at a middle school located in a medium-sized city in the southwestern United States. The age of the students ranged from 12 - 14 years. There were approximately an equal number of male and female students. Students worked in teams of heterogeneous groups determined by the classroom teacher.

3.2 Treatment

For this research, a hypermedia-supported problem-based learning environment was developed in the content area of astronomy. The learning goals of the HALE were for students to be able to:

- Plan and implement procedures for solving complex problems
- Identify relevant information needed in solving a complex problem
- Identify the characteristics of objects in our solar system
- Describe components that comprise probes used for astronomical research
- Rationalize the design of a probe in regards to it's intended mission
- Analyze data and draw conclusions from astronomical data

The environment supports students with the following tools: notebook, bookmarks, presentation tool, probe builder, solar system database, mission database, alien database, and expert tool.

3.3 Dependent Measures

Of primary interest in this study is how students of varying characteristics working in teams utilize the tools and support present in the PBL environment and how those tools affect student learning. Therefore, all student actions in the environment were logged to a data file for analysis. Additionally, measures of knowledge recall and transfer were administered, and interviews were conducted with the participants and the classroom teacher. The triangulation of the quantitative and qualitative data sources will help to answer the research questions with richer and more detailed information.

3.3.1 Audit Trail of Tool Access

The learning environment kept a log of all student actions in the environment, notebook contents, probes built, and time spent using the program. The log consists of time and date stamped entries.

3.3.2 Recall Measure

The recall measure evaluated the amount of declarative knowledge students have concerning the astronomy concepts being taught in the study. The measure consists of multiple choice and fill-in-the-blank items. A panel of reviewers were asked to verify the validity of the measure. Items were revised until agreement was reached. The recall instrument was administered as a pretest, posttest, and retention measure. Due to the factual and objective nature of the measure, it was scored by the principal investigators. The recall measure was used to gauge the degree to which students acquire an understanding of astronomy.

3.3.3 Attitude Toward Science in School Assessment

Attitude toward science was measured with Germann's (1988) Attitude Toward Science in School Assessment (ATSSA). Germann developed ATSSA in response to the ambiguity that exists in science attitude as a construct. Germann points out that there are many dimensions that make up attitude toward science and that attitude measures must be clear as to what they measure. Attitude toward science can include such things as scientific careers, methods of teaching science, scientific interests, assessing ideas and information, and science as a subject. The purpose of ATSSA is to measure a single dimension of attitude toward science, that is, how students feel about science as a subject (Germann). The instrument consists of 15 Likert scale items and has a Cronbach alpha of 0.95.

3.3.4 Attitude Toward the Environment

The Attitude Response Log gathered information on students' attitudes toward the difficulty of the learning environment, level of interest in the activity, attitude toward learning science with computer, and attitude toward the tools. The questionnaire used in this study consisted of 20 likert-scale items. The 20 items are partitioned into statements concerning the following areas: how students perceived the difficulty of the activity (difficulty scale), what students' level of interest was in the activity (interest scale), whether students prefer learning science on computer or in class with other students (computer preferences scale), and how students liked the tools (tool scale).

3.3.5 Transfer Measures

As noted in the literature review section, students are often unable to apply what they have learned in problem solving situations. The review of literature put forth that this is due to the decontextualization of learning. Therefore, in order to evaluate student learning it is not sufficient to only measure acquisition of concepts. But one must also measure the ability to apply that knowledge in context. Hence, near and far transfer measures have been included in the design of this research.

3.3.5.1 Description of Near Transfer Measure

In order to evaluate to what degree students are able to apply their knowledge in solving problems similar to the one received in the treatment, participants were given a scenario in textual form describing a problem similar to the one received during the study. The near transfer measure was given as a posttest and used to provide information on the effects of the expert stories on student learning. . After reading the problem scenario, participants were asked to provide the following information: hypothesis, rationale, list of information needed to solve the problem, and a description of the tools needed to solve the problem.

3.3.5.2 Description of Far Transfer Measure

In order to evaluate to what degree students are able to apply their knowledge in solving problems that they have not encountered before, students were asked to solve a problem unlike those encountered during the treatment. The far transfer measure was given as a posttest and used to gauge the degree to which students are able to apply what they have learned to a novel situation. . After reading the problem scenario, participants were asked to provide the following information: hypothesis, rationale, list of information needed to solve the problem, and a description of the tools needed to solve the problem.

3.3.5.3 Scoring of Near and Far Transfer Measures

Since scoring the near and far transfer measures is subjective in nature, responses from the near and far transfer measures were evaluated by three trained graders who will be blind to the subjects' treatment conditions. Due to the large number of responses to evaluate, the responses will be randomly divided between the three graders. In order to ensure inter-rater reliability, each grader was given an additional 20% of the essays from each of the other two graders. These additional essays were randomly selected, scored, and compared with the scores from all graders. Each essay was scored in the following manner:

1. A score from 0 to 15 was given for the essay on the following criteria: (a) Quality/plausibility of the hypothesis and supporting rationale, (b) Level of incorporation of details and facts in the essay, (c) Thoroughness of analysis of needed information to support answer, (d) Number of tools cited and the appropriate use of them, (e) overall originality of ideas, (f) overall quality of the essay.
2. Scores from each of the criteria were collapsed into one overall score for the response.

3.4 Procedures

Data was collected from ten intact classes resulting in data from 60 student groups. Students were presented with information about the nature of the learning environment. They were informed that at the end of the activity they would be asked for input concerning the aspects of the environment they found useful and those they did not.

Prior to treatment, students were asked to complete the recall measure and attitude toward learning science instrument. After all groups had completed the activity, participants were asked to complete the recall measure, near transfer measure, and far transfer measure and attitude toward environment instrument. Three weeks after the completion of the study, the recall measure was administered once again to all of the participants to collect retention data.

3.5 Analyses

Since data gathering has just been completed, there has not been sufficient time to complete the data analysis. Data analysis will be completed and research results and conclusions presented in the conference presentation. In several studies of hypermedia, researchers analyzed navigational data and found that different profiles of users tended to emerge. In this study, the users were students working in heterogeneous teams of two to three students determined by the classroom teacher. Each team used the HALE as a group, and hence we will analyze the group navigational data. Individual navigational performance is difficult to record, given that the students used the learning environment as a group. To determine whether different group profiles emerge, we will analyze the group navigational data, using cluster analysis. If clusters do emerge, we can study how each cluster tends to use the different navigational tools and design features, giving us a profile for each cluster. As other authors have done in similar studies, the external variables will be compared to the profile groupings using analysis of variance procedures. If differences do exist, this will not only lend support to the existence of such profiles but also give insight into whether learning as expressed by the recall and transfer measures is different among the profiles.

If no clusters emerge, we will look for relationships between the group measures of navigational variables and the individual student measures of the external criteria. Pearson correlation coefficients and analysis of variance procedures will be used to find these relationships. Here the heterogeneity of the group may hinder the analysis. For example, if one group was composed of students of varying levels of ability, the navigational scores would be the same for all group members whereas their recall and transfer measures may range from high to low. The resulting correlation coefficients may be insignificant. In this scenario, future studies of learning environment may need to take into account an individual's navigation through the program.

4. Conclusions

As problem-based learning becomes more popular, instructional designers must find new ways to utilize technology in order to support problem-based learning. For this research an innovative problem-based learning environment was created which provided the context for learning and authentic activities for students to engage. Once the analysis is completed, it should provide insight into the tools and features that can support students of varying characteristics when working in hypermedia-supported problem-based learning environments.

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Streaming Video Cases for the Support of Pre-Service Teacher Education

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Abstract: Universities struggle with ways to help better prepare pre-service teachers for the realities of teaching in today's schools. Professional organizations call on teacher preparation programs to increase the opportunities for teacher candidates to observe good teaching and reflect on professional practice. Case-based learning provides an opportunity to immerse students in various teaching contexts where they are given opportunities for reflection. Video cases embedded in hypermedia learning environments hold great promise for providing the much needed context individuals need to learn. This project is a web-based learning environment where teacher candidates are provided a series of streaming video cases that illustrate teaching methodology. The cases are enhanced with textual descriptions, teacher reflections, and expert analyses. Since the learning environment is currently under development, there has not been sufficient time to complete a summative evaluation of the system.

1. Theoretical Framework

Reformers have urged educators to make schooling relevant to students through emphasis on learning through experience and making connections to the world outside of the school walls (Dewey, 1938). Popularization of current learning theories, such as constructivism and situated cognition, further emphasize the value of providing opportunities for students to engage in authentic activities (i.e. reflection, problem solving) in authentic contexts (i.e. real world situations). Emerging technologies such as hypermedia and streaming video provide unique capabilities for the creation of authentic contexts. These environments can provide rich experiences not economically feasible prior to the availability of technology.

This paper describes a case-based hypermedia system for pre-service teachers. Streaming video cases help provide a context for the examination of classroom teaching methodology. Expert analyses of the cases help students reflect on the essential components of the lesson.

1.1 Situated Cognition

An issue concerning school-based learning is the difficulty many students experience in applying what they have learned in school to everyday situations. Many schools are concerned with the transfer of abstract, decontextualized concepts (Brown, Collins, & Duguid 1989). Increasing amounts of research indicate that the inability of students to apply concepts learned in formal contexts is due to the abstraction and decontextualization of learning (Cognition and Technology Group at Vanderbilt 1992). Situated cognition argues that the context in which students learn and the activities in which they engage are essential to the learning process. Situated cognition helps provide a rationale for the use of video-based scenarios in this project since the cases illustrate teaching methodology in specific contexts and engage students in authentic activities such as reflection on professional practice.

1.2 Case-based Learning

Case-based learning has been used for many years in other professional fields such as business and law.
A case is a descriptive narrative based on a real-world situation. The case attempts to represent the different perspectives and context of a given situation. The essential elements of a case include realism, grounding in a rigorous examination of research and practice, and possibility for student development of multiple perspectives (Merseth, 1994). Many researchers believe that individuals problem solve by engaging in case-

based reasoning. In case-based reasoning, an individual draws upon situations that are similar to the one under consideration in order to reason or make decisions (Schank & Edelson, 1990). By providing pre-service teachers cases in streaming video format, they will have opportunities to examine teaching methodologies from many different perspectives. The video-based case provides a rich medium for providing a descriptive narrative of the situation under consideration.

2. Description of the System

The National Council for the Accreditation of Teacher Education (NCATE) has called on universities to increase opportunities for pre-service teachers to observe good teaching and reflect on professional practice (NCATE, 2000). Yet increasing pre-service teacher field experience hours is difficult and expensive. The media capabilities of hypermedia can help create rich environments that are consistent with real-world contexts. Hypermedia allows for the creation of authentic situations in which students can be immersed without the costs associated with real-world contexts.

Based on the theory and research cited, a case-based learning environment is currently under development. The environment is web-based providing pre-service teachers access to rich video-based cases that illustrate teaching methods in context. The core features of the system are listed below.

- **Streaming Video**: Streaming video provides a rich medium for the delivery of the case descriptions and allow efficient anytime anywhere access. Additionally, streaming video allows quick access to different segments of the scenario.
- **Rich Case Descriptions:** The case descriptions are enhanced with resources such as lesson plans, online readings, teacher reflections, and expert analyses.
- **Reflection:** Pre-service teacher reflections on the cases are enhanced through online discussions with their peers and university faculty members.

3. Conclusions

As case-based and problem-based learning becomes more popular, instructional designers must find new ways to utilize technology in order to support situated learning. The use of hypermedia and streaming video provides unique opportunities for the enhancement of pre-service teacher preparation. Case-based learning is well suited to teacher preparation since the method exposes the learner to concepts illuminated in context. Video enhances the cases by providing rich context and engaging students in authentic activities such as reflection on professional practice. Hypermedia enhances the learning environment by providing students control over the access to the case-based materials and enhancing the case descriptions with various media types.

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Distance Education Creating an Environment for All: Content Accessibility - Tools, Techniques, and Methods

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ABSTRACT

This paper covers various tools, techniques, and methods that educators, who are involved with Web-based distance education, may utilize to create a total environment for virtual participants. When dealing with distant participants an educator cannot know the diversity of the total group. Participants may be second language speakers, blind, deaf, or they may be color-blind, to name a few. Currently, there are techniques and methods available that can be used to create materials that will serve a more diverse population. For example, content can be translated back to the natural language of a participant. Content can be tested against browser screen readers. Materials, which contain audio/video segments, can be prepared with static captioning. Materials can be tested on monochrome monitors to test color contrast. This paper will stress tools, techniques, and methods, which are available to content designers that will assist them in opening the world of distance education to a diverse population.

INTRODUCTION

The following statement by Tim Berners-Lee [1], W3C Director and inventor of the World Wide Web, sums up what should be an essential concern of all Web-based educational content developers:

> "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect."

W3C and WAI

The World Wide Web Consortium (W3C) is committed to developing the Web to its full potential. A subset of this commitment includes promoting a high degree of usability. Yet, where do individuals go when they wish to create educational content that is accessible to a diverse population? A good starting point for developers is to survey information set forth by the Web Accessibility Initiative (WAI). WAI in conjunction with organizations around the globe pursues accessibility of the Web through the areas of: technology, guidelines, tools, education and outreach, and research and development. WAI has developed a set of Web Content Accessibility Guidelines, which when followed; help content developers create Web pages that are accessible to a more diverse population.

CAST and BOBBY

An organization that has utilized the accessibility guidelines from WAI to develop evaluation software is the Center for Applied Special Technologies (CAST). The mission of CAST is to expand educational opportunities for all people through the development and innovative uses of technology. One of its products is Bobby ResearchWare a tool for Web page authors. It helps Web content developers identify needed changes to pages so users with disabilities can more easily use their Web pages. Bobby provides authors with suggested corrections, which will help ensure content accessibility to a diverse population. Bobby recommends additions based on priority levels established by the Web Content Accessibility Guidelines.

Priority levels are three tiered. Web content developers must satisfy priority 1 checkpoints. In priority 1-accessibility issues, Bobby lists problems that seriously affect the page's usability. Satisfying priority 1 is a basic requirement for some individuals to be able to use Web documents. It places content at an approved status equivalent to Conformance Level A for the Web Content Guidelines. Priority 2-accessibility is access problems that an author should try to fix. Although not as essential as priority 1-access, these items are considered important for access. Satisfying this level removes significant barriers to accessing Web documents. It places content at an approved status equivalent to Conformance Level AA. Satisfying priority levels 1 and 2 is considered to be the minimum standard that Web authors should strive toward in their Web-based materials. Developers may address priority level 3. If they do not, one or more groups will find it somewhat difficult to access information in their pages. Satisfying level-3 improves access to Web documents. It places content at an approved status equivalent to Conformance Level AAA. CAST offers Bobby as a free public service. CAST also offers a downloadable application that meets the needs of content developers who want to test sites before publishing their content to the Web. Using the content principles and guidelines set forth by WAI and testing sites using Bobby ResearchWare places developers in line with the statement by Lynch [2]: "...*developers* are creating the street grid and social contract of a virtual society that will have concrete long-term effects on the way your organization thinks and works, and the way the world thinks of you and your mission." Educational content developers might phrase this statement in the following manner: "Access for All equals Knowledge for All." Especially in light of the fact that between 10 and 20 percent of the world's population has some type of disability.

BROWSER SCREEN READERS

For some individuals print-based text can be completely inaccessible. In recent years developers have produced electronic browser screen readers that have an ability to produce sound that resembles human speech. Although they can't match the full spectrum of human cadences and intonations, speech synthesis systems can read text files and output them in a very intelligible voice. Following the WAI Web Content Guidelines and passing priority levels 1 and 2, in most cases assures that Web content pages will be accessible to most browser screen readers. Educational content developers would do well to test their content against one or more browser screen readers to assure a less stressful journey through their education content by individuals with learning, visual, and reading disabilities.

CASCADING STYLE SHEETS

Another means of assisting individuals is to utilize cascading style sheets (CSS). Style sheets allow an author to separate the formatting from the content of the Web page. This allows authors the ability to concentrate on content separate from style. Various CSS features assist in making the Web more accessible to individuals. Authors can use the properties to control font appearance. An author can create several style sheets with different font sizes and then place a change style button on Web documents which when pressed simply cycles through the various style sheets and thus change preferences for viewers. Individuals with visual impairments are able to change the size of print by simply making a selection using the change style button instead of using browser options. Utilizing style sheets, authors can control various media types. Pages can now be tailored to specific devices and media types. Style sheets also give authors more control over voice and audio output, and other multi-media output.

SMIL

Synchronized Multimedia Integration Language (SMIL) is another tool that developers can use to make Web content more accessible to individuals. SMIL is a W3C sponsored language. When streaming multiple clips, SMIL lets the designer layout the presentation and integrate multimedia components into a unified presentation. Using SMIL authors have the ability to add static captioning to audio/video clips. Static captioning opens the audio/video information to hearing impaired individuals. It is becoming the glue that holds multimedia elements together.

FINAL STATEMENTS

Utilizing the above tools, techniques, and methods, authors can be assured that educational content is accessible to a wide variety of individuals. I have found them effective in the distance educational environment. A major gauge, but not the only measure, of their effectiveness is the improved retention rate in distance education courses in which I have been involved. I have been able to maintain a retention rate between 97 and 100 percent versus a normal retention rate of 83 percent.

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Six WWW Based Learner Supports you can Build

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Abstract: Effective teaching is systematic and well planned and student learning depends not only on student-based factors such as ability and prior knowledge, but also on the teaching context and on good management. Often, students need to be supported in gaining mastery in skills and new concepts. In this article we outline two forms of support that can be offered online which we call initial and ongoing support. Initial support is provided from the start of a course, and faded so that students can learn to self-regulate. Ongoing support is provided during a course, and is based on student input. The examples mentioned in this paper are not intended as an extensive framework for WWW-based learner support, but more as examples of good practice.

Introduction

One of the challenges for instructors when designing a course for online delivery is to provide a task that is demanding enough for the learner, but not too challenging, as the learner should be able to accomplish the task. When learning in a classroom where face-to-face contact is possible, an instructor may easily spot the difficulties students have while learning, and provide extra support, so that the learners are able to accomplish the task. When learning via Web-based environments, possibilities for face-to-face contact are reduced, making it more difficult for instructors to respond to student requests, and to provide adequate support. This paper provides some examples and opportunities for WWW-based learner support as forms of effective pedagogy. In an ongoing effort to find ways for supporting students, the settings wherein these supports are provided are varied, but have some common factors. First of all the learners are assumed to be active, which means in practice that students will be working on designing a product. Hereby the product is a proof of learning, and monitoring of progress takes place by delivering and providing feedback on a number of prototypes for this product. In some cases the result of student work is used as content for the course itself (see Collis, Winnips, & Moonen, 2000). For the teaching-learning context, a course support environment is used, and it is assumed that the supports presented in this paper can be applied in any course support environment.

Learning theory underpinning learner support

The key concept underlying learner support is scaffolding. Traditionally, scaffolding has been a principle aimed at promoting self-reliance in students. The principle of scaffolding was originally described in the context of language learning (Bruner, 1978; Wood, Bruner, & Ross, 1976), where it was used as a metaphor to describe effective interactions between a teacher and a student. The term can be traced to Vygotsky's concept of "the zone of proximal that is the actual developmental level of the learner compared with the level of potential development that can occur with guidance or collaboration with a more competent person. Scaffolding should enable learners to perform activities they were unable to perform without this support (McLoughlin, 1999). Scaffolding as a form of learner support is related to cognitive-apprenticeship theory (Collins, Brown, & Newman, 1989) in that cognitive-apprenticeship theory provides one of the frameworks in which scaffolding can be conceptualised.

When we think of scaffolding we often think of the temporary structures thrown up around buildings to support workers as they build. When the building is completed, the structures are removed, as the support is no longer needed. Similarly, in a learning context, when students can cope with a task independently, the support is faded.

Scaffolded learning should eventually result in self-regulated learning, and thus more self-reliant students. Recent developments in pedagogy and educational science also picture this more active, self-reliant role for students, self-regulating their own learning processes (Boeckaerts, 1995, 1999; Pressley, 1995; Shin, 1995; Winne, 1995); and actively creating new knowledge (Perkins, 1991). For self-directed learning, metacognition is needed (Boekaerts, 1995), which is also helpful for lifelong learning (Dunlap, 1999). As students are being supported to work self-reliantly they can learn how to learn, which is critical for their professional futures where they will be required to keep themselves up-to-date in their own professions. Designers of WWW-based learning environments can benefit from this research in order to help students learn to self-regulate their learning.

In this paper we distinguish between two types of support, initial and ongoing. Initial support is provided from the start of a course, and faded so that student can learn to self-regulate. Ongoing support is provided during a course, and is based on student input. Examples are given of initial and ongoing supports, with advantages and disadvantages, supported by attitude data from students. These examples are not meant as an extensive framework for WWW based learner support, but as examples of good practice.

Initial supports

Many forms of initial supports can be discerned. For example, learners can be given access to a database of student projects of the year before, hints can be given about common problems and planning can be provided to structure course activities. During a course, as fading is going on, students should have less need for initial supports as they learn to self-regulate. The following examples of initial support are described: giving away parts of the solution, providing WWW links, and providing video comments.

Giving away parts of the solution

When the learner has to complete a specific task, that requires a variety of cognitive skills, some form of initial support can be used to free learners from potentially boring, repetitive tasks. This enables students to engage with the more complex and cognitively demanding aspects of the task. By giving away a part of the solution the learner can devote more time to the more challenging cognitive elements of the task. Acovelli & Gamble (1997) used this form of support when learners had repeatedly demonstrated mastery of a modeling task. If a learner has proven to be able to complete a task, a computer coach will complete all of the tasks smaller components for the learner.

A similar approach was chosen in a course about learning to design educational media-products in the faculty of educational science and technology. The task was to build a WWW site with some explanation about a specific design guideline for the design of media-products. The layout for the explanation page was provided for the students, as they had already demonstrated their ability to design and build a WWW site, and the content of their explanation was more important than the layout of the page. A screendump of the template for doing this assignment can be found in Figure 1.

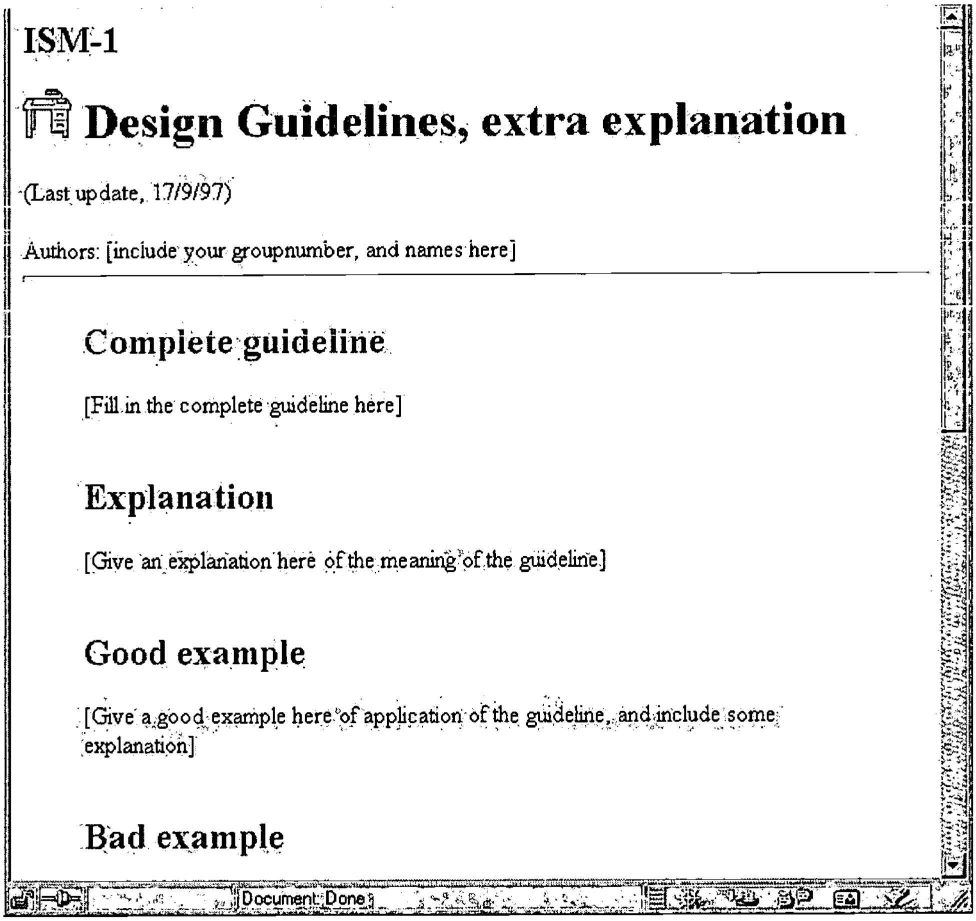


Figure 1. A WWW template for providing extra explanation about a design guideline.

By providing this WWW template, students did not spend time on doing layout for their pages, and could free more time to focus on the content, which was more cognitively demanding.

Providing WWW links

Another way to provide initial support is by providing WWW links. In a course about the theory of media use in education, called ISM-2, students were asked to design a WWW page with information about the theory of designing media-products. In the course environment of ISM-2 links were provided as starting points for the search for information about the topics students chose. When asked in the beginning of the course student scored neutral on the question whether they would like to receive more support via built in explanations on the WWW (such as text descriptions, video, examples, hyperlinks) (mean 2.97, sd 0.83, on a five point scale ranging from negative to a positive attitude), indicating at least no dislike of being supported in this way.

Video comments

In the same ISM-2 course of the last example video comments were included to give the first introduction to the topics of the course. These were 2 to 3 minutes long video clips in Realvideo format that were synchronized with the accompanying PowerPoint slides with software called 'Sync-O-Matic 2000' (available from http://www.syncomat.com/). Figure 2 shows a screendump of one of these video comments.

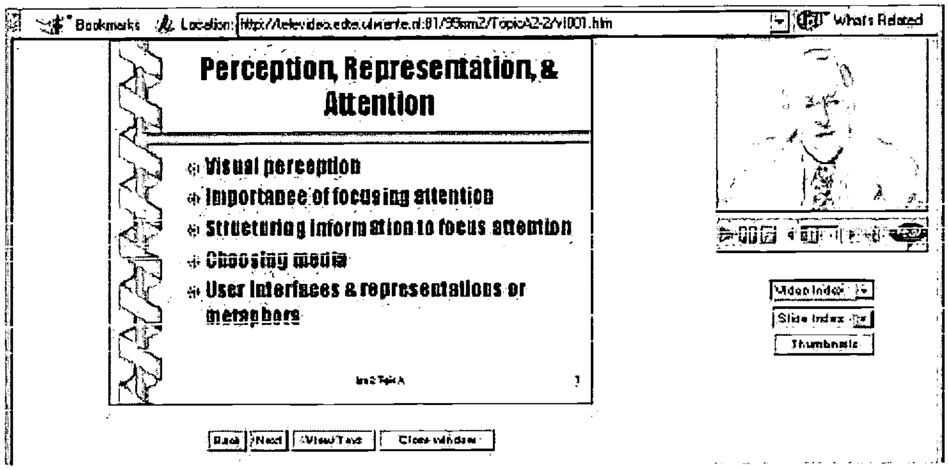


Figure 2. Video comments synchronized with PowerPoint slides as initial course support.

The text of the clips was also made available by clicking the 'View text' button. Students could browse through these comments in order to choose a topic they would like to explore further and provide more information on. Providing extra information on one of the course topics was the product students were asked to design for the course. Some, not all, students were very positive about having these video comments to study. Not so positive students experienced problems with the length of the video clips (too long), and bandwidth problems (the clips were designed for 56K modems).

Ongoing supports

There are many ways to include ongoing supports in a course. Ongoing support should be based on monitoring the progress of students. So, ongoing support is personalised support, and therefore will generally cost more time-investment from the instructor or peer-students providing this support. Further, in ongoing support scaffolding can easier take place, as support can be faded when it is no longer needed. Ways of providing ongoing support can be building a list of frequently asked questions during a course or providing hints based on student work. Three other examples are explained below.

Providing open feedback comments

The ISM-2 course was planned for students to submit several subproducts of the WWW site before submitting the final version. By way of these subproducts learner progress could be monitored and feedback could be given. First learners had to submit what articles they had chosen as an addition to the course, with a statement of the reason why they had chosen this particular article. After that learners produced a summary of the article to contribute to the course materials. When the learners improved their summaries with the help of instructor feedback they were added to the course materials. The instructor feedback typically consisted of one page, with comments about the chosen articles, personal notes about the authors, and the adequacy of fitting this article into the course.
Students were positive about receiving these kinds of extensive instructor feedback. Table 1 indicates that students were more satisfied in this course with receiving feedback from instructors than with receiving feedback from peers.

Student level of satisfaction	Mean (n = 29)	SD (n = 29)
The support from staff members is sufficient (in group sessions, by personal e-mails, conversations, etc.)	3.41	1.10
I think the support given from staff members (by personal e-mails, conversations etc) fits my actual level of knowledge.	3.62	0.88
I would like to receive more support via peer-feedback	2.71	1.05

Table 1. Student levels of satisfaction with teacher feedback compared with peer feedback [a]

[a] All scores are based on responses to a five-point scale, with 1= to strongly disagree and 5= strongly agree.

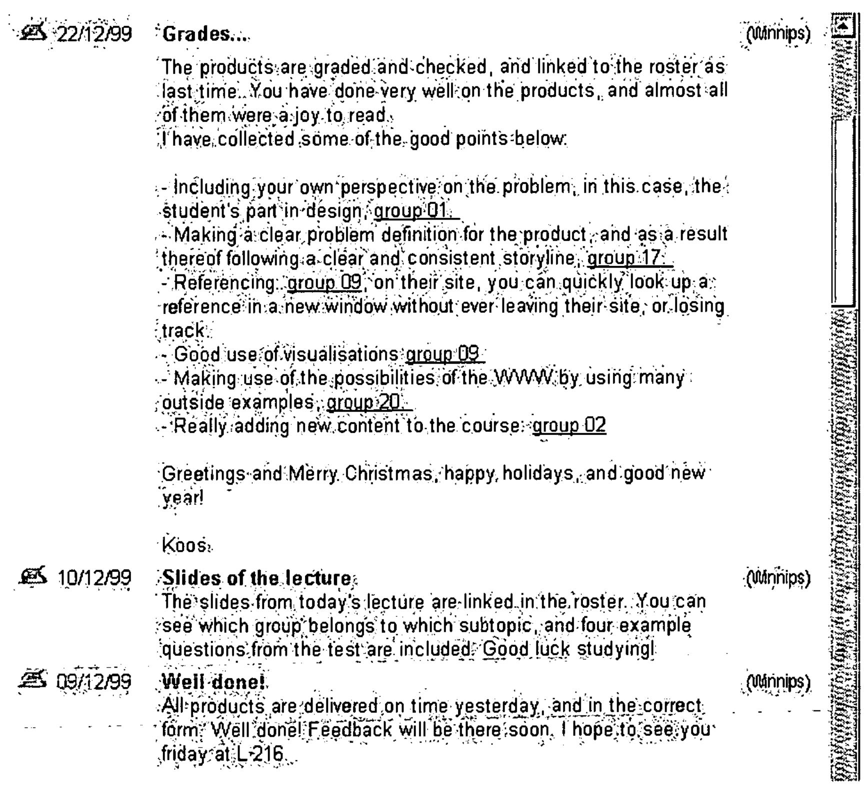
A problem with providing extensive feedback comments was instructor time-investment (see Collis, Winnips, & Moonen, 2000). In order to write the feedback, the course instructors needed to read all the proposed articles in order to form their own opinion about them, and needed to take care in recording the comments, as they were included in the course support environment. However, when we compared a group of students who received this feedback with a group that did not receive this feedback but did a similar assignment, no significant differences were found on achievement scores for the final examination of the course.

Using a peer-feedback form

Peer-feedback can be used as a way to deal with time-investment problems of instructors when they are providing open feedback comments. In a peer-feedback form groups of learners can comment on each other's work, using the criteria as stated in the course requirements as a framework for providing comments. Apart from reducing some of the workload of instructors, and providing support for students, giving peer-feedback could help students to focus on the course criteria in relation to their own work. By using the criteria for others, learners become more active and may be challenged to reflect on the criteria in relation to their own work. Form fields can be used on a WWW page to structure the feedback. When the form is posted to the course support environment learners can directly see what feedback was received and they can respond to it. Not all course support environments nowadays have the possibilities to include self-made forms. This problem was solved in one of our own courses by programming in Active Server Pages (ASP) which made it possible to include the filled-in form directly on a WWW page. Though awkward in terms of usability, this problem could also be solved by including the questions in a text file, asking the learners to add to this file, and repost it into the course environment.

Linking to good examples of student work

A further way of providing ongoing support in ISM-2 was to link to good examples of student work. The assignment of adding to the ISM-2 course materials was repeated two times in the course. After points were given for the first assignment good examples of student work were linked to the 'Newsflash' section of the course support environment. The comments in the Newsflash message related back to the criteria for the products that were provided beforehand. In Figure 3 the message with the links to good examples in Newsflash can be found.



22/12/99 **Grades...** (Winnips)

The products are graded and checked, and linked to the roster as last time. You have done very well on the products, and almost all of them were a joy to read.
I have collected some of the good points below:

- Including your own perspective on the problem, in this case, the student's part in design, group 01.
- Making a clear problem definition for the product, and as a result thereof following a clear and consistent storyline, group 17.
- Referencing: group 09, on their site, you can quickly look up a reference in a new window without ever leaving their site, or losing track.
- Good use of visualisations group 09
- Making use of the possibilities of the WWW by using many outside examples, group 20.
- Really adding new content to the course: group 02

Greetings and Merry Christmas, happy holidays, and good new year!

Koos.

10/12/99 **Slides of the lecture** (Winnips)

The slides from today's lecture are linked in the roster. You can see which group belongs to which subtopic, and four example questions from the test are included. Good luck studying!

09/12/99 **Well done!** (Winnips)

All products are delivered on time yesterday, and in the correct form. Well done! Feedback will be there soon. I hope to see you friday at L-216.

Figure 3. Message in 'Newsflash' with links to good examples of student work.

This way of providing learner support can help to give learners more clarity of what was aimed for with the criteria for products as stated by the instructor. A disadvantage of this way of learner support however is that it is a 'public display' of work, and resulting from that only positive examples should be included.

Conclusion

In this paper six examples of providing WWW based learner supports are provided. Three of them are initial supports, 3 of them are ongoing supports. Implementation of these depends on course structure and requirements, the course support-environment that is used, and the desired time investment of instructors. The supports mentioned require no advanced technologies so they can be implemented in most course support environments to help learners self-reliantly perform their tasks.

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Collaborative Technology Exploration:Bridges Between University and K-12 Education

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This paper describes and analyzes the process of five educators learning about technology as a pedagogical tool in university and public school classrooms. Information is drawn from a collaborative project between content and teacher education faculty at Saginaw Valley State University and master elementary and secondary teachers from urban and rural schools surrounding the university. Participants grapple with the effectiveness and pitfalls of technology while redesigning curricula for implementation at their various sites.

Capturing the Past: How Technology Helped Middle School Students Learn History

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Abstract: This paper describes how technology was central to the process and the outcomes of a middle school history project. The role of technology in the following areas is discussed: teacher instruction; student research; and presentation of student work. Observations suggest that students' overall learning experience is enhanced through the incorporation of technology into history teaching.

Introduction

In 1998, the Center for Technology in Teaching and Learning (CTTL) at Rice University and Hogg Middle School in the Houston Independent School District began a three-year project[1] to make history more relevant to students' lives and to incorporate technology into humanities instruction. In the spring of 2000, seventh grade history classes began exploring World War II by collecting the oral histories of community members who lived through the wartime period. Technology was incorporated into this history project as a vehicle for facilitating student research and for presenting student work. The purpose of this paper is to discuss the implementation of technology in, and its impact on, this project.

Implementation of Technology

The goal of the World War II project was not just to teach students the history of World War II, but also to capture and to preserve the history through a series of interviews with community members who lived through the wartime period. Before the students could begin assembling oral histories, they had to learn the basic facts of World War II and the methods used to collect oral history. To teach the students about World War II, the teachers relied upon a combination of traditional methods and tools such as lectures, independent student research, and textbooks and new technology—specifically Internet sites such as "What Did You Do During the War, Grandma?" [2] and the BBC's "Modern World History."[3] While conducting independent research about World War II events that were specific to their interviewees' experiences, the students discovered a plethora of additional Internet sites which expanded their understanding of the war.

To teach students about oral history methods, the teachers relied on the advice of a professional oral historian and on technology. Before the interviews began, the oral historian spoke to approximately thirty students at the school and presented the methods they needed to gather oral history. These students and their teachers then had the responsibility of returning to their classes and teaching oral history methods to the remaining students. To facilitate this task, the CTTL staff captured the presentation with a digital video recorder. The video was converted to Quicktime and Real Media formats, and then made accessible via an Internet site. Thus, when the teachers and selected students began teaching oral history methods to other students, they had an abridged version of the presentation for use in their instruction.

To present the students' work, technology was used to create an Internet site and an accompanying print booklet. Each World War II veteran's oral history interview was recorded with a digital video camera.

Carefully selected portions of the interviews were converted to Real Media format and made a part of a new Internet site entitled "The Heights Remembers World War II."[4] (Complete versions of the interviews are currently archived at CTTL.) Additionally, narratives describing the highlights of each interview were written and compiled with brief biographies and photographs of the interviewees, comments from the student interviewers, wartime memorabilia, and other special anecdotes that arose during the interviews to create a print booklet. These booklets, bearing the same title as the Internet site, were distributed to all the project's participants, community supporters, and any interested individuals. Finally, the contents of the booklet were combined with the Real Media clips of the interviews to complete the "The Heights Remembers World War II" Internet site.

Impact of Technology

The technology which was used to implement the "The Heights Remembers World War II" project contributed positively to student learning in three ways. First, technology similar to that used on the "What Did You Do During the War Grandma?" Internet site and the digital video of the oral history methods presentation provided concrete examples on which students' could model their own work. For example, one student recounted in great detail the methods that were articulated by the professional oral historian. Also, several students relished playing the role of interviewer and conducting themselves as professionals. Technology not only made the presentation of skills more interesting, but also made the students' recollections of these skills more powerful and lasting.

Second, the incorporation of technology in this project provided students with the enthusiasm and the means to learn more. The students used the Internet to research specific aspects of World War II prior to their interviews. A preliminary questionnaire was returned from each interviewee so that students could be as specific as possible in their research. Many students returned to the Internet outside of the classroom and after the interviews to further explore topics such as the Bataan Death March or women in the military. The students' independent research also yielded several informative and useful Internet sites which the teachers will use in future lessons.

Last, technology allowed the CTTL and Hogg Middle School to create a final product which served (and continues to serve) students, educators, historians, and the community at large. "The Heights Remembers World War II" Internet site not only offers a multimedia display of students' work, but is also a model project for other history teachers and students, an archive of primary sources for historians, and a lasting tribute to the community's veterans.

Faculty Development Webbing: A Model of Just-in-Time Mentoring and Beyond

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Abstract: This research-based example of good practice presents a fresh approach to faculty-development needs for technology training. The purpose of the Just-in-Time Mentoring research addresses the training needs of faculty members across career stages. Use of the faculty development model will assist faculty in staying current with technological change while reducing computer anxiety. The results of a significant difference in computer anxiety reduction through hands-on training reflected the effectiveness of this program. A case study documents "just-in-time" mentoring.

Narrative

Teaching in the digital civilization presents opportunities and rewards for making use of technology in teaching, learning, assessment and communication. However, as digital tools change and increase, public school teachers and University faculty are faced with a "need to know" challenge: meeting their training needs required to keep pace with technological change at just the right time (Papert, 1998).

This faculty-development strategy is implemented through Northeastern State University's College of Education. Students admitted to the teacher education program meet weekly with a technology instructor. The students then mentor public school teachers or university faculty members in technology integration techniques once per week.

Within the spring 2001 semester, the mentoring program was expanded to incorporate faculty/peer mentors in each academic unit at the university. The University has a ubiquitous computing environment that provided faculty development from non-academicians. The need was stated through dialogue across campus for faculty development to be conducted by faculty. Colleges were asked to select a representative who would be interested in assuming a role of instructional technology mentor to their faculty (MacArthur & Pilato, 1995).

Procedure

This research-based example of good practice presents a fresh approach to faculty-development needs for technology training. As education students meet the International Society for Technology in Education's national educational technology standards, they in turn mentor public school teachers and university faculty in the identical concepts (International Society for Technology in Education Accreditation and Standards Committee, 1996).

During the Spring 2001 semester, a study was conducted to investigate computer anxiety among undergraduate students enrolled in EDUC4823, Technology in Education. These students were asked to voluntarily participate in this study to evaluate computer anxiety reduction. Students were randomly selected for participation. Initially, students completed a participation consent form approved by the NSU Human Experimentation Advisory Committee. Students completed the Computer Anxiety Index (CAIN) published by the Iowa State University Research Foundation, Inc. (Simonson, Montag, Maurer, Oviatt, & Whitaker, 1992) at the beginning and end of the semester to identify changes produced in levels of computer anxiety.

Random number codes were assigned and individual student scores entered and compared. All individual identifying information was eliminated, insuring complete anonymity. Each student's CAIN pretest score was paired with his posttest score and sorted. Pretest scores were subtracted from posttest scores, reflecting a gain or difference in computer anxiety levels at the end of the course

Results

The results of the data analysis of the CAIN test for EDUC4823 students were based on an independent t test. The value was calculated and the data showed a significant difference in computer anxiety reduction of participating students. Statistical significance was determined at the .05 level.

The results of a significant difference in computer anxiety reduction through hands-on training reflect the effectiveness of this program. Data are currently being gathered to determine the correlation between a faculty mentoring program and a student-to-faculty mentoring program. The anecdotal data indicate a positive result of the reduction of computer anxiety via faculty mentoring.

Case Study

During the fall 2000 semester, an educational psychology faculty member was given a unique opportunity to research "Life at Sea" on a US Naval destroyer for a portion of their deployment to the western Pacific. In the process, the professor experienced teaching in the digital civilization in an unfamiliar culture in a most unexpected situation. The circumstances precipitating the opportune leave and the professor's novice skill level of the use of technology integrated in the classroom was such that she quickly solicited the aid and expertise of colleagues, which resulted in collegial mentoring and a classic case of "just-in-time" learning.

The informal mentoring situation, which took place before the professor left campus, inspired the need for online instruction and the continued dialogue with colleagues and students created the need for modification in the areas of the logistics of integration of technology in the classroom environment and the instructional procedures and awareness of personal responsibility in a hybrid class.

Conclusion

There exists a myriad of implications for this study. The faculty development model incorporated at Northeastern State University begins in the classroom with pre-service teachers partnering with public school teachers and university faculty. The mentoring aspect networks into the colleges and the university faculty in the specific colleges who serve as models for instruction to pre-service teachers. This webbing effect incorporates teaching strategies to enhance learning that carries into the professional careers of students after having participated in this open community of learners.

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Authoring Tools for Construction of Personally Meaningful Artefacts

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Abstract:

Multimedia authoring tools have long been used by teachers, to support learners in representation of their ideas when adequate technology has been available in classrooms. Through the 1980's and early 1990's, tools such as HyperCard were used extensively in schools with the emphasis on children as designers. However, many of these tools used old design metaphors and tended to constrain learners to specific ways to construct their representations of their ideas (e.g. HyperStudio). Additionally, there has been some concern expressed at the unfocused nature of the construction process within such tools. New tools are being developed to attempt to reduce the imposition of technology and to limit the recognised constraints. Designers of these tools are seeking to offer modern interface conventions and to simplify design including use of pre-constructed objects as well as task or problem templates that set goals for learners. One such tool, MediaPlant, is being used to construct tasks for learners, situated in unconstrained environments. These types of task templates, with scaffolding tools, are being investigated within classrooms.

Interactive Learning Environments

Interactive learning environments, if well designed, can support learner construction of knowledge through problem solving experiences or through more creative expression. Such frameworks are based upon arguments that learners should be placed in authentic environments that incorporate sophisticated representations of context through such constructs as "virtual worlds". The assumption is that within these environments the learner is supported by visual metaphors constructed to represent the information structure supplied and how the "world" operates. Within these learning environments, students are often given a rich set of resources to construct artefacts, which reflect their solutions to problems. Designers construct these environments assuming the resource base included has the argumentation elements and data needed to resolve the problem posed. However the transfer of skills and learning from the 'virtual world' to the real world is not always well supported.

Researchers such as Seymour Papert (Papert, 1993 p.142, 1980) have long called for more open environments based on his theoretical view of learning termed constructionism. Constructionism is based on two different senses of 'construction'. It is grounded in the idea that people learn by actively constructing new knowledge as well as asserting that people learn with particular effectiveness when they are engaged in 'constructing' personally meaningful artefacts in the context of resource rich 'virtual worlds' containing embedded tasks, designed for, or as a result of, open-ended construction by learners.

Authoring Tools Supporting a Constructionism View

Multimedia authoring tools have long been used by teachers, to address this second aspect of constructionism, when adequate technology has been available in classrooms. Through the 1980's and early 1990's, tools such as HyperCard were used extensively in schools with the emphasis on children as designers. However, many of these tools used old design metaphors and tended to constrain learners to specific ways to construct their representations of their ideas (eg HyperStudio). Additionally, there has been concern expressed at the unfocused nature of the construction process within such tools. New tools are being developed to attempt to reduce the imposition of technology and to limit the recognised constraints. Designers of these tools are seeking to offer modern interface conventions and to simplify design including use of pre-constructed objects as well as task or problem templates that set goals for learners.

MediaPlant (Wright et al, 1999) is an example of such a tool, making use of a simple design interface and drag and drop design conventions to offer children a powerful tool to represent their ideas using not only the full range of media types, but also cognitive tools to support their investigations (Harper et al, 2000). This new authoring tool for students and teachers has been designed to support student centred exploration of ideas and is based on a constructivist view of learning. Through our investigations with MediaPlant, we are identifying the pertinent characteristics of an authoring tool that best embody contemporary views of learning. Within this authoring environment, learners can rapidly construct multimedia representations of their ideas and share resources and projects with their friends across the room or around the world. Learners can reuse all of their media resources from project to project and publish their projects on the World Wide Web as interactives. A level of transportability between projects means that each new object constructed, such as active buttons or animations, can be shared and taken from project to project. Part of our research plan includes the fostering of a web-based community of users where the opportunity to share 'objects' with other MediaPlant users becomes heightened. In this way learners have a much more open and resource rich environment in which to construct representations of their ideas.

Task Driven Construction of Artefacts

Learner construction of a representation of their knowledge in open-ended environments, such as an authoring tool, may be facilitated by support tools and task templates, which represent the kernel of a project. This approach could offer learners an unconstrained environment to develop a representation of their knowledge, and at the same time scaffold the learner with pre-constructed cognitive tools to support their thinking and design approaches. Unlike constrained systems, users would be free to make use of whatever resources best suited their needs.

In order to investigate use of such environments by learners, a number of learner task templates and sophisticated mpObjects are being constructed within the MediaPlant authoring environment. Some initial generic cognitive tools have been developed and a further series of tools are under construction. This paper will report on the ways in which learners will make use of such tools to resolve a task and their understanding of the representation they have developed. An assessment of how the MediaPlant authoring environment supports contemporary views of learning will also be provided.

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Planning A Technology-based Learning Infrastructure for Recurrent Education of Police in Taiwan

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Abstract: The Central Police University (CPU) is the only institute that is responsible for police higher education in Taiwan. The two-year recurrent education program is the unique ' channel through which more than seventy thousands of police can earn a bachelor degree and an instant promotion. However, the current problems for the recurrent education are limited learning opportunities, incompetent curriculum and low cost-effectiveness. Therefore, there is a critically urgent need for technology-based learning solution to the in-service training of police in Taiwan. A learning technology infrastructure forms the focus of this paper. As the infrastructure building up, it could foster high capacity of police and promote the police learning organizations in the near future.

Background

While the situation of public security becomes rigorous daily, the threats to the police service are real. It is necessary for police departments to find solutions for manpower cultivation. Ideal solutions should focus on the intelligence of police, not on their quantity or physical strength. However, police administrators recognize that the complex demands of the job dictate that police receive as much training and education as possible. The first thing is how to improve the capacity and performance of police effectively. As Dixon (1997) stated that "police departments can be changed, have changed and will continue to change." It is no doubt that learning is the best strategy of adopting changes and that the key to change puts the components of learning into police departments. The Central Police University (CPU) is the only institute that is responsible for police higher education in Taiwan. The two-year recurrent education program is the unique 'narrow' channel through which more than seventy thousands of police can earn a bachelor degree and an instant promotion. Of course, learning does not end at the police academy. To push over seventy thousand police earning bachelor degrees is a major task for police administrators in Taiwan.

Challenges of Police Recurrent Education

Limited Learning Opportunity

The recurrent education has the great influence on police career development. According to the statistics of pass rate in entrance examination in the 1997~2000 academic year (1997: 3.5%, 1998: 3.3%, 1999: 4.3%, 2000: 4.4%), we could understand that the serious lack of the recurrent education opportunities. Because the CPU dose not supply enough educational resources in terms of facilities as well as faculties. Meanwhile, the opportunity for recurrent education is far away from the request of police nationwide.

Incompetent Curriculum

The CPU doesn't re-design a specific academic curriculum for the two-year in-recurrent education program. A number of condensed programs adopted from pre-service programs of each CPU department, and same faculty groups without practicing experience form the incompetent curricula, which cannot meet the needs of in-service training. Meanwhile, CPU has no special consider if students have enough basic knowledge. The curriculum can't meet their actual needs. So, the learning outcomes become questionable.

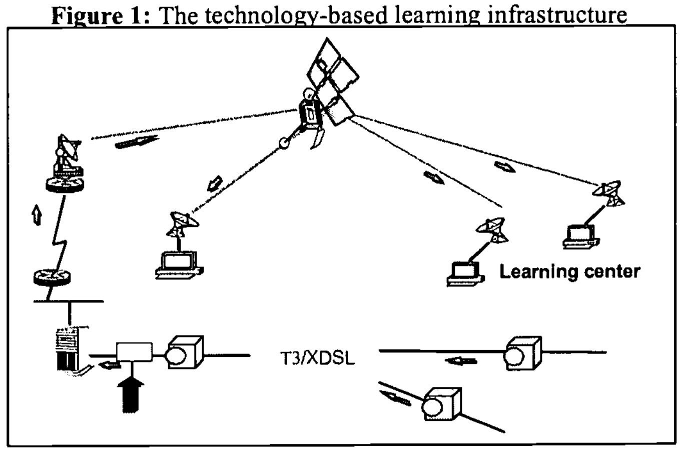
Low Cost-effectiveness

According to the statistics of police recurrent education budget, it costs approximate US$30,000 per person per year. At the same time, they do not need to work during two-year school days. Every year there are only 200 in-service police get the benefits. During their studying period, the loss of the police service value perhaps is far ahead six million US dollars every year. It is not only inefficient, but also low cost-effectiveness.

Technology-based Learning Infrastructure

To be effective, technology-based learning needs to be a 'police-driven' process. The whole technology-based learning infrastructure (Fig.1) needs to be directed towards providing an environment conducive to integrating technologies into education and training effectively. One distance learning experience for police and allied criminal justice personnel demonstrates that (1) techniques proven in past applications of distance learning continue to be valid for this medium, (2) instructional design and production know-how are vital components of successful application of the medium, and (3) available production tools do permit dedicated workers to generate effective distance learning materials with minimal technical support (Walker et al 1998).
There are four aspects that we should focus on, named Visionware (police learning organization), Hardware (broadband learning environment), Software (professional curriculum) and Peopleware (degree and program certification). A critical factor when considering the implementation of technology-based learning infrastructure is to establish a vision (Riley & Gallo 2000). To police, the vision is based on police learning organizations. Consequently, a vital role of technology-based learning could be to focus on making this type of learning available to police, especially consider police job characters and organizational culture.

Figure 1: The technology-based learning infrastructure



Conclusion

Nowadays police need to be able to think, analyze, perform, and make decisions based on life-long learning. This solution could enhance the life-long learning opportunity for police. To technology-based learning succeed, nationwide police must be highly motivated and disciplined.

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Communication Styles of Mentoring in an Electronic Forum

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Abstract: This study investigated the communication styles of five mentors in telementoring a class of 33 preservice teachers. Electronic forum was the instrument of communications between the mentors and the students. Data collected in an 8-week period resulted in 52 mentors initiated discussion threads and 43 follow-up posts. Analysis of these posts revealed four discussion threads initiating styles and six follow-up posting styles.

Introduction

With the advent of computers and telecommunication technology, Computer-Mediated Communication (CMC) has shown its impacts on teacher education in the recent years. Usage of CMC can extend the traditional preservice teacher education teaching and learning environment. CMC enhanced environment can facilitate interactions among student teachers and help building new partnerships between preservice teachers, inservice teachers, and their prospective pupils (Van Gorp, 1998). Well-designed CMC activities can result in valuable learner-centered experience. Electronic forum, one of the widely used form of CMC, by being able to support reflective dialogues and collaborative processes, can facilitate the construction of teaching knowledge of preservice teachers (Loiselle, St-Louis, & Dupuy-Walker, 1998). Successful implementation of electronic forum in preservice education programs is abundant in the literatures (e.g., Casey, 1997; Wu & Lee, 1999).

Mentoring refers to a relationship where experienced teachers work with preservice teachers to help strengthen their professional skills. Traditional mentoring relationship is usually limited by school context factors, and the characteristics of experienced teachers and preservice teachers (Wildman, Magliaro, Niles, & Niles, 1992). By using CMC as a median in mentoring, telementoring gives the mentors the flexibility to collaborate with preservice teachers at anytime and any place. It provides a mechanism for dialoguing and sharing pedagogical practices; it helps preservice teachers construct teaching knowledge through real world experiences (Dobson, 1997). Studies in telementoring have shown plausible gains of the preservice teachers (e.g., Sanchez & Harris, 1996; Wu, Lee, Chiou, & Ho, 1999). However, they also raised many issues, among others are selection of electronic mentors and timing of replying to raised questions.

Spitzer, Wedding, & DiMauro (1995) attributed the success of LabNet electronic forum for high school science teachers to that of the moderators. They noted that skilled moderators are able to use variety of modes of communication to nurture collegial connections and reflective conversations. McMann (1997) also attest to the requirement of having specific skilled moderators for fostering learning in a CMC environment. When telementoring via an electronic forum, mentors usually double as forum moderators so that they can employ their professional expertise to stimulate reflective dialogues among preservice teachers. Although there is no clear-cut qualification for being a good moderator, but being able to prompting questions and following on responses skillfully are two fundamental aspects of moderating. For example, prompted questions that only require a yes or no answer often result in no discussion. On the other hand, responses that bring about related questions have better chance of maintaining the discussion.

The purpose of this study was to investigate the communication styles of mentors in initiating and following-up discussing threads in a preservice teacher's electronic forum.

Method

In this study, we used a web-based CMC system, namely Student Teacher Network (STNet) (Chiou, Ho, Wu, & Lee, 1998), to facilitate the instruction in the Teaching Practicum course. The Teaching Practicum course concentrates on micro-teaching in the first semester and field-teaching in the second semester. Thirty-three preservice computer teachers who enrolled in the course were asked to access the course materials and to attend the discussion forum in STNet. The students were randomly assigned to five groups. Each group consisted of six to seven students and had its independent forum. Five experienced teachers, all from different schools, were invited to serve as the mentors of the groups. Each of the experienced teachers was to initiate topics for discussions and to lead the discussions in the forum of their respective group.

Data analyzed in this study were the articles posted by the mentors during a five-week micro-teaching period and a three-week field-teaching period. Two raters examined the articles. The examination focused only on the communication styles of the discussion initiating articles and the follow-up articles of the mentors. Two worksheets had been designed and used by both raters, one for the analysis of discussion initiating article the other for analysis of follow-up articles. The worksheets specified possible communication styles and their operational definitions. A preliminary analysis was conducted before the two raters actually went on rating all articles separately. As it turned out, the percentages of agreement on analysis of initiating styles and follow-up styles were 87% and 80%, respectively. The disputed points were singled out for discussion so that the two raters could adjust their bases of judgment in later analysis of all articles. The worksheets were revised after the preliminary analysis.

Results and Discussion

Participation of the forum

Table 1 is a breakdown on the post counts of data collected in an eight-week period. On the average, there are over 100 posts per week, indicating a moderate discussion activities going on the forum. Aside from Group A, the other 4 groups had comparable count. Note that the mentor of Group E is very active in the discussion forum, almost doubling the posting counts of the all the other mentors and accounts for almost a third of the posts in the group.

Table 2 gives an account on the mentor initiated discussion threads, the students' responses, and the follow-ups by the mentors. The last column indicated the average length each discussion thread. From which, the average thread length in Group E is the longest, by an average of 2 more posts than the other groups. This can be attributed to the active involvement of the mentor of the group.

Table 1: Breakdown of post counts in the forum

Group	# of students	Student posts	Mentor posts	Total posts
A	6	81	19	100
B	7	163	21	184
C	7	153	30	183
D	6	140	23	163
E	7	132	51	183
Total	33	669	144	813

Table 2: Number of mentor initiated discussion threads, number of responses by the students, and number of follow-ups posts by the mentors

Group	Mentors initiated discussion threads	Students' responses	Follow-ups by mentors	Avg. # of students' posts per thread
A	8	34	4	4.3
B	12	63	6	5.3
C	12	72	8	6.0
D	11	60	7	5.5
E	9	68	18	7.6
Total	52	297	43	5.7

Initiating Styles

By analyzing the 52 posts among the 5 mentors (see Table 2), we are able to categorize the styles of the thread initiating articles into 4 categories:

(1) Direct questioning - asking questions in a straightforward way. This mentor-questioning/student-answering style usually results in no discussion; thus causing short threads.

(2) Context explaining - providing background information to make a question more explicit and influencing the directions of the discussion. For example, one mentor initiated the thread *Which programming language will you choose to teach in high school?*:

> *In the high school computer science curriculum, computer programming accounts for 14 to 16 hours of lectures . . . . If you were a high school computer science teacher, which programming language will you teach? Why?*

Although the mentor could simply asked the question, by pointing out that there are only 14 to 16 hours of lectures allocated to teaching programming language, the discussion are therefore more focused and in depth.

(3) Experience sharing - sharing personal experience before prompting the question. For example, in initiating the thread *Have you met a ferocious teacher?*:

> *When I was in Junior high, I had a ferocious math teacher, most of my classmates disliked her, but not me (perhaps because I was good in math).... What kind of teachers would you like to be? What kind of professional relationship would you like to uphold with your students? ...*

Sharing personal experiences helps bridging the gaps between the students and the mentors. Furthermore, students are better able to immerse into the circumstance so described and therefore inducing more discussions.

(4) Greeting - starting by polite "how are you" like remarks or social conversations before prompting the question. This type of posting gives the impression of politeness; thus the discussion tends to be polite in nature. However, as indicated in Table 3, mentors are more reluctant in using this style in originating discussion thread.

As Table 3 indicated, direct questioning and context explaining styles are the favorites among the mentors.

Table 3: Categorical account of strategies used by mentors in initiating discussion threads

Strategy \ Mentor	A	B	C	D	E	Total
Direct questioning	5	4	2	4	4	19
Context explaining	1	3	7	5	1	17
Experience sharing	1	3	2	1	3	10
Greeting	1	2	1	1	1	6

Follow-Up Styles

The 5 mentors had a total of 43 follow-up posts (see Table 2). Six communication styles can be categorized from those posts.

(1) Direct answering - answering questions raised by students directly. Though quick to the point, this style provides few opportunities for further interactions with the students.

(2) Suggesting - offering several possible alternative solutions rather than giving one "right" answer.

(3) Agreeing - recognizing and agreeing with the viewpoints of the students. This gives students great self-esteem; thus more willing to participate in future discussions.

(4) Summarizing - summarizing students' discussion and refocusing.

(5) Relating - explore an issue in depth or bring up related questions. For example, when discussing about what to teach on operating systems (O.S.), one student wrote:

At first, I thought teaching Win95/98 is not necessary ....a senior teacher suggested that using Win95/98 as an example when lecturing on O.S. I now think that the students can probably better receive the lectures with the aid of a real working O.S. ...

The mentor's reply was:

Sure it was a good starting point. But don't forget to give some examples when talking about the Win95/98 architecture. BTW, what are some of the most important characteristics of Win95/98 in terms of the O.S. architecture? ...

(6) Questioning - asking for clarifications, mainly to solicit ideas and responses. For example, on the issue of Who is to blame, the teacher or the student?, one student wrote:

... Well, if the teacher comes to class well prepared, then it must be the students' fault (not learning the material taught) ...

And the mentor's reply was:

Really? Sometimes I thought I was really well prepared for the lecture and the students were all very earnest too. But they still cannot comprehend everything that I talked about. I feel so discouraged when that happened. So what went wrong? ...

As indicated in Table 4, the agreeing and relating styles are used most often, followed by the direct answering style.

Table 4: Categorical account of styles of mentors' follow-up posts

Style \ Mentor	A	B	C	D	E	Total
Direct answering	1	2	0	1	5	9
Suggesting	0	3	1	0	0	4
Agreeing	3	0	6	0	6	15
Summarizing	0	1	1	2	0	4
Relating	1	1	1	6	4	13
Questioning	0	0	1	1	4	6

Conclusions

In this study, electronic forum was used as an instrument to enhance a class of 33 preservice teachers' teaching preparation course work. They were divided into 5 groups, each group was lead by an experienced teacher acting as mentor and forum moderator. The mentors were asked to initiate group discussion topics that could entice students to participate in the discussion and to follow-up on the responses by the preservice teachers. It was found that active participation by the mentor in the discussion can prolong the discussion thread. Timely follow-up posts by the mentor was perceived by the preservice teachers that the mentor is interested in their comments.

Further analysis of the 5 mentors' 52 initial thread generating posts, four styles can be abstracted: the direct questioning, the context explaining, the experience sharing and the greeting styles. It was found that the 5 mentors most often post a question in straightforward fashion (direct questioning). Context explaining style was used quite often too.

On the follow-up posts, it was found that six categorical styles exist among the 43 posts: the direct answering, the suggesting, the agreeing, the summarizing, the relating and the questioning styles. Here the agreeing, the relating, and the direct answering styles were used most often. It seems that the follow-up posts in those 3 styles are easier to generate.

The generalization of the communication styles of the mentors is a first step toward formulation of the necessary skills of the mentors in a telementoring environment. Further investigation into the effect on students' will and posting tendencies in response to the different styles of mentoring is necessary to obtain insights into the best telementoring communication styles.

Acknowledgement

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Collaborative Adaptive Instructional Planning: Problems, Issues and Concerns

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Abstract: There are significant requirements imposed on the planning of adaptive instruction. Usually multiple experts are called to come into play and work in a collaborative manner. This paper discusses, via a proposed framework, on these problems, issues and concerns for collaborative adaptive instructional planning. It is suggested that in order to be successful, a versatile scheme for the representation and manipulation of the various related knowledges and their interactions and relations has to be in placed. Together with WWW adequately empowered with Java applets and servlets, the problems associated with "collaborativenss" are surmountable.

Introduction

Planning for adaptive instruction is a formidable task involving the consideration of many and sometimes competing factors and constraints such as the organization of subject domain knowledge for efficient information structuring on one hand and for adaptive and responsive on the other. Very often, multiple experts would participate in the process. (McCalla, 1992; Peterson, 1988)

A Framework

Here we propose a framework (see Fig.1) to facilitate the discussion on the problems, issues and concerns for adaptive instructional planning.

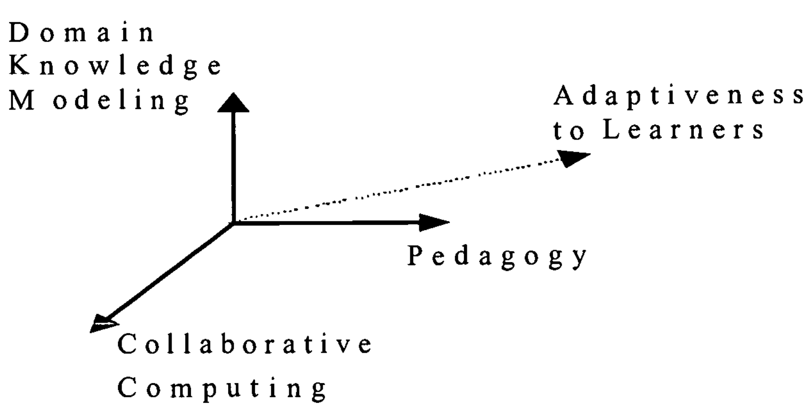

Fig.1: Framework of Dimensions for Adaptive Instructional Planning

Referring to Fig 1, there are four fundamental major dimensions related to adaptive instructional planning. They are domain knowledge modeling, ii) pedagogy, iii) adaptiveness to learners and iv) collaborative computing. Due to space reasons, the various problems, issues and concerns for adaptive instructional planning are summarized as in the following table.

Dimensions	Issues & Concerns	Problems
Domain Knowledge Modeling	• how curriculum knowledge is organized for efficient storage and versatile retrieval for instruction and learning • how curriculum knowledge is structured for easy accessing for queries • how knowledge is organized to allow for update under a many-access distributed situation	• what knowledge representation scheme can be used and manipulated for the purpose of versatile knowledge storage and retrieval, queries and update • how curriculum knowledge is presented for distributed concurrent editing and update
Pedagogy	• what learning and teaching strategies are adopted • how various styles of teaching and learning actually function based on the chosen model of domain knowledge, more particularly the selecting, sequencing and, elaborating of subject knowledge • what type and particulars of interaction are anticipated for the teaching and/or learning	• how different learning and teaching strategies can be described and prescribed • how different interaction models can be described and described • how the different models mentioned above are presented for distributed and concurrent editing and update
Adaptiveness to Learners	• what type of adaptiveness will be anticipated, e.g. reactive key-press feedback, proactive adaptiveness on learner' s states • what type and amount of learner' s information will be saved and used • how the learner' s information will be used for i) interaction; ii) learning status monitoring, iii) performance assessment and what learner models will be adopted	• how different types of adaptiveness are modeled • how different learner' s information be collected and captured and modeled in the computer • how the different learner models are presented for distributed and concurrent editing and update
Collaborative Computing	• how different experts interact for results in view of the design concerns listed above	• how the different fundamental issues related to distributed control, session management, communication and concurrency control are addressed

As shown above, the central issue and concern for adaptive instructional planning is modeling which turn out to be the problem of representation and presentation. In addition, "collaborativeness" introduces an additional dimension of collaborative computing addressing the problems of session management, communication and concurrency control. While these problems are usually tackled by shared objects/tokens, a number of criteria must be met first. They are: availability, transparency, consistency, and responsiveness (Koch, 1995). Given if the implementation is with Java applets on the web, its limitation on execution scope has also to be dealt with. As either the centralized or replicated architectures for shared object management have their own pros and cons, careful consideration should be cast on balancing simplicity, consistency maintenance, responsiveness, system robustness and latency.

Conclusions

Collaborative adaptive instructional planning has been a very difficult task for years. With a framework and tabulated discussion presented, we hope the problems and concerns could be duly exposed and expounded. It is suggested that with a properly reasoned KR scheme and notation and adequate tackling of the "collaborativeness" with the right tool, say adequate empowering of the World Wide Web (or just the Web) with Java applets and/or servlets the problem is not that insurmountable.

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A Web-based Tool for Collaborative Adaptive Instructional Planning

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Adaptive instructional planning places heavy demand on the representation and manipulation of various knowledges of domain, curriculum, student, pedagogy and communication related to instruction and is usually involving multiple experts. In order to enable the situation, apart from the availability of a versatile scheme for the representation, the support for collaboration amongst experts is also needed. Here we describe such a tool for the purpose. Namely it is a system for collaborative adaptive instructional planning adopting Abstract Connected Model (ACM) where ACM is a scheme for representing and manipulating curriculum knowledge for adaptive instructional planning. Besides the provision of support to multiple and concurrent graph editing, the system also features session control, real-time chat and local saving of instructional plan.

An ICT Based Project for The Facilitation of Equality, Understanding and Tolerance Among Israeli Jewish and Bedouin High School Students

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Abstract: One of the major conflicts in Israeli society focuses on the Jewish-Arab axis. Israeli Jews and Arabs are wary of each other and latent hostility permeates the atmosphere between the two societal groups. This study describes how Jewish and Bedouin high school students participated in workshops designed to promote inter-group mediation and bridge-building, attended a number of face-to-face meetings, and most especially interacted intensively through Internet-based chat-room and email correspondence sessions. These complementary strategies were designed to promote the societal values of understanding, equality, tolerance, and peace between Israeli Jewish and Bedouin Arab high school students. The results of the project indicate that Internet-based communication contributes to the reduction of inter-group estrangement and positively promotes the adoption of favorable inter ethnic group attitudes.

Introduction

The Internet network in its present form is the product of an exceptionally dramatic development of a communication network that evolved in the 1960s and 1970s in order to serve the needs of the United States Armed Forces in time of war. During peacetime academic institutions utilized the communication network and as time passed it became a dynamic, worldwide communication medium that turned the world into a global village (Merkle and Richardson, 2000).

There is now no doubt that the Internet serves as a social meeting place and as such it provides new opportunities for the development of interpersonal relationships (Parks and Floyd, 1996). It may be said that in modern society the Internet has greater social influence than any other medium known. This is because nowadays the Internet is used to widen ones social network, to form online virtual communities, to find a marriage partner, to become involved in successful business relationships and even to fulfill sexual fantasies (Wysocki, 1998). Thus for Internet users the face-to-face relationship has been complemented by a social technology that creates a new genre of interpersonal relationships. Today an individual "...requires little more than a computer, a modem and an ability to make conversation to find a companion of ones dreams online" (Wysocki, 1996).

Regarding the influence of the Internet on social relations it appears that early studies that dealt with Computer Mediated Relationships (CMR) led to the conclusion that the network does not create a social climate that leads to the development of interpersonal relationships because the electronic meeting is anonymous and lacks the features (such as outward appearance and non-verbal cues) of a face-to-face meeting (Sproull and Kiesler, 1991). Therefore in comparison with face-to-face meetings the relationships established via online communication are more hostile, divisive and uninhibited (Kiesler and Sproull, 1992). However recent work has raised serious theoretical and empirical challenges to this pessimistic view of Internet-based social relations and indicate that such online relations are intensive and include a large measure of self disclosure (.Parks and Roberts, 1998).

Walther (1996) pointed out that the change in the perception of the Internet as a platform for the establishment of social relationships began with the observation that many of the differences between computer mediated and face-to-face interaction diminish over the course of time. When the limitations of time are removed, online social groups as well as face-to-face groups report similar levels of affiliation. It appears that the possibility of frequently using the network for long-term communication, the opportunity to reflect and plan self presentation and the possibility to carefully choose the message to be sent provide Internet-based communication with far-reaching advantages that outweigh negative aspects of related to this medium when compared to what is achieved in face-to-face interpersonal relationships. Walther, Anderson and Park (1994) added that Internet-based relationships are characteristically more intimate and intensive than those maintained in a face-to-face setting.

A study conducted by Wysocki (1996) also indicates that Internet users form more intimate relations with their peers in less time than that taken to create traditional face-to-face connections. This finding may be explained by the seeming disadvantage of the online relationship, namely the use of anonymity which allows for self disclosure without taking any risks. This serves as a springboard for the forming of intensive, pleasurable, deep and rich interpersonal connections. An added advantage of the online relationship is the ability of the participant to "disconnect" easily from a distasteful or unsuitable connection as well as the opportunity provided by the medium to enter into simultaneous relationships with a number of people (Schnarch, 1997). Thus it appears that online relationships do not only not differ in terms of the breadth and depth achieved in offline relationships, but may also leader greater self-disclosure and feelings of intimacy.

The Mosaic of Israeli Society

In Israel there are significant historical, cultural, religious, and social differences between the ethnic groups that make up the mosaic of Israeli society. Among the different groupings are the Jewish and Negev Bedouin sectors. Between the two there is a lack of cohesion, suspicion, anxiety and even hostility (Glaubman and Katz, 1998). This tension are very much rooted in the differential level of governmental, municipal and public services available to both population groups. This leads to the widening of educational, cultural and other gaps between the Jewish and Bedouin ethnic groups in Israeli society and to resulting tensions and frustrations between the two sectors.

Characteristics of the Bedouin Population in Israel

Since the establishment of the State of Israel in 1948 the Bedouin population in Israel has undergone radical change and has been transformed from a traditionally nomadic population to one which is now largely urbanized (Ben-David,1993). The Bedouin population has been loathe to accept the process of urbanization and as time passes the Bedouins are increasingly more active in their attempts to reject government attempts to settle them in cities, towns, and villages (Glaubman and Katz, 1998). As time passes, the urbanization policies of the successive Israeli governments are perceived by the Bedouin population to be discriminatory and designed to move them from their tribal lands without consideration of their traditional, cultural, social, and economic needs (Abu-Rabia, 1986). In addition to the problem of urbanization the Bedouin population has other acute problems such as a lower standard of living than the national average and unemployment is higher than the national average. All these problems contribute to a feeling on alienation and desperation on the part of the Bedouins as well as a feeling of hostility towards the Jewish authorities and population at large.

Bedouin Education in Israel

Katz (1998) indicated that the Bedouin educational system is characterized by a number of serious limitations which mitigate against educational achievements and success. Bedouin schools are typified by a significant lack of physical facilities, such as classrooms, libraries, laboratories; a significant lack of qualified teachers; a significantly high student drop-out rate; a remarkably low rate of success in the Israeli matriculation examinations which serve as a major criterion for entry into education at the tertiary level; an almost total lack of extra-curricular activities offered to students by school authorities; and an almost total lack of parental interest in their children's educational future.

Characteristics of the Jewish Population in Israel

The State of Israel gained its independence in 1948 after the United Nations resolution (passed on 29th November 1947) called for the establishment of two states (one Jewish and one Arab) in the territory of Palestine which was ruled from the end of World War I by the British government according to a League of Nations mandate. Israel was established as a Jewish and democratic state with equal rights granted to the different minority groups residing in Israel (Talmi and Talmi, 1977). The Jewish population of Israel in 1948 was 600,000 and since then, as a result of mass immigration throughout the state's existence, the Jewish sector of the Israeli population has grown to

5,000,000. Israel has become a modern western oriented country with a well established economic, social and educational infrastructure. The per capita Jewish income in Israel approaches $19,000 per annum and the standard of living of Israeli Jews is similar to the standard of living in an average Western European country.

Jewish Education in Israel

The Jewish educational system in Israel is highly developed and enjoys a large budget which allows for dynamic development of facilities, school-based technology, advanced teaching and learning methodologies, and varied extra-curricular programs for students at all levels in the school system (Gaziel, 1999). The level of teachers is good with almost all teachers in the educational system in possession of a college degree and a teaching diploma. School facilities, such as classrooms, libraries, laboratories, computer rooms, and sports facilities are well developed; achievement of Jewish students in matriculation examinations is on a par with achievement in the average Western country; the drop-out rate of students is fairly low and, in general, Jewish parents are involved in their children's education. In marked contrast to the Bedouin population, the Jewish population in Israel can be described as generally satisfied with the educational outputs of the schools which caters for Jewish students. Jewish parents cooperate with their children's schools and provide assistance and support when necessary, and are at ease with the generally successful Jewish educational system (Gaziel, 1999).

The aim of this research was to add another perspective concerning social relationships conducted through the medium of the Internet. In this study the development of a group relationship was investigated in which Israeli Jewish and Bedouin high school students established and maintained online connections in a project designed to promote a greater feeling of equality and understanding between the students as well as to facilitate greater understanding, tolerance and peace between the two population groups.

Method

Sample

The research sample comprised four 11th grade high school classes, two attending the Jewish high school and two from the Bedouin high school. In each class there were approximately 25 students with a total of 93 students, evenly spread between the two genders, participating in the project.

Instruments

An 80-item research questionnaire was specially designed to examine Bedouin and Jewish 11th grade high school students' perceptions of the other ethnic group (Jewish students respond about Bedouins and Bedouins students respond about Jews) as well their perceptions about their own ethnic identity. The questionnaire was administered twice to the project participants in a year long "before-and-after" research paradigm.

Procedure

In the first phase of the project 6 teachers (3 from each high school) participated in an intensive two-day workshop designed to train them as moderators of student workshops in both the Jewish and Bedouin high schools. The topics discussed by the teachers during the workshop were as follows: dealing with ethnic stereotypes, perception of inter-ethnic inequality, inter-ethnic democracy and equality, inter-ethnic understanding, interethnic tolerance, and the importance of inter-ethnic peace. In the second phase of the project the Jewish and Bedouin students met in a day-long face to face gathering, during which they participated in three activities: a) all students responded to the research questionnaire which examined their perceptions of the other ethnic group as well their perceptions about their own ethnic identity; b) all students attended two lectures given by experts on inter-ethnic mediation in order to prepare them for their participation in the year-long project; and c) students participated in informal face-to-face inter-ethnic small-group meetings in which they were encouraged to get know each other and to form acquaintances that would be the basis of intensive interactions in an internet-based chat-room as well as through the medium of email. In the third phase of the project students from both Jewish and Bedouin high schools participated in fortnightly, teacher-moderated workshops on the following topics; understanding of inter-ethnic stereotypes; perceptions of inter-ethnic inequality; understanding of inter-ethnic democracy and equality; importance of and inter-ethnic tolerance. In the core project activity students from both schools participated in ongoing intensive internet-based chat-rooms in which they discussed their perceptions of each other and problems related to inter-ethnic understanding, equality, tolerance and peace. The chat-rooms were moderated by the teachers responsible for the workshops. The students also corresponded through the medium of email on topics that arose from the weekly workshops and chat-room discussions.

In a second face-to-face day-long meeting which summed up the year-long project and was similar in its structure to the first face-to-face meeting in which they participated, the Bedouin and Jewish once again responded to the research questionnaire which examined their perceptions of the other ethnic group as well their perceptions about their own ethnic identity. The students attended a lecture by a well-known Arab Israeli TV sportscaster and met in small groups for inter-group activities and discussions about their impressions of the project and how they could plan for further inter-group social contact in the future.

Results

Jewish and Bedouin students were compared in a "before-after" experimental design on the factors deriving from the research questionnaire. Two significant factors, labeled "social feelings" and "psychological attitudes", each of which had an eigenvalue greater than unity and explained 10% of the variance, were computed from the data in a primary components factor analysis with varimax rotation. The first factor, social feelings, included 11 significant items which demonstrated social affinity (such as understanding, closeness, warmth etc.) in the inter-ethnic situation. This Cronbach Alpha reliability of this factor was 0.79. The second factor, psychological attitudes, included 8 significant items which indicated psychological feelings (such as anxiety, anger, fear, tension, etc.) towards members of the other ethnic group. This factor has a Cronbach Alpha reliability coefficient of 0.71. The mean scores and standard deviations on the two factors in the "before-after" paradigm are presented in Table. 1.

Ethnic Group	Factor	Mean (Before)	S.D. (Before)	Mean (After)	S.D. (After)
Jewish Students	Social Feelings	2.56	0.53	2.89	0.70
	Psychological Attitudes	3.31	0.63	3.63	0.91
Bedouin Students	Social Feelings	3.94	0.55	3.81	0.72
	Psychological Attitudes	3.77	0.54	3.83	0.47

Table 1: Means and Standard Deviations on Social Feelings and Psychological Attitudes for Jewish and Bedouin Students in "Before-After" Experimental Configuration.

In order to establish possible inter-group differences as well as to evaluate the contribution of each factor to the differences between the two groups after their participation in the project, Discriminant Function Analyses were computed on the data obtained in the "before-after" experimental paradigm. The results of the Discriminant Function Analysis, conducted to examine differences between the Jewish and Bedouin students at the beginning of the project as well as the contribution of each factor to these differences (Table. 2.), indicated statistically significance differences between the two groups and correctly assigned 92.3% of the respective subjects to their particular groups. This analysis also indicated that the social feelings factor contributed more intensively to the inter-groups differences than the social feelings factor.

Variable	Function 1 (pre)	Function 1 (post)
Social Feelings	1.01	0.96
Psychological Attitudes	-0.05	0.15
Wilks Lambda	0.38	0.70
	P<0.00	P<0.00
Canonical Correlation	0.79	0.55

Table 2: Standardized Discriminant Function Coefficients for Jewish and Bedouin High School Students in Pre- and Post-Project Analyses

A similar Discriminant Function Analysis was conducted to examine differences between the Jewish and Bedouin samples after their participation in the project (Table.2.). The results of this analysis also indicated statistically significance differences between the two groups of students, and correctly assigned 78.25% of the subjects to their respective ethnic groups. In the post-project analysis the psychological attitudes factor discriminated similarly to the differences between the two groups whereas the social feelings factor discriminated more intensely than in the pre-project analysis.

Discussion

The aim of the project was to promote a feeling of equality, understanding, tolerance and peace between Jewish and Bedouin 11th grade high school students. It is apparent, that despite the deep social gap that exists between the Jewish and Bedouin population groups in Israeli society, a rationally constructed intervention project has the ability to contribute to bring about a greater affinity and closeness between the two participating groups.

The inter-group communication, especially utilizing the medium of an ongoing Internet-based chat-room and email correspondence through which both Jewish and Bedouin high school students were able to air their views, ask questions, pose dilemmas and receive answers from their peers apparently leads to a closing of the gap between the two ethnic groups in the domains of social feelings as well as psychological attitudes. At the onset of the project there were definite differences between the Jewish and Bedouin subjects and they were easily identified according to their inter-group patterns of social feelings and psychological attitudes (92.3% of Jewish and Bedouin subjects were correctly assigned to their respective ethnic groups). However at the end of the year-long project the sharp inter-group differences were reduced indicating that there was a definite movement of each group in the direction the other with the originally polarized social feelings and psychological attitudes partially depolarized (78.25% of Jewish and Bedouin subjects were correctly assigned to their respective ethnic groups). This reduction in the precision of the prediction of correct group membership indicates that a certain amount of positive mediation and bridge-building between the two groups took place during the communication project.

The positive results of this project indicate that the use of technology, such as internet-based chat-rooms and email correspondence, indicate that technological methodologies are similarly suitable for the promotion of intensive interpersonal contacts and attitudinal change as are face-to-face meetings and contacts. It is apparent that the technology used in the project provided the participants with additional motivation and incentive and added significantly to the inter-group contact. In summary the present study can serve as a model for the further development of the use of technology in social research based on interpersonal and inter-group contact.

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Factors Contributing to Ideal Instructional Interactivity

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Abstract: What are the factors that contribute to "ideal" instructional interactivity? In this study, subjects observed different interactive situations between a student and teacher, displayed in video format on a computer and were asked to subjectively rate the quality of interactivity for each situation. Analysis of pilot test data using multiple regression analysis showed a small but significant effect for factors of *information redundancy* and *paralanguage*.

Introduction

The purpose of this project was to determine factors that contribute to an "ideal" interaction. In particular, we examined the effects of three independent variables: redundancy of information, instructor paralanguage, and overt affective cues on one dependent variable: quality of the interactivity. These variables were selected from several possible variables of interest as they related to a structural model of interactivity (Yacci, 2000).

The structural model of interactivity posits that instructional interactivity is a loop between two entities, originating at the student and concluding again with the student. (see Figure 1.)

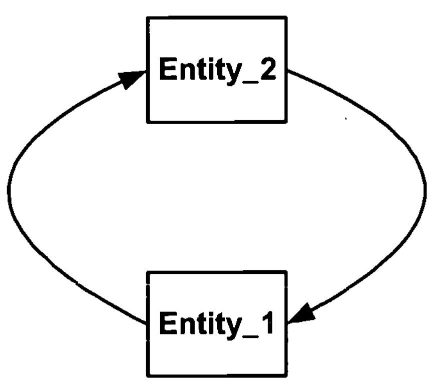

Figure 1. A completed message loop between two entities

The structural model suggests that there are factors within the loop that will make the interactivity between student and teacher more effective. Some of these factors are: the redundancy of information, the paralanguage used, overt affective cues, lag time of response, and the cohesiveness of the exchange. This study was interested in isolating and testing the effect of redundancy, paralanguage and overt affective cues and the impact observers perception of the interaction.

Theory

The quality of this interactive loop is determined by a variety of influencing variables. For instance, consider a question in which a simple response of "yes" adequately completes an interactive loop. If this "yes" response occurs 30 seconds after a question, it will probably be perceived as more immediate and useful feedback than a "yes" response occurring 30 minutes, 30 hours, or 30 days later. *Lag time of response,* (as used in this example) is one of the many structural variables that has an impact on the quality of the interaction. Some examples of other variables include message duration (the length of the message and its response), overt affective cues (statements included in the message that signify "liking" or "disliking"), paralanguage (smiles, head nods) and redundancy (the predictability of the response). *Message duration* refers simply to the time span of a particular message from its beginning to its ending. *Overt affective cues* describe statements that are included within a message that signify friendship or other "approach/avoid" inidcation. *Paralanguage* is a term used in communication theory to describe a message's nonverbal constituents such as voice tone, rate, and velocity and other non-verbal communication behaviors (Yacci, 2000). *Information redundancy* is sometimes referred to as *entropy. Entropy*, a term used in many other disciplines, was used by Shannon (1948) to describe the amount of uncertainty in messages. An example of low entropy occurs when an individual can predict an incoming message with a high degree of accuracy. In this case, the information is also considered to have high redundancy. Pierce (1961) eloquently articulates entropy by asserting, "The more we know about what message the source will produce, the less uncertainty, the less the entropy, and the less the information."

It is believed that these factors will impact the quality of interactivity. That is, these factors can be optimized to produce interactivity that is more "ideal." Although we do not know the exact values of these variables, the structural model suggests these to be important factors for further study.

The Experiment

The following three variables were investigated in this study.

1. **Paralanguage**, operationally defined by whether or not the teacher smiled and used an upbeat tone of voice.
2. **Overt affective cures**, operationally defined by whether or not the teacher used a polite phase ("Thanks for that insight, Jerry.") when talking to the student.
3. **Redundancy in the information**, operationally defined by whether or not the student responded by saying "Thanks, but I already knew that." That is, the information was not new to the student.

A repeated measures experimental design was used in which each of these variables was combined with all others, creating a total of eight treatments showing all possible combinations of these three variables. In turn, each subject was exposed to every treatment condition.

The treatments were in the form of a several short, 20 second dialogues between student and teacher. In each of the treatment conditions, the dialogue itself was kept constant, while different video clips of teacher and student were inserted, producing the eight different treatment conditions.

The program was created using Macromedia's Director, and presented the eight video treatments in a random order. The Director program also collected all of the research data. After subjects observed one of the eight treatments, they were asked to rate the level of interactivity on a scale of 1 to 10, with 1 being the "least ideal" interaction and 10 being the "most ideal" interaction. This pattern was repeated for each of the eight treatments until each subjet had seen all treatments. Also, as an option, subjects were asked to type comments in a message box to describe their ratings for each situation. All of the information entered by each subject was exported and stored categorically as text files.

Subjects

The study used 32 subjects as a pilot test of the study. This convenience sample was primarily friends and family of the experimenters with ages ranging from late 20's to 60's.

The Treatments

The following notations represented the eight treatments that subjects viewed. A brief description of each treatment follows.

SV_P_R:	Teacher smiles, using a pleasant tone of voice and a polite phase. Student responds indicating redundancy of information
SV_P_NR:	Teacher smiles, using a pleasant tone of voice and a polite phase. Student responds indicating non-redundancy of information
SV_NP_R:	Teacher smiles, using a pleasant tone of voice. Student responds indicating redundancy of information
SV_NP_NR:	Teacher smiles, using a pleasant tone of voice. Student responds indicating non-redundancy of information
NSV_NP_R:	Teacher does not smile and uses a monotone voice. Student responds indicating redundancy of information
NSV_NP_NR:	Teacher does not smile and uses a monotone voice. Student responds indicating non-redundancy of information
NSV_P_R:	Teacher does not smile, uses a monotone voice and a polite phase. Student responds indicating redundancy of information
NSV_P_NR:	Teacher does not smile, uses a monotone voice and a polite phase. Student responds indicating non-redundancy of information

Results

The purpose of the project was to pilot test the treatments. These results are preliminary and based on a small convenience sample (N= 32) and should not be generalized at this time. A replication of the study, with a larger N and under more controlled conditions is being conducted at this time.

Average Ratings of "Ideal"

Averages of the ratings from our subjects for the eight different treatments are shown in table 1, below. The highest rated treatments had the same mean score--and differed only in their presentation of the overt affective cue (in this study, the inclusion of a polite phrase by the teacher). Also interested, the lower rated treatments also differed only in their inclusion of the overt affective cue variable.

Treatment	Average
SV_P_NR	6.59375
SV_NP_NR	6.59375
NSV_NP_NR	6.125
SV_NP_R	5.65625
SV_P_R	5.65625
NSV_P_NR	5.21875
NSV_NP_R	4.9375
NSV_P_R	4.375

Key:	N= Not (Variable is off) P=Polite Phase	SV=Smiling with pleasant tone of voice R= Redundancy

Table 1. Average Ratings of Ideal for each of eight treatments.

The highest rated two treatments both showed a teacher smiling with a pleasant tone of voice and a student stating that he is receiving new, non-redundant information. However, in one treatment, an overt affective cure is used; i.e., the teacher says a polite phase while in the other treatment she does not. According to this data, it appears that the inclusion or non-inclusion of over affective cues has no effect on either of these treatments. Furthermore, two treatments tied for fourth place with all variables being equal except for whether or not the overt affective cue was included. Here again, the inclusion of the overt affective cue by the teacher does not appear to effect our subjects' ratings. The overt affective cues, apparently have little affect on the rating of "ideal."

Non-redundancy associated with the student receiving new information and paralanguage such as the teacher smiling and using an upbeat tone of voice were the only significant variables according to our multiple regression analysis.

A stepwise multiple regression analysis was used to create a model of the variables. Stepwise regression automatically includes variables that are significant, and includes them in the model in the order of the most variance accounted for. In this situation, both *non-redundancy* and *paralanguage* variables were similar individually in the amount of variance accounted for. Non-redundancy (individually) has an $r = .2249$, while Paralanguage has $r = .2213$.

Variable	Individual correlation
Non-redundancy	$r = .2249$
Paralanguage	$r = .2213$

However, there is not an additive effect in a multiple regression model, because there is overlap in the variance accounted for between the two variables. Therefore, the Multiple $r = .31553$ for the two-variable model is not a simple additive result of the two individual correlations. Multiple regression models are sensitive to the order in which the variables are entered into the equation. Stepwise regression automatically selected *non-redundancy* as the first variable in the equation based upon the amount of variance accounted for. Both variables, however, were significant at $p < .0003$. This means that there is a real effect of these variables, although the effect is relatively small. Because these numbers are small, we are led to believe that there could be other factors, which we have not measured that are contributing to "ideal" interactions.

Variable	Multiple r	significance
Non-redundancy	$r = .2249$	$p < .00001$
Paralanguage	$r = .31553$	$p < .0003$

Overt affective cues were not a significant variable, and that variable was automatically eliminated from the regression equation. This confirms what our simple comparison of the means suggests--overt affective cues are not significantly important to creating an ideal interaction.

Conclusion

This study suggests that non-redundancy of information and paralanguage are important factors in designing and improving instructional interactions. At the same time, overt affective cues do not seem to create an impact on perception of "ideal" interactivity. What does this suggest for online interactivity, for example? Based on this data, we might suggest that broader bandwidth communication, such as video, which can transmit paralanguage would be more ideal than smaller bandwidth communications. It would also appear that students might see information that is not redundant, but rather new and novel as more ideal than information and content that restates what they already know. Apparently, the inclusion of overt affective cues was not detectable by students, and consequently had little impact when used in a situation in which paralanguage could dominate.

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From Jupiter to Jerusalem: Harnessing Virtual Reality and Visualization Technologies to Teaching Planetary Sciences

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Abstract: The use of powerful visualization technologies in astronomy and planetary science education offers a new and exciting learning experience for students. Simulations and VR make use of updated scientific data. This makes the presentation of complex phenomena easier. Experience with teachers and students shows that without mentoring and guidance, the effectiveness of high-tech astronomy programs is reduced significantly.

Astronomy Teaching in the age of IT

There are many new tools that information technology (IT) offers to astronomy education. CD-ROMs packed with databases on planets and stars, publicly shared images from telescopes and spacecraft on the Web, and astronomical software that produce accurate star maps are the obvious examples. The introduction of powerful computers with very high graphic capabilities have paved the way for scientific visualization, which provides a way of observing natural phenomena that, perhaps due to their size, duration, or location, are difficult or impossible to observe directly. In astronomy, data sent back by the Hubble Space Telescope and by other spacecraft and satellites are transformed into images that are enhanced, edited, and analyzed to reveal important new details about the earth, planets and other celestial objects. Astronomers often create video animations with elaborate computer graphics to model cosmological theories and to study stellar evolution. These scientific visualization tools and techniques can be easily harnessed to science education, allowing teachers new methods to deal with the inherent difficulties of teaching complex subjects such as astronomy.

Students' Initial Conceptions of Astronomical Phenomena

Students have initial conceptions of astronomical objects and phenomena, which are often reminiscent of ancient philosophical ideas, notably the Aristotelian geocentric view of cosmos. Already Piaget noted many such conceptions in his early studies of child development, and showed that children evoke their own cosmological explanations even at very young ages. As they grow up, their early ideas are probably influenced by erroneous information presented in everyday culture and mass media (Lanciano, 1999) such as science fiction films and TV series. The private cosmological ideas become deeply rooted beliefs, which are often inconsistent with the accepted scientific view. Some of these alternative frameworks continue well into adult age, and are even found in university students. DeLaughter et al. (1998) present a variety of misconceptions found among students in an introductory Earth Science course and cites the famous Shapiro et al. (1988) video that showed Harvard graduates failing in explaining the cause of seasons. Comins (1993) identified common misconceptions students have in astronomy and derived a set of origins that account for them. This set includes, among others: factual misinformation, mythical concepts, and language imprecision, misinterpreting sensory information and incomplete understanding of the scientific process and of scientists. With the plethora of visualization tools at our disposal, it is remarkable that such misconceptions persist.

Scientific Visualization and Virtual Worlds

In its modern, digital version, scientific visualization links science, technology, computer science, and applied visual arts in the designing of systems that can translate huge amounts of quantitative data into digital graphic images. However, even a rather simple and unique form of scientific visualization in planetary sciences, such as the one introduced by Miller and Hartman (1993), can be a powerful tool for teaching. They provided vivid and spectacular renderings of the clouds of Jupiter and the rings of Saturn, the volcanoes of Io and the craters of Miranda. These images enabled one to tour and study the surfaces and atmospheres of different planetary objects in the solar system, with no other means but a still picture.

Modern ultra-fast computers enable scientists to use ever-gentler variations in color and shading to represent numerical data, that describes different aspects of natural phenomena and processes. Such representations can portray complex phenomena in their entirety and can also consist of a series of images depicting changes over time. In relation to astronomy teaching, scientific visualization can easily become a powerful strategy to overcome the described hurdles. Images from satellites and spacecraft, as well as from the Hubble Space Telescope, become a source to updated scientific information. Classroom materials, lesson plans and complete courses were already developed by NASA (see for example: http://www.thursdaysclassroom.com/) and are widely popular.

The introduction of virtual reality (VR) technologies to desktop computers have greatly increased the ability to simulate and present complex three-dimensional objects and phenomena to the average PC user (Mohler, 2000). Lately, Yair et al. (2000) described the application of scientific visualization technologies to astronomy teaching. They developed a 3-dimensional model of the solar system, which includes the sun, planets, moons, asteroids and comets. The user can navigate in space, fly above and below the ecl iptic plane, approach any object and view it from many angles. The continual motion of the planets around the sun generates basic astronomical phenomena such as day and night, seasons, eclipses and phases, which can be easily explored and studied.

A new, powerful visualization feature is the fly-over capability that permits extreme close-up views of the surfaces of Earth, Mars and the Moon. This visualization was generated from high-resolution aerial photos (Earth) and from close-by spacecraft images. F ly over enables a student to literally fly above the terrain in a desired speed and altitude, and thus to identify the main landforms and some famous locations (for example the landing sites of the Apollo missions, etc.). A student can tour the streets of London and to speed through Valles Marineris on Mars, and then to keep flying as they wish between the craters and basalt flows on the Moon. This extremely realistic portrayal of planetary landscapes further enhances the learning experience, making it enjoyable and engaging.

The Teacher's Role

This and other learning environments offer an exciting learning experience and help facilitate the construction of a proper scientific picture of the solar system (heliocentric vs. geocentric). It may seem that students can learn it all be themselves just by interacting with sophisticated programs, by mastering the various aspects of technology. Our experience with science teachers shows that users require guidance and assistance in their interaction with the VR program, and that they have difficulty in constructing their knowledge without mentoring and mediation by an instructor or teacher. The teacher s role is to guide students as they freely travel in space, pointing them to special points or phenomena that need exploring. A skilful use of visualization technology requires intensive teacher s involvement, otherwise the VR and CDs remain with limited educational benefits.

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FutureBoard: Supporting Collaborative Design Activities

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Abstract: The FutureBoard system has been developed to support collaborative design activities. Two kinds of board systems have been created: one is a Personal Board for supporting a personal reflective thinking process developed on a wireless note PC, and the other is a Collaboration Board for supporting collaborative learning and the creative process developed on a 50 inch monitor with pen input support.

Design Activities in Japanese Primary and Secondary Schools

In Japan, the national curriculum standards will be changed in the year 2002, and project-based learning known as "The period of integrated study" will be introduced into elementary and secondary schools throughout the country.

During the process of project-based learning, design activities such as making presentations and posters are of utmost importance because they give students' the chance to reflect on their ideas, as well as enter into negotiation and discussion with others. Computers have been used for design activities in project-based learning prior to this. However, they are limited to a student's individual expression when using graphic software.

At the same time, In subject such as "Art and Design" in Junior High Schools, computer-based activities to favor painting and drawing software will be officially introduced to the curriculum.

In these kinds of activities, teachers employ ordinary graphic software used by professionals. However, the software is mainly optimized for professional people, and is not meant for students.

We believe the system for educational design activities must meet the following conditions. Criterion: 1) Natural Interface 2) Supporting Collaborative Design Process 3) Supporting Expression Process.

In reference to the third Point, KARIYADO and his colleague at Daito Bunka University have developed the Paint software called "No-no-Kagami" (These words mean Reflector of the Brain). It has a unique function where a user can go back and change previous work. This enables students to reflect on the process of drawing.

Let us turn our attention now to point 2 (Supporting the Collaborative Design Process), No system has been designed for this topic. We believe that this point is especially important when it comes to designing activities in Project-based Learning.

The Design Process of Professional Designers

To this end, we analyzed the design process of professional interface designers (a university professor and two professional designers in a private corporation) in order to clarify the best way to support the collaborative design process. Let us now share some of our findings with you.

1. Using Tracing Paper
It is interesting to note that all used tracing paper in the collaborative design process. One designer drew an idea on paper, while the other put tracing paper on it, revised and added new ideas to previous ideas.
2. Fast and Interactive Process
The process was fast-paced and interactive. They sketched ideas in a few seconds and talked to themselves as follows: like a "This is better," pointing the revised idea.
3. Using Personal Spaces
Sometimes, personal spaces were used such as a small memo or a corner of the tracing paper to dot down ideas.

Outline of the FutureBoard System

Following this analysis, we made design policies for the new system that supports the collaborative design process. We named it "FutureBoard".

1. Tracing Paper Function
FutureBoard contains 8 layers of tracing paper wherein the levels of transparency can be modified. The lowest layer is called the "Master Layer", a special layer for guiding design activities such as Maps, Axes, Tables, and so on.

2. Pen Input and Drawing Tool
A user can employ the pen input (or his/her finger) similar to drawing on ordinary paper resulting in the interaction being much quicker. Moreover, the software becomes not merely a paint tool but rather a drawing tool, so that each object drawn can be moved or deleted.

3. Personal Board and Collaboration Board
Two kinds of board systems have been developed: one is a Personal Board for supporting the personal reflective thinking process use of a wireless note PC, while the other is a Collaboration Board which supports both collaborative learning and the creative process use of a 50 inch monitor with pen input support.

Personal Board and Collaboration Board

The hardware of the Collaboration Board system (CB) consists of a PC, a 50 inch projection monitor with pen input support and a wireless LAN station.
The software of CB is a simple drawing programme with 7 semi transparent layers. The user can control the visible/invisible aspects of the specific layers and at the same time, control the 5 levels of transparency. All operations are assigned to icons, thereby eliminating the need for a menu bar.
The hardware of the Personal Board (PB) system consists of a pen-based PC and a wireless LAN card.
The software of the PB is a subset of the Collaboration Board that has two layers and is optimized for SVGA screen. (The CB is of XGA size)
Initially, students will use the PB, and then send the work to the CB's layer. With the CB, they can lay ideas out on the other half of the transparent layers. And CB's data can be downloaded to a PB using the wireless LAN system.

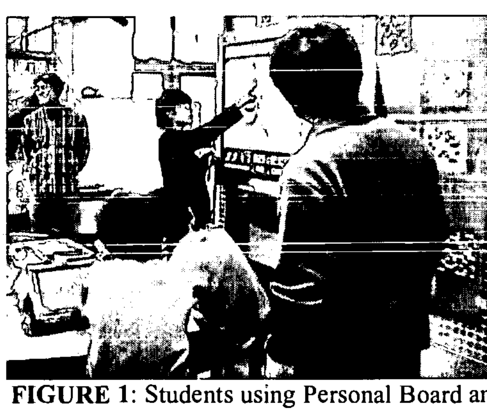

FIGURE 1: Students using Personal Board and Collaboration Board

Case Studies

The FutureBoard system was evaluated from November to December of 1999 at Utase Junior High School in Chiba Prefecture, JAPAN. The system was used in project-based learning activity involving "Makuhari Bay Town" where the students live. To meet the goals of the curriculum, small groups were formed. The students explored and researched many different aspects of their town, such as the traffic system and road safety, the soundscape of the town and so on. They reported the result of their research on the Personal Board and transferred the data to the Collaboration Board. Using Collaboration board, they discovered new ideas from the overlapped information and made final presentations to an audience composed of classmates, teachers, municipal officials and parents.

We have evaluated how these tools supported the collaborative process via protocol analysis and interviewing. In this paper, we will select three cases in order to consider the role of these systems in the educational activities.

("I" in the protocol data is an Interviewer)

Case 1-Finding relationships

When students overlapped their work on the Collaboration Board, some students discovered new ideas about the relationship or analogy between the information.

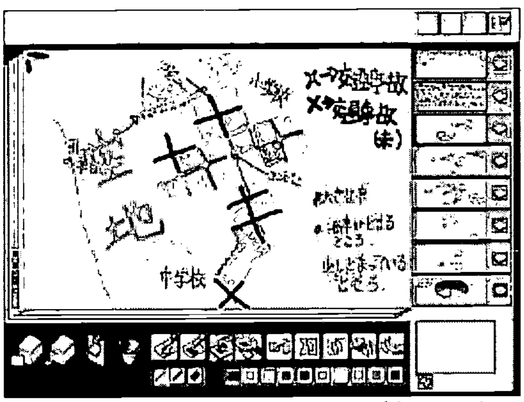

FIGURE 2: Finding relationships using the Collaboration Board

11:04:50	K	So, both dangerous places and safe places exist in close proximity..
11:04:54	I	Do you mean they are in the same place?
	K	Yes.
	O	Then They should be called dangerous places.
...		
11:35:47	O	Well, I think they might be careless there, If traffic accidents usually happen in places where people feel safe.

Table1: Protocol data of case 1

In this case, students researched traffic accidents in their town. Student M interviewed many people about areas people think are safe and areas people think are dangerous. During this time, Student K researched places where traffic accidents happened. The members of the group selected these two layers and overlapped them intentionally. They discussed their findings some traffic accidents happened in places that people think are relatively safe. This finding contradicts the common sense idea that traffic accidents only happen in dangerous places. They discussed the finding and they created a new idea that people might get careless in places they think are safe, and that in turn may cause the traffic accidents.

They changed the transparency level and exchanged layers while discussing. We infer that the characteristics of the Collaboration Board helped students' collaborative discussion process.

Case 2 – Coordination of communication style.

Many students changed their ways of expressing ideas in order to overlap their information more effectively. Some students changed their ways of expressing ideas so that they could compare the information, and some coordinated colors and shapes in order to express the relationship more clearly.

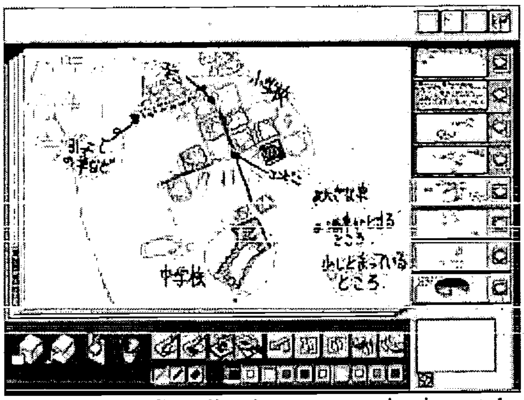

FIGURE 3: Coordinating communication style with others.

11:07:03	O	I am the only one who uses the pie chart.
O changed his work to the map based idea. (11:16)		

Table2: Protocol data of case 2

In this case, Student O made a pie chart when he worked by himself with the Personal Board. But in the process of overlaying his work with another other student's map-based work, he noticed that he could not compare his work unless he changed the style of idea to that of others. He tried to accommodate his work to the other student's work, by changing the transparency level and exchanging layers. This kind of working together is difficult to achieve without aid of the Collaboration Board.

Case 3 – Creating new styles of exchanging ideas

Some students created new styles of expression using the special transparency functions. They are interested in Art and belong to the art club at school.

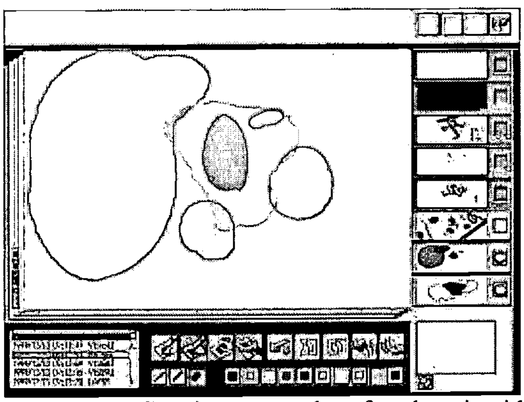

FIGURE 4: Creating new styles of exchanging ideas.

9:11:12	F	This area is vacant land, so…
9:11:27	H	How about making it transparent. (She changed the transparency level.)
9:11:32	H	That's good!
	F	It's like a gradation.

Table3: Protocol data of case 3

In this case, Student F and H discovered the change that was linked to transparency. Moreover and they create d a new 'expression' way to express their styles with subtle colors using the transparency function. These are important even crucial activities for students in Arts and Design.

Implications

1) Natural Interface encourages student's activities through trial and error.
Because the FutureBoard system is pen input based drawing tool, students can add, delete, and change information easily. As a result, they made many such trial and errors while creating their products. We found that many students moved and changed the objects other students had made in order to improve their work.

2) The real size interface activates the student's communication process.
The Collaboration Board is big enough for three to four children to access at the same time. In every group, students had lively discussions about how to express their ideas. In these processes, they often pointed to the work

on the Collaboration Board and used the word "This" or "That". This semi mediated communication style decreases the cognitive task need for the information sharing and activates greater social exchange of ideas.

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Digital Audio/Video in Multimedia: New Challenge for Educators

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Digital technology has provided a chance for non-professionals like ordinary educators to be able to create and produce their own audio/video and be professional. Texas State Board for Educator Certification has published new technology application standards for educators who want to be certified, including teachers of technology. The standards require that educators should know how to create digital audio and video products for a variety of purposes and audiences and use them in multimedia applications. This paper discusses the difference between traditional audio/video and today's digital audio/video in multimedia, examines the latest technology in digital audio, video, and streaming video, and provides a real course example of how video/audio is taught in a classroom to promote the implementation of the standards.

Preliminary Evaluation on a Web-mediated School for All

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Abstract: School for All in the EduCities is an innovative project funded by both the Ministry of Education (MOE) and the National Science Council (NSC) of Taiwan. This project aims to challenge the rationale of traditional education--only teachers educate and students learn. We want to explore via a Web Course-offering contest in the EduCities in order to know if anyone who is willing to dedicate to the Web education can teach regardless of the age and professions, if he/she wants to with the assistance of the Information Technology. In this first contest, 290 courses were registered for competition and evaluation at several phases. Consequently 15 outstanding online teachers were selected for award. The purpose of this paper is to document the process of the study and to report the results. Characteristics of the outstanding online teachers, such as age, professions and pedagogical strategies were also identified.

Introduction

The Ministry of Education (MOE) and National Science Council (NSC) of Taiwan had jointly called for innovative Internet-based research proposals in 1998 under the umbrella term of "Four-year Program for Promoting Academic Excellence of Universities." Consequently, 17 outstanding projects among the hundred candidates were selected for funding. Only one out of the 17 significant nationwide projects is related to applying information technology in education; it is entitled "*Learning Technology: Active Social Learning and Its Applications, from Taiwan to the World*." This research project for excellence aims to investigate and develop networked learning models that will profoundly affect education in the information era. The target user population is people from 8 to 80. This excellence project basically consists of four major sub-projects: 1) Future Classroom Learning; 2) Structural Knowledge Learning; 3) Task-based Learning; and 4) Community-based Learning.

This paper focuses on the preliminary evaluation the 4th sub-project implemented over the past year. The Community-based learning model will be supported by a newly established web site called "Educities." It is challenging to create a significant and rich learning environment on the Web (Palloff & Pratt, 1999). Teaching on the Internet is different from traditional classroom teaching. Many of the skills of good teaching transfer to a distance learning environment, but some additional teaching skills are required.

The Study: School for All—the First Web Course-offering Contest in the EduCities

Educities intends to provide a web-based educational environment where we can cultivate a cyber learning community with members across different sectors of society, including students, teachers, parents, volunteers and any web browsers of various professions who are willing to make a contribution. It takes city and citizen as the operating metaphor, providing a variety of opportunities for students to take roles such as peer tutors, police, and student journal editors to serve others. Through role-playing in this cyber city, students' efforts and contribution will be recognized and respected.

Nowadays students have much more intellectual freedom on the Internet (Nolan, 2000). Moreover, it has long been predicted from the advent of the Internet that if access and communication turn out to be free and natural, then the emergence of informal, subject oriented groups of learner/teachers can be expected. Those who educate will not be so exclusively teachers, but fellow browsers in cyberspace (Pickering, 1995). The Web Course-offering contest of the School for All aims to experiment with the above prediction and challenge the traditional concept of education, i.e. only teachers educate and students learn.

Purpose of the Study and Research Questions

The purpose of this paper is to provide a new perspective on Web-based instruction and learning which incorporates peer tutoring and peer assessment. Due to the limitations of this paper, the focus of this preliminary report is on the characteristics of the outstanding online teachers; more about the learners will be reported in a separate paper. A set of questions have been raised as follows:

1. Is there a possibility that we can provide courses that are accessible and free to all people in Taiwan?
2. In addition to the accredited teachers in the real world, who will be willing to and able to become the online teachers in the Internet-based learning environment?

The first online Web Course-offering contest was in 2 phases: a pre-contest/promotional phase (January through March, 2000) and a contest phase (March through June 2000). The paradigm adopted has elements of both qualitative and quantitative research methods, with the researcher collaborating with two co-researchers and five other research assistants in data collection. Major data were collected during the Web Course-offering contest during March through June 2000. In chronological order, the following methods have been employed.

On-line questionnaires. The first questionnaire requested personal and background details (demographical data, such as sex, age, profession, behaviors of using the Internet) of the online teachers and students. The follow-up questions at the end of the project solicited thoughts and feelings about their own role and specific skills experienced in teaching in or learning from the School for All.

Individual email questions. At the half-way point of the course offering, the 285 online teachers still remaining were sent an email containing a few questions about the organization, management and communication within their classes. In addition, data from each online class were analyzed to identify teachers, and students' use of the course offering system for their class management and pedagogical strategies.

Data Analysis and Preliminary Results

During the first Web Course-offering contest from March to June 2000, a total of over 17,000 participants enrolled as online learners in the School for All. In the real world, we could hardly find a school this size formed in such a short period of time. Their age distribution ranges well from 10 to 60. There were more than 968 courses offered, and in the School for All approximately 290 out of the 968 courses were registered for the contest.

In this contest, 15 students comprised an online class size minimum. Any class that failed to maintain 15 students would be cancelled. Throughout the course-offering contest, about 8% (22 out of 290) of the courses were terminated for various reasons, such as not enough students, poor course contents or inability to fulfill course requirements. The Online teachers' ages ranged from 10 to 55. The primary group of the online teachers fell in the age range of 23-30 (Figure 1). According to the data analysis, people who offered courses came from various occupations, such as psychologist, lawyer, government official, teacher, student, administrator, teaching assistant. Consequently, among the final 15 selected outstanding online teachers, 8 out of 15 were students, 5 teachers, 1 interpreter, and 1 teaching assistant

Data collected from the focus group interview, web classes and observations indicate that the 15 successful teachers in the web-based environment have certain characteristics in common. They

1. Are comfortable with the use of a computer network or Internet;
2. Enjoy the sharing of ideas and thoughts with anonymous people, and feel self-fulfilled in on-line teaching;
3. Are students in the real world (here, we mean 8 out of the 15 online teachers);
4. Are active and highly self-motivated; are very self-disciplined, and have higher expectations of themselves;
5. Are good at on-line classroom management and organizing students into groups;
6. Spend huge amounts of time (day and night) in web discussion and communication (including emailing) with students;
7. Adapt their teaching methods to accommodate the web-based learning environment by integrating creative ideas and including other means, such as group contest awards, unlimited online tests, etc., in the instructional process;
8. Tend to possess a more serious attitude and responsibility toward their course offerings;
9. Tend to establish good relationships and connections with distributed students;
10. Use their nicknames or registered codes, instead of their real names, to interact with distributed students.

According to the data collected from the focus group interview, their motivations to offer courses in the EduCities can be categorized into 3 types: 1. Self-fulfillment: to seek new information, to improve homepage skills and to enjoy teaching as a highly respected job; 2. Job-related and Job-extended: to support their primary teaching work or to associate with their research work; and 3. Group –sharing: to look for a group of people with whom the online teacher can share his/her expertise through intensive interactivity and mutual understanding; to teach and to learn.

From the data analyzed from their class homepages, the pedagogical characteristics of these outstanding online teachers included: 1. Rich web course design: Multimedia presentation to attract students; 2. Self-expression: Teacher intensively posting messages via e-newsletters and requiring students responses 3.

Dialogue: Teacher responding immediately to student's enquiries; 4. Extension of real-world teaching: Teacher using this website to enhance students' learning ; and 5. Learning Community of similar interests: Students and teachers sharing and learning closely together and having additional face-to-face meetings.

Conclusion and Future Work

The results of this study shows that people who teach excellently on the Internet are not necessarily accredited teachers. This fact indicates that the active web browsers who took advantage of web literacy could become outstanding network teachers if they dedicated themselves to web-based teaching. The result of this contest confirms Pickering's point (1995) that those who educate on the Internet will not be so exclusively teachers, but fellow browsers in cyberspace. Teaching on the Internet is different from the traditional way of teaching. It is noteworthy that without information/web literacy, accredited teachers could not become online teachers.

So far there has been only one round of the Course-offering contest. The preliminary results pave the way for our future work. In the following four years, more data will be collected through a series of different campaigns as stated earlier. The generous support from the Ministry of Education (MOE) and National Science Council (NSC) for this project enables us to conduct this research project. This study provides evidence that free courses on the Internet are possible, but not without placing substantial demands on system maintenance and teachers. The results also confirm the possibility, as mentioned in Pickering's paper, that those who educate on the Internet will return education to more convivial and less authoritarian practices. We hope that more people will participate in many significant experimental activities held in the EduCities and that meanwhile, business and industry will continue to support this innovative web site. Those on-line teachers are the representatives of the online generation who have taught us much about the 21st century and they can envision future education with their creativity, commitment and enthusiasm. Teaching online is a totally new experience. In order to be able to understand how to teach well online, we will continue to explore the possibility and potentiality of the use of the Internet via the EduCities in the years to come, while meanwhile challenging the traditional concept of formal education.

Acknowledgements

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Confident Men - Successful Women: Gender Differences in Online Learning

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Abstract: This paper describes gender differences in a cohort of undergraduate computing students studying a course that is taught flexibly. We report three years of research using pre- and post-course questionnaires, assessment results and online behaviour of the different demographic groups of students. We consider differences such as online material usage rates, formative and summative assessment completion rates, communication skills, confidence levels, student motivation and learning strategies.

The Internet and Web Development course is available as either classroom sessions or as a completely remote online course and students are free to choose how to study and which sessions to attend. The option of online learning has proven to be very popular with the students, particularly those with work and family commitments.

We found that our online course favours women and older students, who seem to be more motivated, better at communicating online and at scheduling their learning. In contrast, the male students and younger participants need the discipline that classroom sessions provide – perhaps these students approach the course and it's assessments with over-confidence. The ongoing challenge continues to be encouraging young loner males to succeed with self-paced online study.

Introduction

It is generally noted that computing is gendered, with women opting out of IT. Will the impact of online learning change this? Some researchers claim that women are disadvantaged in online courses (e.g. Blum, 1999) and that we need "women friendly cyber-classrooms". Yet our experience is that the women achieve better results than the men; it is loner males that are disadvantaged by distance learning. We argue that online courses need to be people friendly so that no learners are disadvantaged; and that motivational strategies need to be built into the course.

The Course

Internet and Web Development is a popular first year introductory course in the Bachelor of Computing Systems degree, that is studied by students with a diverse range of ages, ethnic backgrounds and life and work experiences.

Since 1999, IWD has been taught flexibly (Young et al., 1999; Dewstow et al., 2000; McSporran et al., 2000). As well as classroom sessions, we offered our students the choice of working remotely on a course website hosted using WebCT. Students could access the self-assessment quizzes, course notes and exercises in the classroom sessions or offsite at any time of day or night. The option of online learning proved to be very popular with the students, particularly those with work and family commitments.

In two summer school semesters the course has only been available completely remotely, with no face-to-face sessions. The students found this a more challenging way of studying, when there was no option of attending class to seek specific help (Dewstow et al., 2000).

Study Methodology

This study is part of an ongoing program of research that uses pre- and post- course questionnaires and focus groups, and includes the assessment results and online behaviour of the different demographic groups of students.

There have been few changes to either the method of assessment or the nature of the questionnaires over the last three years. We can thus directly compare the gender differences between the following groups of students:

- studied in class, with supporting resources online
- studied online, but had the option of attending class to seek specific help
- studied online, truly remotely, only electronic tutor-student contact

Results

Among our results are the following:

- The IWD course is more popular with women than the degree as a whole
- The women are more likely to choose to work remotely than men
- The women access many more course website pages and many more discussion forum posts than men - from 1.5 to 2 times as many pages/posts
- The women attempt more self-assessment quizzes than the men, and are much less likely to never attempt any self-assessment quizzes

semester	Female					Male					total
	Hits	Read	Posts	quiz tries	never tried	Hits	Read	Posts	quiz tries	never tried	possible quizzes
Semester 1, 1999	-	-	-	-	1	-	-	-	-	11	16
Semester 2, 1999	217.9	0.0	0.0	11.8	5	144.6	0.0	0.0	8.7	10	18
Summer School, 1999-2000	498.9	120.3	5.0	12.7	1	342.8	68.7	3.9	11.6	1	18
Semester 1, 2000	416.9	38.5	4.3	11.4	4	249.2	16.2	2.6	7.4	20	20
Semester 2, 2000	307.3	26.1	2.8	11.0	6	217.4	21.7	3.2	8.9	13	20
Summer School, 2000-2001	184.0	11.0	2.7	13.3	0	164.8	17.1	3.5	8.9	7	20

Hits = Average total number of course note webpages viewed per semester
Read = Average total number of bulletin board postings read per semester
Posts = Average total number of bulletin board postings made per semester
Quiz tries = Average total number of unique quiz attempts per semester
Never = did not record any quiz attempts over the entire semester

Table 1: Average total semester WebCT page views, bulletin board access and quiz attempts by gender.

- The women are more likely to complete all parts of all assessments, the men are more likely to fail to submit one or more parts of their assessments
- The women obtain better assessment results than the men

Female	Ass 1	Ass 2	Exam	Total
mean mark (range, std.dev.)	63.9 (46.2-70.4, σ 7.5)	62.3 (57.6-73.0, σ 5.0)	62.3 (49.1-68.4, σ 6.4)	60.0 (55.1-67.6, σ 4.8)
% NS (range, std.dev.)	0.0 (0.0-0.0, σ 0.0)	0.9 (0.0-3.4, σ 1.3)	9.7 (0.0-18.2, σ 8.0)	-
Male	Ass 1	Ass 2	Exam	Total
mean mark (range, std.dev.)	54.1 (49.5-59.1, σ 3.6)	58.0 (54.3-68.2, σ 4.4)	63.2 (60.9-67.2, σ 2.1)	54.9 (50.7-59.8, σ 3.1)
% NS (range, std.dev.)	1.5 (0.0-3.8, σ 1.4)	3.1 (0.0-9.6, σ 3.5)	13.8 (5.3-22.2, σ 6.4)	-

% NS = Non-submission (% of that group of students)
Ass1 = Assignment 1 (group research report)
Ass2 = Assignment 2 (website project)
Final = Final Exam

Table 2: Semester mean assessment marks by gender, averaged across all 6 semesters

We found that women and older students succeed on our course; they seem to be more motivated, better at communicating online and at scheduling their learning. In contrast, male students and younger participants need the discipline that classroom sessions provide. Our young males appear to be over-confident of their abilities, and lack the basic skills of time-management and self-regulation necessary for successful online study. The challenge now perhaps is to motivate young "loner" males to succeed online. Some of the motivational strategies that we use include:

- Weekly emails to the entire class that remind the students what they should have accomplished and what they need to plan for, along with more general motivational content.
- Reminder emails to those students who have not accessed the online course or not attempted any self-assessment quizzes.
- Answering bulletin board and email inquiries promptly.

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Innovative use of Bulletin Boards in undergraduate and masters level online courses

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Abstract: This paper describes the use of web-based discussion forums (bulletin boards) in undergraduate and masters level Internet and Web Development courses within the School of Information Systems and Computing at UNITEC Institute of Technology.

At both undergraduate and masters level, bulletin boards were used for general class discussions, soliciting help and advice from tutors and classmates, and inter-group communication during group research assignments. Levels of bulletin board participation across five semesters of the undergraduate course gradually increased as we tried more ways to encourage student use.

Additionally at the masters level the bulletin board was used in a variety of highly structured ways as part of the formal assessment, including both individual and group critiques and debates. This case study reports on the different assessments that were tried, and shares my experiences of what worked and what went wrong.

Both the WebCT and Blackboard CourseInfo course building shells were used, and some differences between the discussion forum facilities of each are also noted.

Introduction

Online conferences, either synchronous or asynchronous, are generally recognised as a powerful tool for active learning. As Klemm (1998) points out, they require students to "comprehend what is being discussed by others, to create ideas in the context of the topic at hand, to organize thinking coherently, and to express that thinking with carefully constructed language (hopefully, clearly and concisely)". However it is also generally recognised that students are reticent about posting in shared class spaces – perhaps because they lack the confidence to assert themselves in public, or they are afraid of embarrassing themselves in front of their peers.

In 1999 when we first used the WebCT course building shell for our Internet and Web Development course website (Young et al., 1999), we enabled the bulletin board facility and encouraged the students to use it for general class discussion and to ask questions. There was a very low level of usage, even on completely online courses where the students were denied normal classroom interaction with their peers (Dewstow et al., 2000).

In 2000 we began to use the private forum facility, so that the students could communicate with the other members of their team during their group research assignment. We also assessed their discussion, with a component of their research report mark awarded for discussions that were effective, timely, and showing evidence of discussion of content. Levels of usage of the bulletin board increased somewhat although the average number of postings made by each student was still only 3.

Also in 2000 the Masters of Computing degree started at UNITEC. This degree programme is taught part-time one weekend a month, with a large part of the course work taking the form of online discussions between the monthly class sessions. To avoid minimal student participation, many of these discussions became part of the formal assessments. Following the advice of Klemm (1998) and the ideas of my colleagues I designed several different highly structured assessments using the bulletin board of Blackboard CourseInfo.

Innovative Assessments

Website critique exercise

This assessment type was an individual component of a group research project. The students formed three member syndicates and chose a topic, and then each student submitted a critique of a single website within that general topic area. A week later the students were required to reply to the critiques of their fellow syndicate members. After a further week the writer of the critique submitted a response that integrated all the posts. Thus in a three person group, each student wrote two replies, and each student received two replies. This exercise worked well although there were a few minor problems in student usage and a high marking workload.

Debate exercise

This assessment type was a syndicate assessment and followed a typical debate format, again on a weekly basis, with the groups required to make opening and closing statements and to respond to the points made by the opposing syndicate. Some very high quality discussions resulted, although I found the exercise hard to mark.

URL Synopsis

This assessment was individual, designed to encourage the students to continue their reading around the subject and develop their communication skills. I required them to write one sentence reviews of a useful web resource. These were marked on quality and applicability of the resource and accuracy of the review. I also required the students to use simple HTML formatting – for many this was their first experience of HTML and was intended as an introduction to

Software Evaluation

Another assessment type was software evaluations. I wanted each student to evaluate one piece of software and to share that evaluation with the rest of the class to build up a deep and wide knowledge base. The first time I tried this many students had problems with HTML formatting as they tried to incorporate tables into their evaluations. As a result, the next time I tried this exercise the students used spreadsheet software and attached their evaluations to a discussion forum message.

Levels of Student Participation

Masters students would be expected to be more motivated to take part in class discussions than undergraduate students. However levels of participation in non-structured, non-assessed discussions were equally poor. Levels of participation in structured non-assessed exercises were disappointing. Only when the exercises were assessed was there near 100% participation.

Differences between WebCT and Blackboard bulletin boards

Both course-building shells offer private group and whole class forums. Both have support for HTML and attachments in posts, and discussions are threaded by topic. The major differences include:

- The Blackboard interface is slightly easier to use and has a more pleasant visual design.
- Crucially, for use in assignments, Blackboard allows students to edit their posts.
- WebCT offers a more powerful tracking mechanism, giving information about how many posts were made and how many were read by each student. Blackboard only offers summary information.

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AN INTERACTIVE MULTIMEDIA VISITING AND STUDYING PROGRAM FOR VÄRTAN TRIGENERATION POWER PLANT IN STOCKHOLM

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ABSTRACT

The Division of Heat and Power Technology at the Royal Institute of Technology Sweden, in cooperation with Birka Energi AB, has developed a "Virtual Visit of the Värtan Trigeneration Power Plant" program. The program is intended to serve as a concise yet comprehensive educational and visiting tool in the related field.

The Värtan power plant is well known for its high-tech production of electricity, heat and cooling. It supplies a large proportion of Stockholm city's district heating and district cooling demands. The program has been successfully served for the visitors to the Värtan power plant. The program has also been used in the lectures at the Division of Heat and Power Technology, Royal Institute of Technology, Sweden. Both teachers and students profoundly believe that, if combined with traditional education, this multimedia tool will enhance not only the knowledge of the students but also their interest in the Power and Energy field.

INTRODUCTION

The twenty-first century will be the multimedia communications century. The development of a global view of multimedia computers and its applications provide one a direct interactive environment for learning and career enhancement.

The Division of Heat and Power Technology at the Royal Institute of Technology, Stockholm, Sweden, has developed a "Virtual Visit to the Värtan Trigeneration Power Plant" program using multimedia technology. The major objective of this "Multimedia ance the learning process for the university students or people who are interested in the Power and Energy field. The Multimedia Visit is also a good tool for the visitors to the Värtan power plant.

Thus, this paper mainly presents the pedagogical advantages of multimedia and how this multimedia visiting tool enhance both the teaching and learning efficiencies in the field of Power and Energy Technology.

BACKGROUND AND OBJECTIVES

The Värtan power plant is Stockholm's main combined heat, cooling and power plant. Since commissioned in 1903, it has expanded and developed into one of the biggest in Europe.

The plant covers more than 65% of Stockholm city's current heating demand in the central grid. About 50% of the heating requirement is covered by heat pumps in what is in fact the biggest heat pump plant in Europe. Just over 25% is covered by coal, and slightly less than 25% by oil and electrical boilers, when needed. The Värtan plant produces annually about 2700 GWh district heating.

District cooling is extracted from cold sea water or from the cold side of the heat pumps and is distributed through a grid similar to the district heating system, with annual production capacity about 100 GWh.

Electrical output from the Oil-fired and Coal-fired Combined Heat and Power plant (Pressurised Fluidised Bed Combined-Cycle) is 220 MW and 140 MW respectively, with an annual total production of 600 GWh.

The goal of the "Virtual Visit to the Värtan Power Plant" is not to develop a multimedia show. Instead the main aim is to develop an educational tool that illustrates how a modern power plant is designed and operated in order to coop with the delicate adaptation to the economic and environmental conditions, and efficiently enhance both the students' knowledge and motivation in the Power and Energy field by using a multimedia learning environment.

ADVANTAGES OF USING MULTIMEDIA LEARNING TOOL

Multimedia complements traditional material such as books. It enriches the learning process by mixing different media, such as text, still pictures, sound, moving pictures, and animation. Good multimedia educational software simultaneously stimulates different senses, resulting in better assimilation and memory. Each student reacts differently in these two processes; for instance, some appreciate visual memory, others oral memory.

During the past years, a significant amount of multimedia-based learning program have been developed aiming to perform an effective and efficient study. Ideal educational software could be compared to a supra-intelligent teacher, able to identify the needs of each of the students. Such a tool is very hard to establish as it can be compared to an Artificial Intelligence tool. Nevertheless,

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there is one aspect that enables the user to judge a large part of the multimedia software's quality: "interactivity". Interactivity can be defined as an intelligent agent within the computer able to communicate with the user depending on user's requirements. For instance:

- Make suggestions to the users;
- Give answers to the interrogations;
- Evaluate the user's assimilation of the knowledge;

Apart from providing benefits to the students, the multimedia educational software can also bring support to the teachers in terms of availability during the lectures. Lecture notes can be updated and integrated in the multimedia educational software as well.

Moreover, the multimedia-based on-line technology has been a great potential for the distance education in the future. The use of World Wide Web has been introduced into the program, where the users can browse some useful web-site or journals related to the subject covered.

Convinced by the tremendous advantages which could result from the application of multimedia education to the field of Power and Energy field, the Division of Heat and Power Technology, in cooperation with Birka Energy in Sweden, has initiated this effort and developed the "Virtual Visit of the Värtan Power Plant" program.

The "Virtual Visit" program can be also integrated in the "Multimedia Educational Package[6]" developed at the Division of Heat and Power Technology, serving for the practical part of this electronic learning tool.

GENERAL LAYOUT OF THE PROGRAM

The program has been developed by using authoring software: Macromedia Director. Several aspects of the Värtan Power Plant have been developed in the "Multimedia Visit". The ones shown here are History, Guided-Tour, Tour of Your Own, Environment, Frequently Asked Questions and Quiz. The whole program is developed in a way to be user-friendly and attractive to the students. The user can start with the program by entering a "Guided-

Guided-Tour

The Guided-Tour gives the users an overview of the Värtan plant, the main production units and the main sites of the plant, providing the visitors a feeling how a real power plant is sited and operated.

The guided-tour is a 10 minutes' general tour from the plant site to the harbour site, with both speakers and texts available. During the Guided-Tour the visitors can also get access to different production units and components to get detailed information by using the bottom tool bar, or they can go back to the previous scene or jump to the next scene if they want. A small arrow-guided map is always available in each scene to show where the visitors are in case they get lost (Fig. 2).

History

History provides the users an overview of the development and the technical milestones of the Värtan power plant over nearly 100 years since commissioned in 1903. Many historical photos and information are available in this part (Fig. 3).

Tour of your own

"Tour of your own" consists of three sections: The Trigeneration System, The Plant Site and The Harbour Site (Fig. 4).

The "Trigeneration " concept and the practical operation of the power plant are introduced and shown to the users (Fig. 5).

By laying out all the production units at the plant site (Fig. 6) and the harbour site (Fig. 7), the users can easily enter their interested site to get detailed information. For example, if the user visit the "Oil-fired Combined Heat and Power Plant", he will have the possibility to get the general information of the plant, the process flow chart, the heat balance of the process, the steam turbine, the boiler, and the control room. Also the users can go inside to see the components and equipment within the plant. Moreover, for each production unit, there are quiz questions specifically designed for the students to evaluate and enhance the quality of the Study-Visit.

Environment

"Environment" (Fig. 8) highlights the environmental concern and efforts that the Värtan power plant has made to maintain one of the Europe's not only biggest but also cleanest combined heat and power plants.

Electricity is an environmentally friendly source of energy and is indispensable for a cosy environment with light and heating. District heating has contributed a great deal to the improved environment by reducing local firing. The district cooling system has greatly reduced individual use of harmful refrigerants. Cleaner fuels, new production and emission technology, are being successively introduced.

In the program, it has shown that the emissions of dust, nitrogen oxides and sulphur oxides have all been reduced. For sulphur and nitrogen oxides, the total reduction is several thousand tons.

Frequently asked questions

A brochure of "Frequently Asked Questions" is developed for this part, where the users can find many common questions they might come up with during the visit (Fig. 9). These questions are ranging from very general ones to the technical ones, the answer to each question is always available under the form of hypertext or link to certain part of the program.

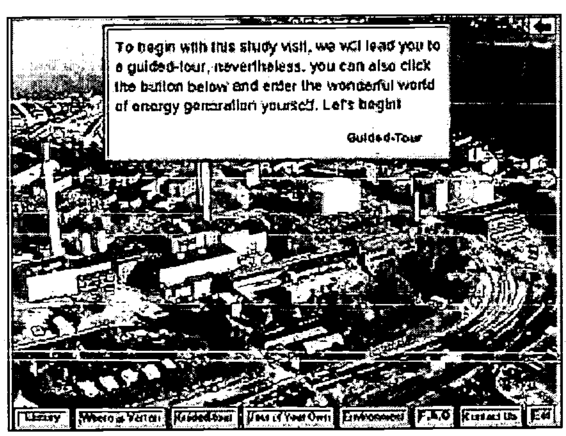

Fig. 1: The user can start with a "Guided-Tour", nevertheless, it is up to the user to choose the content by using bottom bar.

[6] An interactive learning platform focusing on Heat and Power Technology

Fig. 2: One site in the "Guided-Tour".

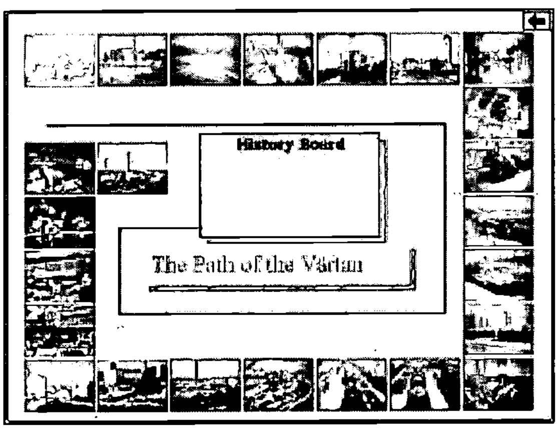

Fig. 3: Interface of "History".

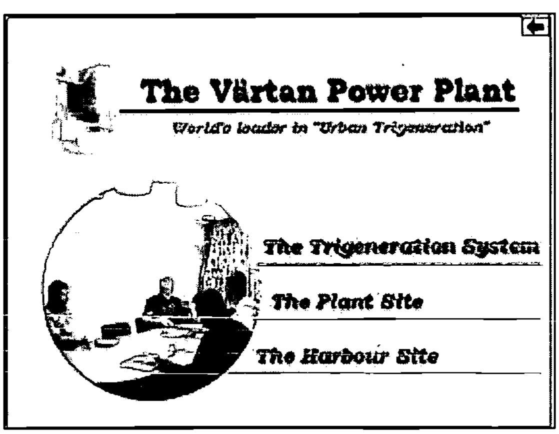

Fig. 4: The interface of "Tour of Your Own".

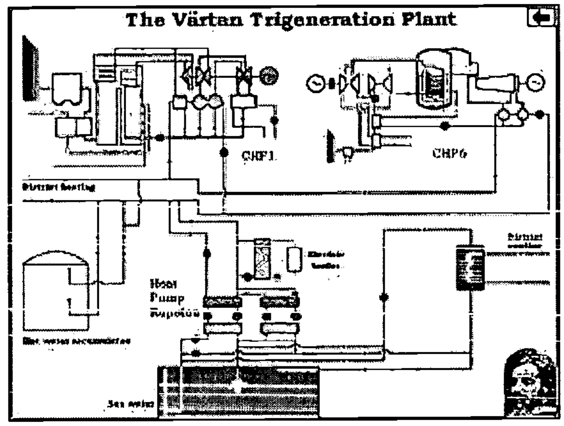

Fig. 5: The Trigeneration system at the Värtan power plant.

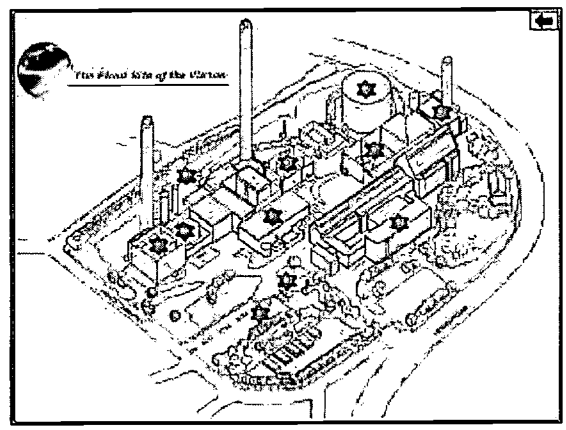

Fig. 6: The layout of the plant site.

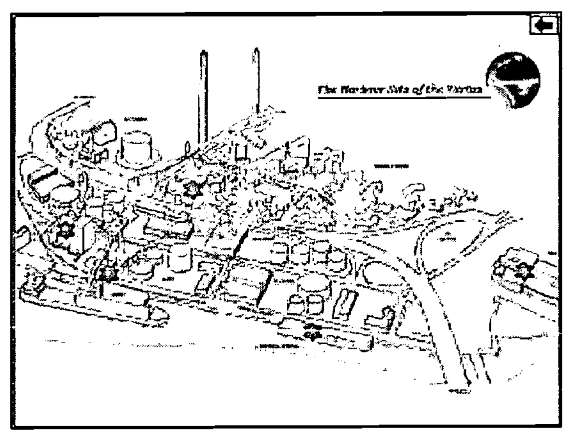

Fig. 7: The layout of the harbour site.

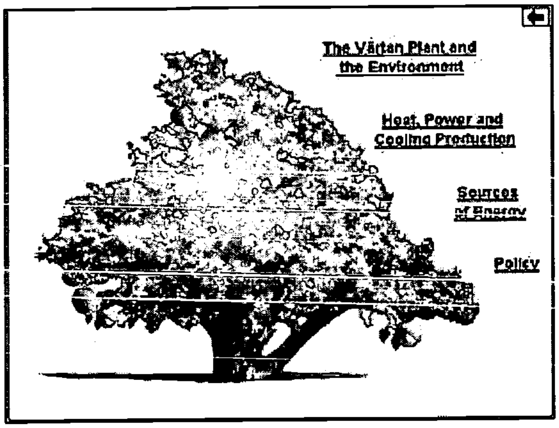

Fig. 8: The Interface of "Environment"

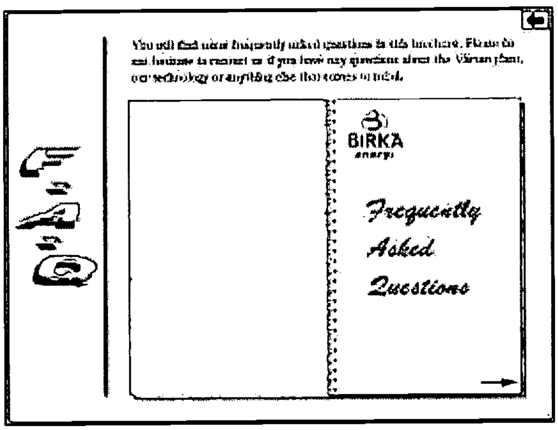

Fig. 9: The brochure of "Frequently Asked Questions"

USING MULTIMEDIA FOR TEACHING AND TRAINING

Using multimedia for teaching and training must fulfil two main objectives: it must improve the pedagogical quality of teaching when used by the teachers and it must increase learning speed and quality when used by the students or trainees.

Presently, the "Virtual Visit to the Värtan Power Plant" is developed as a complement to the Heat and Power course at the Chair of Heat and Power Technology. The program can be also used as a training tool for the trainees in the industry.

As a student, why should I use this program

For the students studying Heat and Power Technology, an important aspect enhancing their knowledge is getting practical experience by visiting the real power plant. This "Multimedia Visit" gives the students a unique opportunity to visit the world's first Trigeneration power plant right from their desktop. The "Multimedia Visit" is designed in a way that the students will learn more, better and faster when complementing it with the conventional education.

The first advantage of using this program is that the student will get a feeling how the knowledge learnt from the lectures and books are applied in the reality. For example, when studying combined cycle theory, the students can use this program to find out how the CHP1 plant is designed at the Värtan plant, similarly, when studying gas turbine, the students can go to the PFBC plant to see how the gas turbine is designed and operated there. In this way, the students will get a better understanding and an enhanced knowledge of what they are supposed to learn during the lecture.

Secondly, using multimedia-based products for study is time-independent, the students can use it at school, at home at any time they want. It is faster and time-efficient compare with a real visiting of the power plant. However, this "Multimedia Visit" is not intended to replace the real study visit, it is simply a complement to the lectures and the visit of the real power plant in order to enhance the quality of learning in the related area.

Moreover, letting the students to visit the plant with questions is also an important pedagogical objective of this "Multimedia Visit". There are many questions related to the corresponding production units in the Study-Visit. Since some of the questions will be also related to the further exam, the students will have to think about it when they use this "Multimedia Visit" or go to the real power plant. This will, in turn, enhance the knowledge they assimilate in the lecture and the quality of the real study visit.

What can I learn from this program

The program explains how a modern power plant is designed and operated in a multimedia environment. The Värtan plant is the world's first Trigeneration power plant for a high-tech production of electricity, heat and cooling. For the future engineers, visiting the Värtan plant is a great opportunity to learn how the Trigeneration system, district heating system and each single production units are operated in a modern power plant.

This "Multimedia Visit" provides the students an efficient tour of the system and production units, they will be able to learn some important points such as:

- How the Trigeneration system is designed and operated in a modern power plant?
- How does the district heating production work in a modern power plant?
- How the heat and electricity are produced at the Combined Heat and Power Plant?
- How the heat and electricity are produced using PFBC (Pressurised fluidised Bed Combustor) technology?
- How is district heating and cooling is produced using heat pumps?

Furthermore, the program includes many other technical subjects related to the visit, such as the technical layout the CHP plant, the basic principle of the heat pump and so on. The purpose is to make this "Multimedia Visit" easy, time-efficient and user-friendly.

I can browse the program beforehand and afterwards to ensure a high quality of the real visit

Of course, this is also one of the purpose of the program. The program, which is stored in the CD-ROM currently, can be used at home, at work, even travelling. By playing the CD-ROM, the user can have an overall feeling of how the Värtan plant is sited and operated, and can also have a detailed repetition of the visit afterwards.

The role of this program in the classroom and training process

Again, this program is not intended to replace traditional book and teacher. It is used as a good complement in the classical teaching environment to enhance the quality of teaching and learning process.

USING MULTIMEDIA FOR THE VISITORS AND COMMERCIAL PRESENTATION

Every year many visitors visit the Värtan power plant to see how urban "Trigeneration" really works. The visitors represent a wide cross section of both the domestic society and from abroad. The "Multimedia Visit" can serve as a good tool for the visitors, providing them information on the plant from both general and technical perspective in an efficient way.

The "Multimedia Visit", which will be put on the Internet later on, is also an effective way to present this world's first "Trigeneration" plant. It can be also used by the business persons for commercial presentation.

CONCLUSIONS

In cooperation with Birka Energi AB, the Division of Heat and Power Technology at the Royal Institute of Technology, Sweden, has developed a "Multimedia Visit of the Värtan Power Plant". The Virtual Visit contains detailed information on the "Trigeneration" system and main production blocks at the Värtan plant, providing the users a feeling how a modern power plant is designed and operated in an urban environment.

The "Multimedia Visit" is used both by the teacher during lectures and by the students at school or home. By performing this "Multimedia Visit", the students will have a chance to see how the theory is applied in the real power plant during the lecture. The "Multimedia Visit" also allow the students to use it as a pre-visit of the plant in order to enhance the quality of the real study visit.

Multimedia learning tool conveys the information to the students by means of several senses. Teachers and students at the Division of Heat and Power Technology are deeply convinced that education is further enhanced when complementing this multimedia tool in the traditional education environment. Undoubtedly, the computer and associated multimedia tool will play an ever-increasing part in the education and many other fields in the future.

FUTURE WORK

More feedback and evaluation are needed. In order to serve for the visitors and students worldwide, the "Multimedia Visit" will be also available on the Internet later.

ACKNOWLEDGEMENT

The financial support from the Birka Energi AB is gratefully acknowledged. Special thanks to the great work done by Dr. Ian Cotgreave, who revised the texts and acted as the speaker for the "Guide-Tour", MSc. Vincent Demargne, who designed the CD-ROM cover, and photographer Eddie Granlund who provided outdoor pictures for the Värtan Visit. Further thanks to Prof. Torsten H. Fransson, MSc. Eloi Klein, and MSc. François-Xavier Hillion, for their critical assessments and significant supports.

Evaluation of Asynchronous Web-assisted Instruction: A Case Study of NTU WAI Project

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Abstract: This paper first introduce the theoretical background of this study as well as the implementation of the asynchronous web-assisted instructional project at National Taiwan University (NTU); then describes the research questions and methods used in this study. It also reports the results of data analyses and provides implications and recommendations in relation to web-assisted instruction and educational technology.

Rationale

With the impact of emerging computer technology and network techniques, the rapid change of current informational society, as well as the shift of learning style and instructional paradigm, web-assisted instruction has overcome the limitation of traditional instructional methods in many ways. It brings a new way for the use of instructional media, and inevitably become the major trend in the field of education of the 21 century. Along with this change, educational technology is now an area in which educators look into for better plan, design, development, and evaluation their instruction. With systematic instructional design, teachers can assess students' learning needs, analyze instructional objectives and tasks, sequence instructional content and information, select an appropriate media to deliver their instruction, and implement formative and summative evaluation to assure their instruction achieve the goal.

The web-based learning environment is more flexible and has more functions than traditional instructional media as well as many computer-assisted instructions. Although there have been significant efforts put into the application of web and network technique in education, the quality and function, however, are never the same among them. Due to the lack of systemic research available regarding a well-constructed model for web course design, development and evaluation, the purpose of this study is first to investigate students' and teachers' attitude toward the web pages created for assisting instruction of courses in the asynchronous web-assisted instruction project at National Taiwan University which includes 50 courses offered by different departments of 9 colleges. Also, using both quantitative and qualitative research methods, this study further assesses the effectiveness of the web courses on teachers' teaching and students' learning. It is expected that the result of this study will contribute to the improvement of web instruction at all level of schools in Taiwan, and to provide important information to the field of educational technology and curriculum design in general as well as to web-assisted instruction in particular.

Research Questions

The purpose of this study are: (1) to investigate the effectiveness of the web-assisted instruction approach in supporting teachers' teaching and students' learning, (2) to examine how students' attitude toward web-assisted instruction and some background variables can affect the their learning process as well as outcomes, (3) to examine how the appropriateness of subject matters can affect the students' learning and teachers' teaching via web-assisted instruction.

Research Methods

This study attempts to empirically investigate the effectiveness of construction of course web pages in supporting classroom teaching and learning. The web-assisted instructional pages are used as a learning tool in terms of providing alternative channels for students to learn outside the classroom. The learning context (courses) includes 50 courses offered by different departments in 9 colleges at National Taiwan University. All of these courses provide web-assisted instructional pages in addition to classroom meetings.

The target population for this study is students registering in these 50 courses in Spring, 1998. Students are required to fill out a questionnaire designed to collect their attitude toward the use of web-assisted instructional pages in facilitating their learning. Also, teachers in these courses are required to fill out a similar questionnaire to collect their perceptions toward this practice in terms of facilitating their teaching and students' learning. Some qualitative data will be collected by individual interview with teachers and students. The data collected on the different types of assessment will be analyzed by means of Descriptive Statistics and Chi-Square Analysis.

Results

For the attitude survey, both teachers and students shown highly positive attitude toward the application of the web-assisted instructional approach. Although most students do not know in advance that their instructors were going to apply web system in assisting class instruction, however it doesn't affect their motivation of taking these courses. Most functions applied in different web-assisted courses include course information supplement and discussion board application. Most students browse the course homepage one to three times per week, and they think the course homepages are convenience for their self-learning. Moreover, they are willing to take web-assisted course in the future.

On the other hand, result of this study also demonstrate that there are different degrees of correlation among the function, design, content organization of the web pages, the achievement of students' learning, the effectiveness of teachers' teaching, the implementation of the web-assisted instructional approach, the on-line assessment, as well as the integration of curriculum planning. It is also found that the more students browse the webcourse pages, the more the encounter system functional problems in the process. However, for students who use the webcourse pages more often , they tend to think that webcourse applications are more effective than other courses without webpages.

Conclusions and Implications

Based on the results of this study, conclusions and implications are discussed as follows. First of all, evidence from teachers and students' attitude survey and feedback comments shows that web-course pages can assist teaching and learning in many ways such as course material delivery, course content review, information retrieval, relevant resources connection, as well as student-teacher interaction.

Secondly, most teachers and students of different courses in different areas all agree that the practice of applying asynchronous web-assisted instruction is generally better than conventional classroom teaching. Also they agree that students taking asynchronous web-assisted instructional courses do perform better on learning than they do in conventional courses.

Thirdly, most teachers and students claim that the experience from asynchronous web-assisted instructional practice can help them in other classroom teaching and learning. Moreover, they feel that they do have learned a lot from this experience.

Fourthly, almost all teachers state that they would like to continue this effort in the near future. A variety of reasons include that (1) this kind of practice can help improve teacher-student interaction; (2) it can facilitate classroom instruction; (3) it can help instructional design process; (4) it shows better instruction and learning outcomes; and (5) it is one of the most important trends of education in the near future.

Fifthyly, although it shows a great deal of positive responses in results in applying asynchronous web-assisted instructional practice, however, there are some disadvantages as well. First of all, this kind of practice demands more time and efforts in designing and developing instructions, which add a lot more load to teachers. Secondly, students need to have certain levels of computer literacy to learn better in web-assisted instructional classroom. And thirdly, course contents and materials need to be well organized which demands more efforts from teachers and instructional designers

Sixthly, while most teachers are not familiar with web technology application and also lacking of instructional design background, training programs are needed to improve the quality of web-course pages and the effectiveness of implementing web-assisted instructional practice in a large-scale project.

Finally, to design a better web-assisted instruction, teachers need to plan in advance with instructional design perspectives. They need to first define the main purposes and functions of the course pages and then cautiously plan for the content. In addition to the design of the web pages that include extent, organization and presentation of information, teachers also have to consider the interactivity and innovation of the course pages design, as well as the potential impact on teachers' teaching and students' learning in the classroom.

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The Fluid Reading Primer: Animated Decoding Support for Emergent Readers

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Abstract: We have developed a prototype application called the Fluid Reading Primer to help emergent readers with the process of decoding written words into their spoken forms. When a reader requests help for a particular word, the Fluid Primer uses interactive animation to break the word apart to visually indicate its constituent sounds. The Fluid Primer can also play back audio versions of each segmented constituent sound, as well as the blended complete word. We envision that our method could be incorporated into future e-books to provide scaffolding on demand for readers of arbitrary texts. Moreover, we believe that the animations shown by our tool provide a valuable visualization of the decoding steps that will help readers learn to perform the same steps more quickly and confidently on their own.

Introduction

Although reading remains a crucial skill in the Information Age, learning to read is a difficult task. A carefully controlled study of adults in the United States by the National Center for Educational Statistics found that 22% could not answer simple questions about short newspaper articles (McGuinness 97, page 9).

Computers have been applied to a variety of aspects of teaching reading. Computer programs and games can help children develop reading readiness skills, such as replacing initial consonants to form new words (e.g., Reader Rabbit (The Learning Company 94)), read aloud to them while highlighting the words or phrases being spoken (e.g., Living Books (Brøderbund 92)), and provide pronunciations of unknown words on demand (also Living Books). Some programs reformat text to enhance readability (e.g., Proportional Reading, which displays one word at a time for a length of time that is proportional to the length of the word, with optional synchronized speech (Adams 98)). Other programs reformat text for comprehension (e.g., Live Ink, which analyzes sentence structure and displays semantic phrases (Walker 00)). Computers have been used to lengthen and enhance constituent sounds within words to help disfluent readers improve their audio processing for reading (Merzenich 96). Researchers have also applied speech recognition to listen to children read and to highlight incorrectly spoken words (Mostow 94). Eyetrackers have recently been used to judge from children's eye movements when to provide spoken assistance with a printed word (Sibert 00). A good overview of other electronic support for literacy can be found in (Topping 97).

However, most previous efforts have ignored a crucial and difficult piece of the reading process – namely, the actual steps involved in decoding a written word into its spoken form. Mastering the decoding process enables a reader to read any word, even unfamiliar or nonsense words.

We have developed a prototype application called the Fluid Reading Primer to help readers with the process of decoding written words into their spoken forms. When a reader requests help for a particular word, the Fluid Primer uses interactive animation to break the word apart to visually indicate its constituent sounds. The Fluid Primer can play back audio versions of each segmented constituent sound, as well as the blended complete word.

Because the Fluid Reading Primer can be used with arbitrary text, it should motivate early readers by allowing them to select material of interest to them. Furthermore, we believe that the animations involved in our tool provide a valuable visualization of the decoding steps that will help readers learn to perform the same steps more quickly and confidently on their own. Finally, since the Fluid Primer focuses on the decoding part of the reading task, it can be combined with other computer-based techniques for supporting readers.

Wise et al provided some decoding support in their computer-assisted remedial reading program (Wise 00). However, their support was given at a higher level (onset + rimes, such as r/ing, st/ing, rather than single sounds), and they used a much simpler visual presentation (white text on alternating green and blue backgrounds, with no animation). They found no benefits of their segmented form over whole-word support. We believe that our method's sound-level segmentation and careful animation will yield benefits, but verification awaits future empirical study.

The Fluid Reading Primer is part of a larger research project called Fluid Documents, which is exploring the use of interactive animation of typography to show additional information in computer-based documents. A user study indicated that animated annotations do not prevent readers from attending to the reading task (Zellweger 00). However, some subjects preferred static text to animated text. These results suggest the need for careful animation design. The Fluid Reading Primer extends this prior work by focusing on an educational task and incorporating audio into the interactive animation.

Reading

Diane, Carmen, and Geoffrey McGuinness have recently developed a systematic and relatively simple way to conceptualize and teach the decoding process using conventional paper-based books and exercises (McGuinness 97, McGuinness 98). They argue convincingly that it is important to teach these steps explicitly because other current methods, such as phonics and whole language, fail many students. They have experienced broad success with their method with both reading remediation and new readers. This section summarizes the issues and their method.

Reading English

We learn to hear and speak on our own, but we must be taught to read and write. Writing uses symbols to show sounds. We reverse this process to read – that is, readers decode symbols into sounds.

The English language, in particular, poses a challenging set of problems for readers. [Note: We focus primarily on children learning to read English as their first language. However, the basic concepts behind our tool are also applicable to learning to read other languages, to older individuals or to learning to read English as a second language.]

- Unfortunately, although English has 43 sounds, it has only 26 letters, so some sounds are represented by groups of letters.
  Ex: The letters "ch" show a sound /ch/ (as in "chair") unrelated to the sounds shown by "c" or "h"
- To make matters worse, some letters and letter groups can represent more than one sound.
  Ex: The letter "o" shows the sound /o/ in "ox" and the sound /o-e/ in "old"
  Ex: The letters "ow" show the sound /o-e/ in "own" and the sound /ow/ in "town"
- Moreover, there can be multiple ways to show a single sound.
  Ex: The sound /a-e/ can be shown using 9 different combinations of letters: "a_e", "ai", "ay", "ea", "ey", "eigh", "a", "ei", and "aigh" (the letter groups are shown in the order of their frequency of use in English words)

Recent research in reading suggests that a better way to teach reading is to start with the sounds, which students know already, and teach the corresponding letters or letter groups. This reverses the traditional phonics approach of letters to sounds.

The decoding process

An emergent reader must learn three steps to decode words into sounds: visual segmentation, sound assignment, and sound blending.

Step 1. Visual segmentation. The reader must divide a word into groups of letters such that each group shows a single sound. A difficult word like "though" may have several possibilities that must be considered, including:

t h o u g h
th ou g h
th ough

Step 2. Sound assignment. The reader must assign a legal sound (again, typically choosing among several possibilities) to each letter group.

Step 3. Sound blending. The reader must remember each sound and sequence them in the correct left-to-right order to form the spoken word. No letter group's sound may be omitted or reordered during this step, nor may any other sounds be inserted.

For a difficult word, the entire process may require several applications of these steps to try alternative segmentations and assignments. The process ends successfully when the resulting spoken form matches a known word that makes sense in the given context.

Teaching the decoding process

The McGuinnesses teach the decoding process by starting with a Basic Code, in which each of the 43 sounds in English is associated with a specific letter or a pair of letters. After the emergent reader has learned the three decoding steps described above, the Advanced Code is taught as "spelling alternatives" for those sounds with more than one spelling, and "code overlaps" for those letter groups that show more than one sound. The code developed by the McGuinnesses uses every letter in the word in a left-to-right fashion to show the final spoken form, which simplifies the logic of the decoding process for the emergent reader. For example, the letter "k" in the word "know" is not thought of as silent. Rather, the letter group "kn" is another way to show the sound /n/. The so-called "silent e" requires only a bit more explanation: a few letter groups can be written in two separate parts. For example, the letter "a" and the letter "e" in the word "ate" work together as a single letter group "a_e" to show the sound /a-e/.

Once the Advanced Code is mastered, the McGuinnesses teach two additional steps for decoding multi-syllable words: chunking and emphasis assignment. In the chunking step, which takes place before the steps described above, the reader must segment the word into chunks, or auditory syllables. Chunks are related to conventional syllables, but they obey auditory rules rather than visual ones – for example, they do not break between two doubled letters; the doubled letters go to one side or the other of the break. In the emphasis assignment step, which takes place afterwards, the reader must choose which chunks should have strong or weak emphasis applied to them.

The McGuinnesses have also developed a home schooling curriculum that includes a few stories in which each word is printed using special typography to represent the results of the visual segmentation step, as shown below. Emergent readers who are trying to master the Advanced Code find these prepared stories much easier to read than the unmodified versions. This printed form, which they call the Phono-Graphix code, uses a minimal representation to avoid confusing early readers with new and unfamiliar symbols. Studies have shown that introducing special symbols can create a greater barrier to reading conventional text later (McGuinness 97, page 179).

Ex: McGuinness Phono-Graphix code: t ea ch   a t e

Fluid Reading Primer and Animated Decoding Support

The Fluid Reading Primer provides animated online support for the steps in the decoding process. Our contribution is to use the computer a) to provide a powerful new dimension to the method described above and b) to broaden its applicability from a few specially prepared texts to potentially arbitrary texts.

The Fluid Reading Primer initially shows simple static text formatted in the usual way, which encourages readers to decode words on their own. When students need help decoding a word, they click on it with the mouse. The first click triggers an animation that demonstrates the visual segmentation step: the characters of the word move slightly together or apart to form the correct letter groups (Figure 1). The animation proceeds in a left-to-right order so as to emphasize the correct processing of groups into sounds, since sounds are inherently one-dimensional (time) and must be ordered properly, while text is inherently two-dimensional (x-y). This segmented form encourages the students to proceed with the sound assignment and sound blending steps on their own. If they need more help, they can click on the word again to fire a second multimedia animation that demonstrates the sound assignment step: again proceeding from left to right, letter groups are individually highlighted as the corresponding sound is played (Figure 2). Finally, a third click demonstrates the sound blending step: all of the letter groups are highlighted simultaneously while playing back an audio version of the complete word (Figure 3). Discontiguous letter groups use a special linked highlight (Figure 4).

a) Then Snow White awoke and saw seven little dwarves.

b) Then Snow White awoke and saw seven little dwarves.

c) Then S now White awoke and saw seven little dwarves.

d) Then S n ow White awoke and saw seven little dwarves.

e) Then S n ow White awoke and saw seven little dwarves.

Figure 1: Animation of the visual segmentation step for the word "Snow." (a) mouse click, (b) word moves right, (c) (d) (e) letter groups move one after the other. As each letter group moves, its color changes from black to red.

a) Then S n ow White awoke and saw seven little dwarves.

b) Then S n ow White awoke and saw seven little dwarves.

c) Then S n ow White awoke and saw seven little dwarves.

d) Then S n ow White awoke and saw seven little dwarves.

Figure 2: Multimedia animation of the sound assignment step for the word "Snow." (a) second mouse click on the word, (b) (c) (d) filled rectangles highlight each letter group separately, synchronized with audio of the corresponding sound. There is a slight pause between each letter group.

Then S n ow White awoke and saw seven little dwarves.

Figure 3: Multimedia animation of the sound blending step. The word is spoken while filled rectangles highlight the visual segmentation.

Then Snow Wh i t e awoke and saw seven little dwarves.

Figure 4: Highlighting a discontiguous letter group during the sound assignment step.

We envision that the Fluid Primer will ultimately have adjustable settings corresponding to a reader's current ability. An early reader may need slower animations than a more experienced one. A reader who is just beginning to read multi-syllable words would see a more complete animation, beginning with chunking, and proceeding through visual segmentation, sound assignment and sound blending for each chunk, followed by emphasis assignment and the spoken version of the entire word. A more experienced reader may generally require only the chunking and emphasis assignment steps, although full decoding assistance should remain available. The final minimal level of assistance would simply play back an entire spoken word on demand.

- **Issues in effective animated user interface design**

The user interface of the Fluid Reading Primer has been designed carefully to promote learning the decoding process. Although the basic concepts involved in animating the steps of the decoding process are relatively simple, subtle issues are involved in developing an effective animated design. This section discusses some of these issues.

The Fluid Reading Primer necessarily accentuates the decoding process in order to demonstrate and teach it. However, we use a careful and parsimonious design for displaying the text and the animations to promote easy transfer to printed books. Although it would be possible to create elaborate graphics or animations to entertain children, we have deliberately resisted this temptation. Recall that some experimental studies suggest that introducing special typographical symbols can either confuse readers or make them dependent on these representations (McGuinness 97 p 179). Elaborate graphics or animations are likely to distract readers in a similar way.

Step 1: Visual segmentation. We use a single distinguished color for the selected word throughout the three decoding steps (red is the default, but the color can be changed if desired). Because this color differs from the background color of the remaining text, the word remains a visual unit: its letter groups neither visually join adjacent words nor become separate "words" on their own. However, color does not distinguish between separate letter groups.

We use only whitespace to separate letter groups in the visual segmentation step. This choice differs from the McGuiness Phono-Graphix code, which also emboldens and underlines various characters, for two reasons. First, since the Fluid Primer uses a distinguished color and it only shows the segmented form of one word at a time, the spaces are more distinctive. Second, the animation in the visual segmentation and sound assignment steps further accentuate the distinction between letter groups. Following our design principle of parsimony, the closer we can remain to the printed form without compromising clarity, the better.

The discontiguous "vowel+e" letter groups pose special problems. They must indicate their two-part but related nature in the visual segmentation step. We use a light shaded background to join the two parts of these letter groups even in the visual segmentation step, where other letter groups have no background shading. This shaded background darkens in the sound assignment step (Figure 4).

The animation of the visual segmentation step provides a smooth transition between the conventional form of a word and its segmented form. The smoothness of the animation, which shows several intermediate positions of each letter, demonstrates that no letters appear or disappear in the transition to the segmented form; the letters simply move together or apart. Thus a reader is shown that *every* letter in a word becomes part of some letter group that shows a single sound in the following sound assignment step. This removes the concept of "silent" letters, which can lead to inaccurate reading strategies.

This animation is also intended to encourage readers to notice each letter group and hence to realize that it represents an actual sound that is part of this word, because studies show that disfluent readers may fail to notice letter groups (McGuinness 97). Each letter group changes color as a unit and then all of its letters move left at once. The distinguished color and the motion call attention to it.

Finally, the visual segmentation animation is designed to demonstrate the left-to-right ordering of the decoding process, because disfluent readers may also perceive letters out of order. After experimenting with a variety of movement strategies, we determined that a good way to emphasize the left-to-right ordering is to move each letter group exactly once, to the left, into its final position. We can see the importance of this as follows: if an earlier letter group moves *during* the positioning of later letter groups, it tends to distract attention from the desired focus on the later letter group. Similarly, if earlier letter groups move *after* the positioning of later letter groups, it breaks the left-to-right flow of the process. Thus the letters in the first letter group turn red and move smoothly into their final position, followed by the letters in the second letter group, and so on.

Ideally, the segmented word should still be centered between the surrounding words. This can be a bit tricky to accomplish while maintaining the emphasis on left-to-right ordering. We combine the following two strategies to avoid reader confusion: First, the initial layout algorithm places the words on the screen to allow room for each word to expand into its visually segmented form. Second, we borrow a trick from cartoon animation, which anticipates movement in one direction by a pre-movement in the opposite direction. Here we move the entire word a bit to the right and compress it slightly as feedback for the reader's first click (requesting the visual segmentation), to allow more space for moving left during the remainder of the visual segmentation step (Figure 1b).

Step 2: Sound Assignment. In the sound assignment step, we use filled rectangles behind the letters to create the impression that a separate visual layer is showing the sound assignments. These filled rectangles must neither be too dark (interferes with readability) nor too light (interferes with the perception of synchronized sound and letter group).

The animation of the sound assignment step again emphasizes left-to-right processing. Starting from the left, each corresponding sound is played back independently. The sound playback is synchronized with the appearance of a filled rectangle behind the corresponding letter group, thus demonstrating that this sound is a possible alternative for this letter group. Slight pauses between playing the sounds keep them audibly separate.

Step 3: Sound Blending. All rectangles are shown while the word is spoken aloud. A smooth animation is used to remove the filled rectangles and close the letter groups after it has been read.

Fluid Primer Infrastructure

Several underlying dictionaries, tables, and files support the operation of the Fluid Primer:

- *A dictionary of words.* Each entry includes:
  a. its segmentation into letter groups. Care must be taken here with the discontiguous e, which must appear in its own segment, but participates in a single sound in the sound assignment step
  b. its assignment of which sound corresponds to each letter group
  c. its segmentation into chunks
  d. emphasis assignment for chunks
  e. a pointer to an audio pronunciation of the entire word

Sample dictionary entries:

Word	Visual segmentation	Sound assignment	Chunking	Emphasis assignment	Audio file
snow	s n ow	s/ n/ o-e/			snow.au

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white	wh i- t -e	w/ i-e/ t/			white.au
dwarves	d w ar v es	d/ w/ or/ v/ z/			dwarves.au
pillow	+ p i ll * ow	p/ i/ l/ * o-e/	pill * ow	+ pill * ow	pillow.au

This dictionary contains information that cannot be derived easily from standard dictionaries, so it must be created anew. Note that in general, it must also explicitly contain inflected forms of all words: top, tops, topped, etc. However, once created, a single dictionary can be consulted to help readers with arbitrary texts. If desired, regional pronunciations can be provided for selected words in a separate user dictionary. This feature is particularly useful for names.

Note that some words have different pronunciations for different word senses, such as "read" or "lead". Simple versions of this situation, in which the different word senses form different parts of speech, could be distinguished by automatically parsing the containing sentence. If the different word senses form the same part of speech, such as "primer" (introductory book) and "primer" (undercoat of paint), the Fluid Primer could offer a choice to the teacher or reader.

- *Audio files pronouncing all 43 English sounds.* This small set of short audio files requires careful speech, preferably by a trained speaker, to isolate the sounds of individual English phonemes. High-quality recording and audio processing are likewise required to make the sounds as clear and distinct as possible. For example, aspirated sounds such as /p/ and /b/ may need to be accentuated, while their plosive portion may need to be softened.

- *A table mapping each sound to the letter groups that can show it.* (for interactive exercises; see below)

- *A table mapping each letter groups to the sounds that it can show.* (for interactive exercises; see below)

Status and Future Work

Our prototype Fluid Reading Primer is implemented in Java JDK 1.1, which provides minimal support for animation and audio playback. Our animations are implemented in custom code using Java's thread facilities. They are carefully tuned to synchronize with the playback speed of our audio files on a 200MHZ Pentium II. We plan to reimplement the prototype in JDK 1.2, which has better audio support. We expect to need better synchronization technology as we extend the prototype to support a larger range of texts on arbitrary computers.

We have not yet conducted an empirical evaluation of the Fluid Primer. However, we have shown it to several dozen parents and elementary school teachers in California and Denmark, and their reaction has been very favorable. We also got an encouraging reaction from two emergent readers who were being taught the McGuinnesses's home schooling curriculum. They quickly grasped that they should click on words to get help, and they did not find the animations confusing. We are currently exploring opportunities to evaluate the Fluid Primer with more early readers.

The Fluid Primer can be extended to allow emergent readers to perform the decoding steps on their own via interactive exercises. For example, in the visual segmentation step, readers could drag the mouse across several letters to collect them into a single letter group. Alternatively, they could choose from lists of legal English letter groups. In the sound assignment step, they might choose among visual representations of the legal sound alternatives for a letter group. Audio feedback for each sound alternative would be given on request.

Discussion

The World-Wide Web is making it possible to access the entire literature of the world quickly and easily. However, the promise of this technology will be reduced if the retrieved literature cannot be read. Decoding words into their sounds is a key skill that will empower a child to use computer-based documents. In this paper, we have described how a computer-based document can also be used to teach an emergent reader this decoding process. Smooth animations demonstrate the three decoding steps: visual segmentation, sound assignment, and sound blending. The animations are carefully designed to illustrate the decoding process with a minimum of graphics and animation. Each step encourages the students to complete the decoding process on their own. Although a systematic evaluation of this technology awaits the development of a more robust prototype, we expect from our previous evaluation of Fluid Documents that these carefully designed animations are not likely to be disruptive to the emergent reader (Zellweger 00). The preliminary observations of our two sample emergent readers support this conjecture.

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An Intelligent Tutoring System: Smart Tutor

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Abstract: Many projects and researches on online distance learning have emphasized the application of multimedia elements that are more necessarily helpful in children education than in life-long/adult education. The researches did not pay much focus on two crucial elements: personalization and intelligent tutoring. SPACE (the School of Professional And Continuing Education, The University of Hong Kong) has developed an online course-learning program which emphasizes on the personalization and intelligent tutoring aspects. This paper is to identify and illustrate the importance of personalization and intelligent tutoring issues especially in Adult Distance Learning and present Smart Tutor as a solution. It will also introduce and explain how they can be practically applied onto the design and implementation processes using some Artificial Intelligent methods.

Introduction

The School of Professional and Continuing Education (SPACE) at The University of Hong Kong performs a role to encourage the Hong Kong population to develop themselves into a better shape for future growth. In SPACE, we provide life-long learning for the public, and create an opportunity for them to pursuit a bright prospect in their own career developments and training. In year 1999, the number of people registered with SPACE programs is around 65,000. The SOUL (SPACE Online Universal Learning) project from SPACE is a project aiming to provide online support for educational purpose and develop SPACE online support courses in both Hong Kong and the Mainland China.

In Adult Continuing Education, Working adults come from a wide range of backgrounds. Most of them have their own full time employment and they are facing the dilemma of preparing for examination and working away. So the way they grasp their limited spare time for further development is respectful and they need more detailed and effective instructions during their learning process. Consequently, there is room for universities and IT companies to develop e-Education to better suit the needs of these adult learners in the domain of learning and examination. However, most exiting platform put much more efforts on technology that facilitates interaction between learner and instructor and among the learners, such as multimedia, computer conference and something like this, neglecting personalization in the learning environment. So an intelligent tutoring system for online education is necessary. Our Smart Tutor system project intends to build an intelligent multimedia learning environment with particular stress on individual tutoring. In the education area to achieve a more automated and personalized learning environment. Private tutoring has proven to be as much as four times educationally effective as a normal classroom setting and 98 percent of the students perform better with private tutors (Bom. B. S. 1984). Intelligent tutoring systems (ITS), modeled after the idea of a private tutor, provide individualized instruction. In summary, we want to achieve an online intelligent learning environment that helps students to learn more effectively with few human working.

The Architecture of Smart Tutor

The main architecture of Smart Tutor consists of six parts: *Course Manager, Content Structure, Student Model, Question Bank, Expert Module* and *User Interface*.

The *Course Manager* is the control center of Smart Tutor. It has the following responsibilities:

- Invokes the *Expert Module* to create a tailored course content from Domain Knowledge for each student and to give individualized suggestions during each student's learning process
- Maintains student's personal information, learning histories, testing results in the *Student Model*
- Deliver the course via the *User Interface*
- Creates adaptive test or examination via the *Question Bank*

Content structure of Smart Tutor provides content orientation. Giving a preview and then going onto the detail directly by a description of the material to students is a normal way to achieve orientation. This resulting clear, flexible and non-linear structure would be used to categorize the course content. The whole content structure can be exhibited as a diagram. Smart Tutor can author and modify the content diagram to represent the resulting content map satisfying each individual's requirements and fitting for his or her prior knowledge. Individuals then will follow their finished content structure diagram as the executing structure for a course.

The key element of *Student Model* is Personal Learning Record which tracks the progress of each student and reflects individual learning performance. It can be a serial of testing results attached to each node. Smart Tutor records the student's learning performance following their personalized content structure and gives some personalized instructions, specific trainings for everyone.

Question Bank is a warehouse of questions that supports the generation of tests. It is also an essential part of an online course system. Smart Tutor controls and evaluates each student's learning steps by using the test generation and results, which are on basis of Question Bank.

Expert Module consists of the Advisor and Planner, which are main functions of Smart Tutor. We make it possible based on the combination of Content Structure, Question Bank and Student Model. We use rule-base, fuzzy model and other methods in Artificial Intelligence to achieve them. There is a rule-base consists of expert rules that allow the Planner to determine the selection and ordering of materials that should be presented to the student and allow the Advisor to generate the appropriate instructions and tests that should be presented to the student. Test generation is both a supporting function of Smart Tutor as well as a basis of Planner and Advisor. More details of Smart Tutor can be found in (Jie et al. 2001).

Conclusion

In the current stage, the SOUL intelligent tutoring system is being implemented. The paper has reported the high–level design of the system and the principles behind. It has provided E-education research with a new horizon because no such an Artificial Intelligence application, which focuses on supporting distance learning and life-long learning, has present yet. Most importantly, the system design also caters for different learning paradigms of education theory which the teachers want to use through application of sophisticated mechanisms of the content structure, student learning record, question bank and smart planner & advisor.

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